Some geographical aspects of the agriculture of the Hartlepool's region

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SOME GEOGRAPHICAL ASPECTS OF THE AGRICULTURE OF THE HARTLEPOOLS REGION

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by

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CONTENTS.

INTRODUCTION

The first comprehensive assessment of the agriculture of the Hartlepools region was the mapping of land use in 1931-32 by the Land Utilisation Survey, on the scale of one inch to one mile. This was followed in 1939 by a study of Durham based on parish statistics by A.S.Gaught(1)who concluded that the county was divided into three agricultural regions, pastoral in the west, intermediate in the centre, and arable-dairying in the east. In 1946 the Summary Report of the National Farm Survey classified the area from the Hartlepools southwards down the Vale of York as one of "general mixed farming" since no single type of farming such as dairying, arable, or stock-fattening was predominant. Unfortunately the National Farm Survey did not complete its mapping of the farm units. The unpublished maps which were completed are now in the archives of the regional branch of the Ministry of Agriculture and are protected by the Official Secrets Act.

L. Dudley Stamp has stated(2)that the relationship between the area of the farm unit and the farm's economic viability is fundamental in any study of our agriculture, and he stresses the importance of mapping farm units as they are today. The preparation of such a map on the scale of one inch to one mile necessitated visits to over 400 farms and over 70 smallholdings, which were first mapped on the scale of six inches to one mile and subsequently reduced. Farm classification has been based on the criteria adopted by the Department of Agricultural Economics of Newcastle University. Visits to the farms have revealed that even within the same type of farming there are considerable differences of method, especially in the fattening of cattle.

(1) A.S.Gaught. "Some Geographical Aspects of the Agriculture of County Durham." Unpublished Ph. D. Thesis, London University, 1939.

(2) L. Dudley Stamp. "Geographical Agenda: A Review of Some Tasks Awaiting Geographical Attention." Trans. Inst. Brit. Geographers, 1957.

A survey of the climate of the Hartlepools region does much to explain the mixed character of the farming. In some years livestock prove the sheet anchor of the farm economy when poor growing weather spoils the crops. The reliability for agricultural studies of temperature data collected at urban recording stations is rather doubtful, and the writer's series of experiments in and around the Hartlepools shows that a well-marked "heat island" exists over the built-up area. Short-term screen records and temperature traverses were used to establish the relationship between the temperatures of the East Durham Plateau and of the Tees lowland.

Soils are another important aspect of the agricultural geography. The cover of glacial drift gives rise mainly to heavy but fertile clay soils but fluvio-glacial sands and gravels occur in patches and ridges, and loams are well distributed. Few farms, however, possess only one type of soil, and the variation, even in individual fields, makes mapping a complex and slow task. An initial reconnaissance of the soils of the whole county was made in the late 1940's by B.M.Dougall on the scale of one inch to one mile. This provides a good base-map for agricultural studies like the present one but detailed field-work has shown its limitations. Some interesting correlations have been found between soil types on the one hand and land use and farm types on the other.

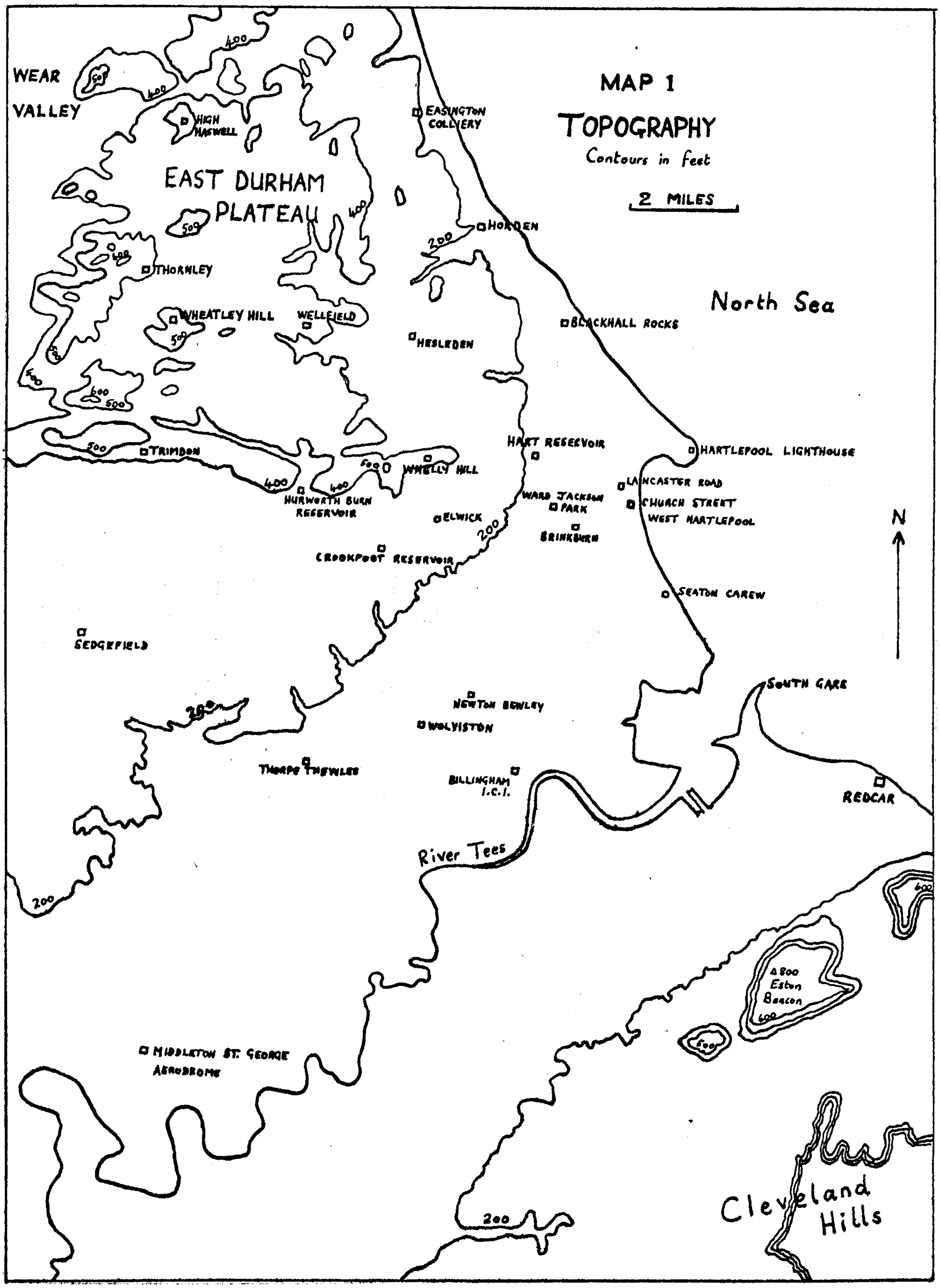
By means of the statistics collected by the Board (later the Ministry) of Agriculture the chief economic trends in agriculture over the last 100 years can be followed. An attempt has been made to show the contrast between areas with a favourable physical background and those more poorly endowed in the ways in which they reacted to the changing economic circumstances.

Access to farms has been improved continuously, and first the railways and then motor vehicles and roads have wrought changes in agricultural production especially in the production of milk and eggs. Nevertheless there remain farms in the Hartlepools region which suffer in various ways from their remoteness.

The rapid growth of the Hartlepools, of Stockton, Middlesbrough, and of the large mining villages on the southern edge of the Durham coalfield since 1850 has had important repercussions on the farming of the surrounding areas. Not least is the loss of agricultural land to housing, industry, and urban amenities. Only two miles of open fields separated the Hartlepools and Billingham in 1963; there were seven miles of countryside between them in 1920, including some of the best soils in the county.

Since the 1947 and 1957 Agriculture Acts the central government has taken into its hands a greater degree of control over farming, by means of financial incentives for certain approved undertakings. Fertilizers, field drains, buildings and roads, for example, are now partly financed by the Exchequer, while tax allowances for wear and tear, and for capital investment, encourage farm mechanization. Over-production is checked and under-production is levelled up by the Annual Price Reviews which adjust subsidies, and Marketing Boards for various commodities also act as government agencies. Most farmers are progressive enough to allow themselves to be guided by these arrangements, and the efficiency of the system is indicated by an increase in net output from the farms of about 80% between 1938 and 1963.

The technological revolution through which agriculture is now passing, with its new applications of chemistry, biology, and engineering, will doubtless continue to alter radically the methods and products of the farms in the Hartlepools region. It may even create the need for specialization on these farms whose traditional cropping and stock-raising dichotomy has proved its resilience for centuries. It is hoped that in a period of rapid change the present study will at least serve as a snapshot picture of the early 1960's which the future generations of geographers and others will study as part of a series of historical documents.


MAP 1
TOPOGRAPHY
Contours in feet
2 MILES
North Sea
WEAR
VALLEY
EAST DURHAM
PLATEAU
HIGH HASWELL
EASINGTON COLLIERY
HORDEN
THORNLEY
WHEATLEY HILL
WELLFIELD
HESLEDEN
BLACKHALL ROCKS
TRIMDON
WHELLY HILL
HURWORTH BURN RESERVOIR
HART RESERVOIR
HARTLEPOOL LIGHTHOUSE
LANCASTER ROAD
CHURCH STREET
WEST HARTLEPOOL
WARD JACKSON PARK
BRINKBURN
ELWICK
CROOKFOOT RESERVOIR
SEATON CAREW
N
SEDGEFIELD
SOUTH GARE
NEWTON BEWLEY
WOLVISTON
THORPE THEWLES
BILLINGHAM I.C.I.
REDCAR
River Tees
800 Eston Beacon
MIDDLETON ST. GEORGE AERODROME
Cleveland
Hills
400
500
600
200

Chapter 1

THE SOILS OF THE HARTLEPOOLS REGION

The region is built up of glacial and post glacial materials resting on the Magnesian Limestone to the North-west, and on the Triassic red sandstone to the south-east of a presumed fault between Hartlepool and Darlington, which follows a curved line convex towards the north-west (1). Neither of these underlying formations crops out at the surface save at the coast where the drift thins out to allow the red sandstone to emerge in the rocks of Hartlepool Bay and on the foreshore at Seaton Carew. The Magnesian Limestone comes within a few inches of the surface on Hart Farm (Grid Reference 45/475345), Quarry Farm (45/476332), Whelly Hill Farm (45/450340), and on farms in the quarrying districts of Bishop Middleham, Kelloe, Trindon Grange, and Old Wingate. Borings have indicated the immense thickness of the drift in certain places - 50 feet under the I.C.I. works at Billingham, 100 feet at Norton (2), 187 feet at Sheraton (3), and no less than nearly 300 feet near Wolviston (4).

Research into the origin of the drift deposits has been aided by their varied composition. Trechmann (5) has shown that Scandinavian ice brought up boulder clay from the floor of the North Sea, identified by Norwegian rock fragments such as rhomb-porphyry and nordmarkite, which were intruded into fissures in the Magnesian Limestone cliffs. Another Norwegian rock specimen

(1) British Regional Geology, Northern England, 1953.

(2) Teesside at Mid-Century, House and Fullerton, 1960.

(3) Borings at Cotefield Close and Sheraton, Co. Durham. D. Woolacott. Geological Magazine, Vol. 6, No. 4, 1919.

(4) A Physical Land Classification of Northumberland, Durham and part of the North Riding. E.H. Dougall 1950 (North East Development Association).

(5) Proceedings of the Geological Association, Vol. XLII, Part 3. C.T. Trechmann, The Scandinavian Drift or Basement Clay of the Durham Coast. Also Q.T. Geol. Soc. Vol. LXXI, Part 1, 1915.

laurvikite, is also quoted by the same worker as being found when the railway viaduct at Castle Eden was being built. Subsequent ice sheets from the Cheviot Hills and the Lake District mountains did not modify the Scandinavian material hidden in the cliff openings, but they did bring separate drift coverings which can be recognised by their contents of erratics. Trechmann contends that there is an unconformity, representing an inter-glacial period, between these later British deposits and those of the Scandinavian ice. During this period weathering took place and wind-erosion may have been responsible for the deposition of loess-like materials.

Pebbles of the porphyrites and lavas of the Cheviot igeous massif are traceable down the east coast of Northumberland and Durham to the Tees estuary and the Vale of York, while the Lake District ice brought drift containing pebbles of such igneous rocks as the Threlkeld micro-granite, Skiddaw granite and quartz-porphyry of the Armboth dyke. Some observers believe that Scottish ice twice occupied the coastal regions of Durham, with an intervening stage in which the Lake District ice reached the same coast. Raistrick (1) described the drift above the Scandinavian material as a purple or blue clay, with abundant boulders, the majority being of local Carboniferous (Pennine) rocks. Between this clay and the upper boulder clay on the coast is a series of sands and gravels. The upper clay is more variable in colour, though dominantly reddish, and is fairly free from large pebbles. Since this clay shows rough prismatic jointing it is sometimes termed the "prismatic clay". Its pebbles are more varied and far-travelled than those in the lower clay. Even when the intervening sands are absent there is still an unconformity between the two clays. The reddish upper clay extends inland as far as Sedgefield, and is the dominant

(1) Proceedings of the Geological Association, Vol. XLII, 1931. A. Raistrick, The Glaciation of Northumberland and Durham.

parent material of soils in the lower Tees valley and in parts of the Vale of York (1).

After the first stage of retreat eastwards the ice halted at or near the present coastline. Since natural drainage was thus obstructed, a lake was formed, in the lower part of the boulder clay depression of the Tees valley. During this period drainage was probably to the south into the Vale of York. Fime laminated clays were deposited, about 25 feet thick under Billingham and Middlesbrough, overlain in places by a brown clay. These clays thin out towards the shorelines of the former lake and disappear in the Eaglescliffe area. They represent undisturbed sedimentation in the lake, while the thin intervening sand partings were caused by flood conditions. Sandy deposits on the edges of the laminated clays are probably lake beaches, occurring between 55 and 85 feet above Ordnance Datum (2). Much of the area north of Teesmouth shows signs of being a former gulf of the sea filled in by heavy deposition from the sluggish River Tees aided by the south-flowing tidal drift. Silty and sandy clays provide an alluvial mantle over the upper boulder clay, but the area is so little above sea level that drainage is poor and the high water-table causes mottling close to the surface. In places east of Cowpen Bewley long narrow lakes or "fleets" form an interlacing system of channels among marshland which is the home of wild birds and dragon flies (3).

Peat-beds of glacial or post-glacial age are found in several parts of the Hartlepools region, varying in thickness from a few inches to eight feet. Along the foreshore at West Hartlepool there is a submerged forest in which the stumps of trees, though softened by the attack of sea-water, are plainly recognisable

(1) B.M. Dougall, op. cit.

(2) House and Fullerton, op. cit.

(3) J.W. Heslop Harrison, A survey of the Lower Tees Marshes. Transactions of the Natural History of Northumberland, Durham and Newcastle, Vol. V. 1918-21.

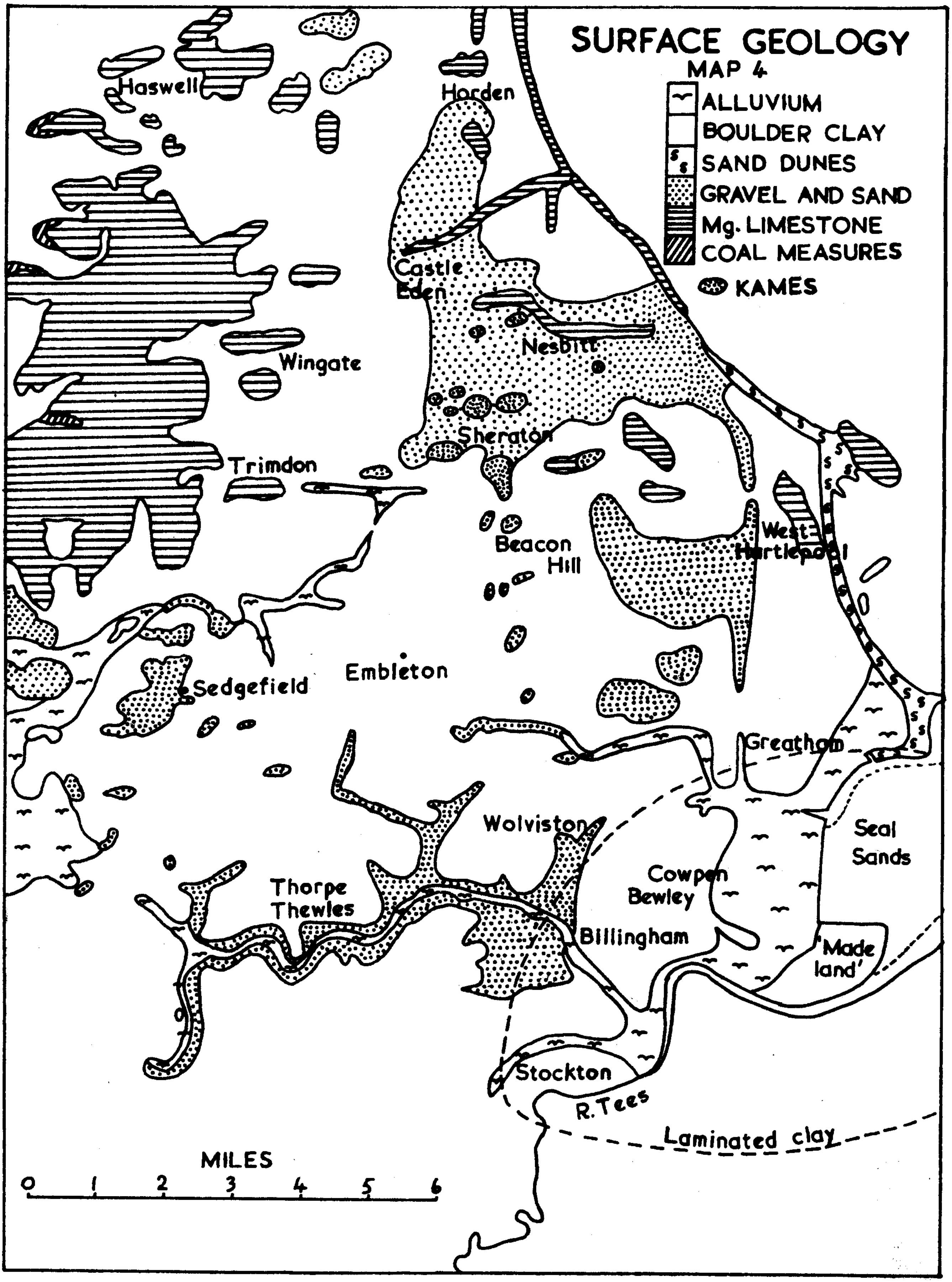
When excavations were made for some timber ponds near the West Hartlepool gas works about 1890 large stumps of trees were dug out of the peat. In 1888, at the Warren cement works at Hartlepool, a boring showed eight feet of peat overlain by 22 feet of blown sand and resting on red boulder clay. The peat at the timber ponds also proved to be eight feet thick with blue clay below 1'10" thick, all resting on ten feet of boulder clay above the Magnesian Limestone. The peat near Newburn Bridge, West Hartleppol, is nowhere over two feet thick, and rests in places on patches of calcareous fresh-water shelly marl. These deposits overlie a bed of sticky or buttery blue clay containing pieces of sandstone and rotted igneous rocks in which the roots of plants are seen. This blue clay rests on hard red boulder clay of the latest or Cheviot drift type, full of well-glaciated stones, or on a hard red banded clay almost devoid of erratics (1).

Bradbury and Mordon Carrs are deposits of basin peat over a blue-grey silty clay. Their formation is due either to the silting up of glacial lakes or possibly to the in-filling of former gulfs of the sea (2). The present writer found peat seams up to four inches thick at a depth of three feet in a trench being cut for a gas pipe near Eden Vale (45/432367), the top twelve inches being greyish-yellow sandy clay loam, and the next two feet sands of an orange colour. Peat beds have been discovered along the shoulders of Billingham Beck at Wolviston Mill (45/430239) and in Wynyard Park at a height of 60 feet above sea-level (3).

(1) C.T. Trechmann, Mesolithic Flints from the Submerged Forest at Hartlepool. Paper No. 7, Proceedings of the Prehist. Soc., 1936.

(2) B.M. Dougall, op. cit.

(3) House and Fullerton, op. cit.


SURFACE GEOLOGY
MAP 4
ALLUVIUM
BOULDER CLAY
SAND DUNES
GRAVEL AND SAND
Mg. LIMESTONE
COAL MEASURES
KAMES
Haswell
Horden
Castle Eden
Wingate
Nesbitt
Sheraton
Trimdon
Beacon Hill
West Hartlepool
Sedgefield
Embleton
Greatham
Wolviston
Seal Sands
Cowpen Bewley
Thorpe Thewles
Billingham
'Made land'
Stockton
R. Tees
Laminated clay
MILES
0 1 2 3 4 5 6

Above the boulder clay patches of post-glacial sands and gravels occur, associated with the period of ice-retreat. These would appear to have been dropped during the eastward retreat of the Cheviot ice (1), or to be small deltas built by streams issuing from glacier lobes lying to the north, since beds and lenses of sand and gravel are often steeply dipping towards the south. These deposits, which sometimes have a hummocky appearance, occur widely in East Durham, and have been quarried in many places - at Easington (both north and south of the village), at Sheraton, where an extensive series of kames marks, in Trechmann's view, if not the western boundary of the Cheviot ice-stream, at least the western limit where Cheviot material continues to form an appreciable constituent of the Drift; at Brierton (45/478303), along the road from Greatham to Wolviston, on the north-west and north-east of Thorpe Thewles, south of Bishopton (where a conical kame was occupied by prehistoric tribes), south-west of Stillington, south and north-east of Whitton, south of Morden, and west of Sedgefield. The writer visited those quarries still in use in the early 1960's at (a) Claxton Grange Farm, near Greatham, (b) Fulthorpe Farm, Wynyard, and (c) Low Middlefield Farm, Norton.

The quarry at Claxton Grange exposed at 16 foot face containing the following strata:

2 feet of grey-brown loam at the surface;

a few inches of red sand;

one foot of tawny sand;

lenses of fine gravel swelling up to 4 feet thick in the middle;

layer of tawny sand one to three feet thick;

lenses of reddish sand 2-3 feet thick;

few inches of red sand;

(1) C.T. Trechmann, Quarterly Journal of the Geological Society, Vol. LXXI, Pt. 1, 1915.

lenses of tawny sand up to 4 feet thick;

lenses of very large gravel (up to 10 inches across) up to 3 feet thick;

few inches of red sand;

layer of large gravel, a few inches thick;

few inches of tawny sand;

few inches of red sand;

bed of fine gravel up to 2 feet thick, containing band of flat coal pebbles;

total section visible 16 feet.

Another good exposure of sand and gravel lenses overlying the reddish clay base was studied at Wynyard (45/416247) on the Wolviston-Thorpe Thewles road, a quarter of a mile east of Fulthorpe Farm. A 50 foot quarry face showed two distinct gravel beds in lenses both at about 40 feet below the surface, and both swelling to a thickness of about 3 feet. At the surface 6 feet of reddish clay loam overlaid 2 feet of yellow-brown sand, 8" of grey-brown clay loam, over alternating layers of reddish fine sandy loam and tawny sands, below which the gravel lenses occurred, giving way once more to sandy material.

A third quarry visited at Low Middlefield Farm (45/415237), one mile east of Thorpe Thewles, had a 60 foot face. Tawny sand was predominant, but gravel lenses, sloping steeply from north to south, occurred at depths of about 20 feet, 35 feet, 40 feet, and 45 feet.

Since the stones occurring within the drift possibly affect the chemical "trace-elements" on which plants rely so heavily it may be worthwhile to quote the list of rocks found by Trechmann in one of the Sheraton kames:

Coarse gneisses (very rare)

Micaceous and other schists (rare)

Carboniferous sandstones, grits, cherts, limestones, etc. (very common).

Cheviot porphyrites, amygdaloidal lavas, agates, etc. (very common).

Lake District green rhyolites, Threlkeld "microgranite", grauwacke,

Buttermere Granophyre, quartz-felsites, etc. (scarcer than Cheviot rocks).

Magnesian Limestone. Concretionary, cellular, and other types (common).

Flints. Dark chalky flint, brown crusted and waterworn pebbles, bits of

Chalk (fairly common).

Whin Sill and other basalts (rather scarce).

Granites, mostly pink and red carieties of indeterminable origin.

A fragment apparently of a rhomb-porphyry.

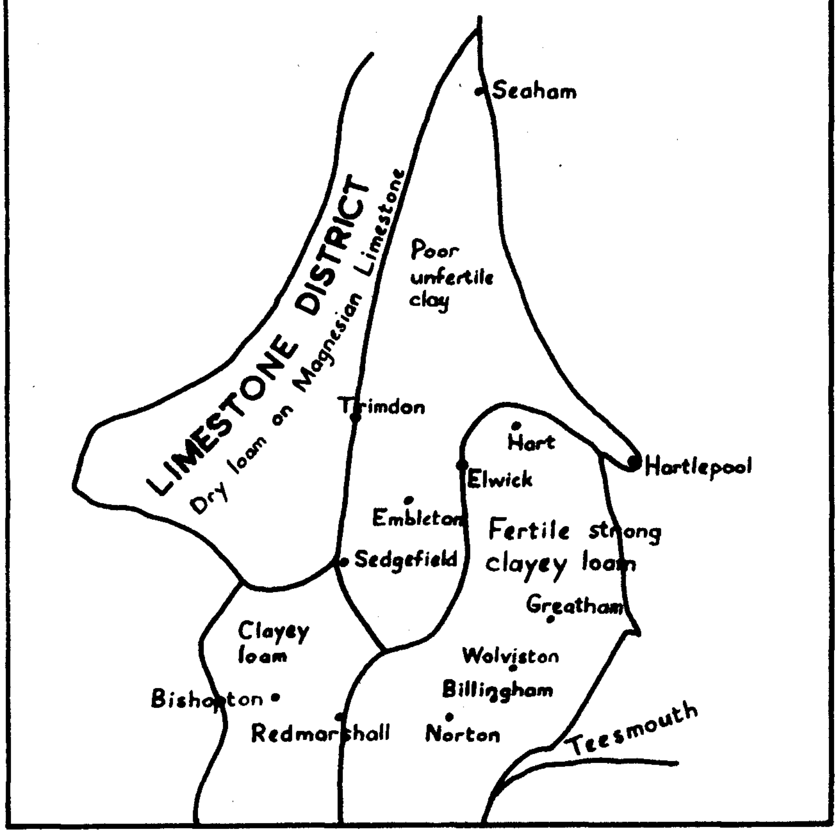
Pieces of very much worn shells occurred among the finer material at all altitudes.

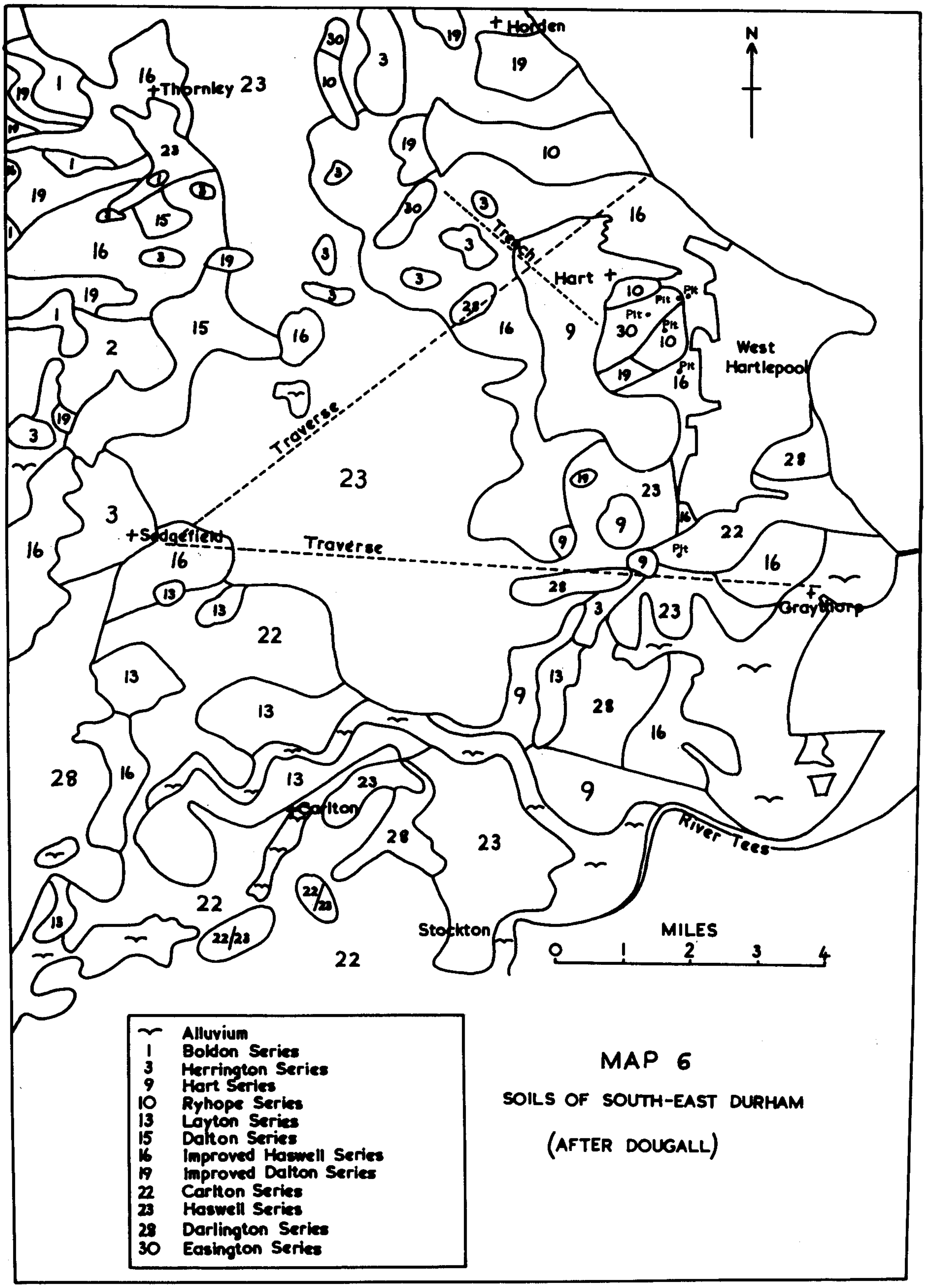
Trechmann also records a red friable sandy stoneless material arranged in more or less regular strata which occurs in Castle Eden Dene and other coastal ravines to a distance of three or four miles from the sea. He attributes this sand to the same source as the red marl rammed into the cliff fissures, that is the Scandinavian ice sheet. A bed of gravelly drift overlying the Cheviot drift along the coast in certain sections is associated by Trechmann with the kames and moraines. It is often very strongly calcreted and has a thickness of 3 - 8 feet, occasionally overlapping the Cheviot drift and resting upon the Magnesian Limestone where the latter rises from the coast (1).

Thus there is a tremendous variety in the parent materials from which the soils of the Hartlepools region are derived; from the solid Magnesian Limestone where it reaches or almost reaches the surface, to the clays and sands of the various drifts of the ice. Apart from their purely textural and structural effects on farming these deposits also constitute an important factor in local relief features. The undulating, and in places hummocky, topography creates differences of drainage and aspect which are often very important on the individual farm. Some of the steeper-sided kames near Sheraton, for example, are impossible

(1) C.T. Trechmann, Q.J. Geol. Soc., Vol. LXXI, Part 1, 1915.

MAP 3
BAILEY'S MAP OF THE SOILS IN SOUTH EAST DURHAM, 1810.

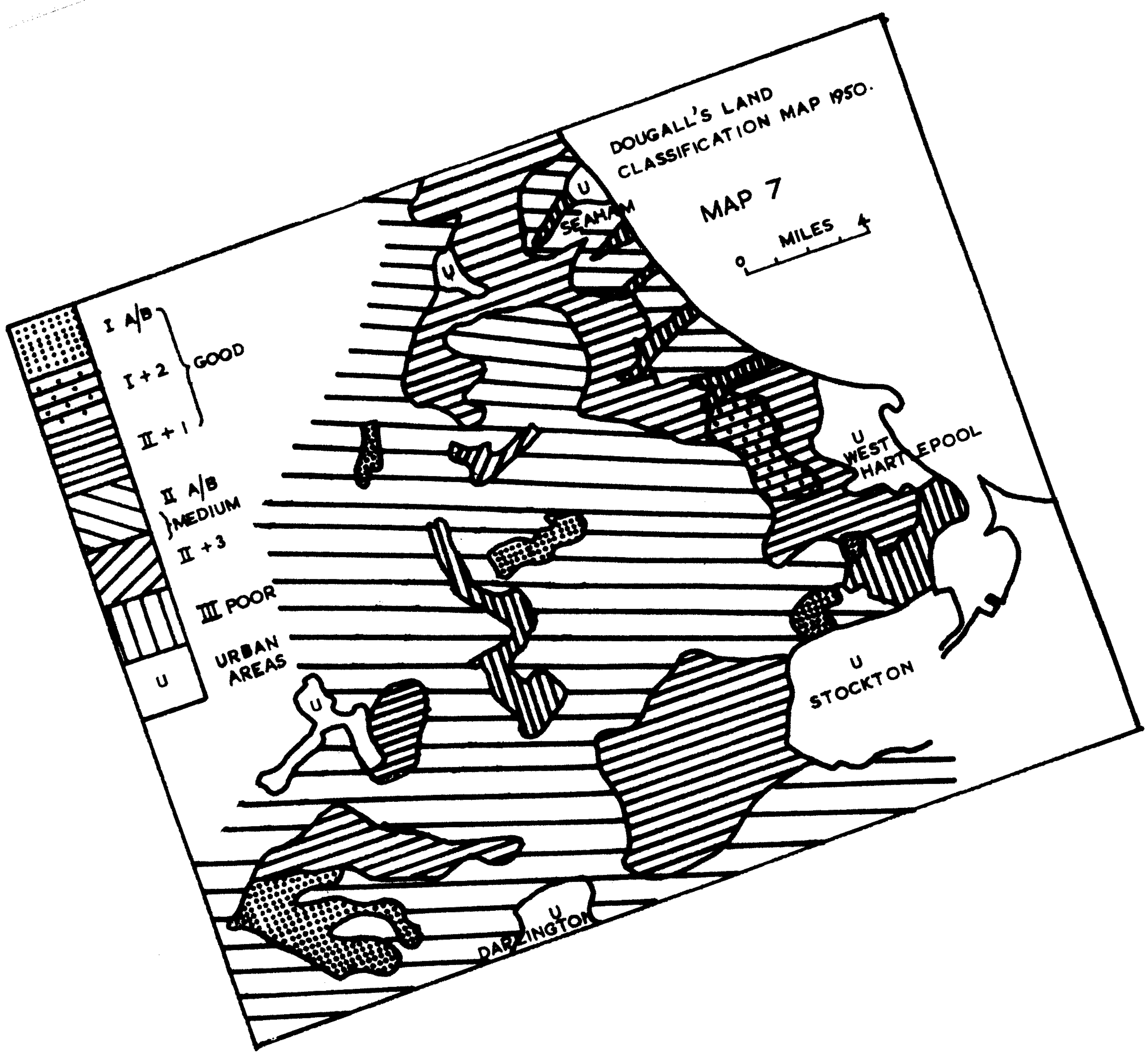




MAP 6

SOILS OF SOUTH-EAST DURHAM

(AFTER DOUGALL)


DOUGALL'S LAND CLASSIFICATION MAP 1950.
MAP 7
0 MILES 4
I A/B
I + 2
GOOD
II + 1
II A/B
MEDIUM
II + 3
III POOR
URBAN AREAS
U
SEAHAM
WEST HARTLEPOOL
STOCKTON
DARLINGTON

to plough and are therefore permanently devoted to grazing. Small hollows between low swells in the moraine cover are sometimes difficult to drain and may remain as reedy marshland which dries out only after a prolonged dry spell. Broken field drains on the coalfield farms are rendered even more tragic in such depressions.

Apart from Bailey's map of the soils of Durham County (cf. chapter on agriculture) drawn at the beginning of the nineteenth century, and Bell's vague and fragmentary account of 1854 no research had been done into the nature of the soils of the Hartlepools region until the late 1940's. A broad reconnaissance of the soils of Durham on the scale of one inch to one mile carried out by B.M. Dougall for the North-East Development Association is the only research work which has been published (1). Since the object of this survey was land classification from an agricultural point of view, no detailed or comprehensive data are given, though many soil series and broader associations are mentioned. The results of the land classification are shown on Map 7.

Other sources of information on the soils of the Hartlepools region are (a) the Max Lock Plan for the Hartlepools, in which there is a map and an account of the soils of the Elwick area, surveyed by B.M. Dougall on a scale of 25 inches to the mile (1); (b) an unpublished map of the soils of the county of Durham, on a scale of one inch to the mile, based on Dougall's survey of the late 1940's (3). It was probably on this latter work that the N.E.D.A. land classification map was based. These two maps are given as Maps 5 and 6 respectively. In addition

(1) B.M. Dougall, op. cit.

(2) A Plan for the Hartlepools, Max Lock, 1948.

(3) Unpublished map possessed by National Agricultural Advisory Service Regional Soil Chemist.


MAP 5
SOILS OF THE ELWICK DISTRICT
(AFTER DOUGALL)
ELWICK
PEAT
Char Beck
L2a
L2
L1
L2a+
H1
H2a
EGGLESTONE Blue Clay
HART H1
H2a
LAYTON L1
CARLTON L2
IMPROVED CARLTON L2a
L2a+
ALLUVIUM
UNMAPPED AREAS
FEET 0
500
1,000 FEET

a soils map of Teesside is given by House and Fullerton (1) which, with the exception of a faulty key, is obviously based on Dougall's survey (Map 7).

In the absence of any comprehensive description of the soils of the Hartlepools region the present writer felt it necessary to test the validity of Dougall's work in the Elwick district and to make two traverses to sample the texture of the soils between Sedgefield and the coast.

In the summer of 1961 the soils of Home Farm at Elwick were sampled, at intervals of 20 yards, to a depth of 2 feet, and the texture determined by feel. Typical examples of each soil variety found were later analysed mechanically (see Appendix 2) and the results confirmed the field estimations. Dougall's boundaries were found to be substantially correct, and the variety of soil textures from loamy sand to sandy clay loam found within this small area shows the inadequacy of Dougall's map on the one inch to one mile scale.

In the summer of 1963 two traverses were made:

(a) A straight line from Cote Hook Farm, immediately east of Sedgefield, to Graythorp, on the coast near Greatham, was sampled at intervals averaging 100 yards. Apart from where wooded ravines, streams, or buildings interfered, this interval was maintained throughout. An auger penetrating 20 inches was used, three inches of soil at a time being withdrawn for a handling test of texture, and an estimation of colour, drainage and structure. Samples of each type of soil texture were later put through a mechanical analysis using the Bouyoucos hydrometer method.

(b) A straight line from Cote Hook Farm to Crimdon Dene on the coast near Blackhall Rocks was sampled at intervals averaging 300 yards, following the same procedure as in (a).

(1) House and Fullerton, op. cit.

The results, shown diagrammatically in Fig. 2 and Fig. 3, and listed in Appendix 3, testify to the mixed character of the soils at the surface in an area which is described by Dougall as being homogeneous (Haswell Series). The texture within this area, from Sedgefield to Newton Bewley, varies from sand to clay loam, though the proportion of lighter and heavier soils differs according to depth, as the following table shows:

	Surface	9" deep	18" deep
Sand or loamy sand	1½%	1½%	0.5%
Sandy or gravelly loam	25%	19%	8.2%
Loam	61%	47%	10%
Sandy clay loam	1½%	5½%	16%
Clay loam	11%	27%	65%

(as percentages of the 146 samples taken)

This shows that the clay loam, though covered by lighter, more easily worked soils over three quarters of the area surveyed, is predominant below plough depth (taken as nine inches) to the extent of about four-fifths of the area. This suggests that the very act of cultivation has lightened the texture of the soils, and there is historical evidence (1) that much of the area has been cultivated for some centuries. Annual dunging and less frequent liming, together with the more modern practice of artificial fertilizers, have probably altered surface soil textures over considerable areas, especially in arable fields.

Natural conditions have also contributed to the heavier texture of the lower layers of the soil. Silt (i.e. particles of diameter 0.02 mm. - 0.002 mm.) and clay (i.e. particles of diameter less than 0.002 mm.) tend to be washed downwards by percolating rain-water to form A and B horizons in the soil, the A

(1) Baker and Baker papers, Dept. of Palaeography, Durham Cathedral.

horizon being eluvial or leached, and the B horizon being illuvial since it receives precipitated particles, as well as soluble salts from the A horizon. The rainfall of the Hartlepools region is sufficient to promote such leaching, and the writer has found that particularly in old pastures the few inches of surface soil were frequently more gritty or sandy than the underlying layer.

The importance of the lower layers of the soil to agriculture must not be underestimated. It is the lower soil which determines the drainage of the upper, and drainage is one of the farmer's primary considerations. Excessive drainage due to porous rock or to sandy or gravelly subsoil may result in the scorching and withering of pastures and hayfields in the early summer, especially in a region like that of the lower Tees where rainfall in April, May and June tends to be light. Impeded drainage may result in delays for ploughing, sowing and harvesting, or in acidity, or even in marshy conditions which preclude any agricultural use of the land. Imperfect drainage (as opposed to impeded drainage) is not always a bad feature in view of the dryness of the springs, though wet autumns can be disastrous to root harvesting on such soils (e.g. 1960).

Drainage conditions are reflected in the colouring of the lower profile of a soil. Freely drained soils show a uniformity of colour throughout the profile; imperfect drainage is shown by rusty mottling along root channels, and impeded drainage is revealed by characteristic greyish mottlings. The present writer therefore thought it desirable to investigate the drainage conditions of several of the soil regions delineated on Dougall's one-inch map by sinking soil pits, and by studying profiles in trenches fortuitously opened in 1963 for the laying of a trunk gas pipeline from West Hartlepool to Blyth. Details of the profiles revealed in the pits are given in Appendix 4.

The drainage as revealed by the seven soil types investigated by the present writer may be summarised as follows:

Free	Impeded
Hart Series	Darlington Series
Ryhope Series	Haswell Series
Improved Haswell Series	Alluvium
	Easington Series

The region is fortunate in possessing little land with slopes too steep for ploughing and yet at the same time having little land which is too flat to give good natural drainage. While clay, clay loam or silty loam, whose mottled appearance indicate impeded drainage, underlie much of the area, even these appear to have a prismatic structure whose deep vertical cracks enable water from the surface to sink deep enough to obviate any waterlogging of surface root systems during the growing season. Improvements to the natural drainage have been steadily proceeding by means of tile-draining, with increased activity since the government offered financial aid for land drainage from the 1947 Agriculture Act onwards.

Quite apart from the fact that such recent artificial drainage may well have altered the agricultural value of certain soils since Dougall's survey, there is little doubt that locally even the so-called Haswell Series has patches of better drained land (e.g. on Oldacres Hall Farm near Butterwick). On the other hand, some of the better drained soil types suffer from waterlogging in the frequent depressions in the drift cover. A particularly good example of this was found on Hart Moor Farm where a brownish-yellow band of sand several feet thick, exposed by the Gas Board workmen in a trench being cut for a pipe-main, gradually changed colour in a horizontal plane from yellow to blue-grey as a hollow was entered. Whether such anomalies as this deserve special recognition as separate soil types or as mere "phases" of the same type is a pedalogical question beyond the scope of the present inquiry, but it is obvious that Dougall's survey-map on the one-inch scale is purely a reconnaissance rather than a detailed study, and therefore many of the boundaries may be ill-defined. At the same time it can serve well as a base-map for agricultural surveys like the present one.

Areas which do suffer from poor drainage are those east of Cowpen Bewley just north of Teesmouth, several patches along the River Skerne (including the notorious carr lands of Bradbury and Mordon), and the alluvial flats along Billingham Beck. The Teesmouth area is so near sea level that exceptionally high tides such as those of Jan. 31st, 1953, and August, 1961, may flood the large extents of rough grazing. The existing embankments have been raised and breaches repaired along the banks of the Old River Tees and Greatham Creek, but deepening of the drainage channels is more important for normal circumstances. In 1962 ¾ mile of the Seaton Snook channel was improved in this way and as a result standing water levels were lowered by 3 feet, enabling private ditching works on individual farms at Hunter House to go forward.

The River Skerne, under the Wear and Tees River Board, is being steadily improved as a drainage channel. Annual clearing of weeds, sludge and debris is carried out, and a comprehensive improvement scheme has been proceeding upstream from the junction with the Tees at Croft since a survey of the problem in 1952. By 1962 this improvement had been completed along twelve miles from Croft northwards, and the regrading of the river-bed had lowered water levels in low-lying areas of Mordon Carrs. One handicap to the drainage is mining subsidence. The upper Skerne flows across the southern part of the Durham coalfield where there is constant interference with drainage through the subsidence of fields and even of the stream-beds themselves. In 1961-62 the efficiency of the River Skerne was impaired between Fishburn and Butterwick, for example, and a scheme to restore the channel, costing £10,350, has had to be shelved for five years because the National Coal Board are continuing to extract coal from this region and damage will be prolonged. It is a long-term temporary problem for these farms, many of which are owned by the N.C.B. itself.

Billingham "Bottoms" are also being cleared annually, and a particularly badly drained section of 3½ miles of the upper Billingham Beck was the first stretch to be improved under a scheme which began in Feb. 1954. By early 1955 3¾ miles between Stony Flat Farm and Sauf Hall Farm, south of Bishopton, had been widened, deepened, and regraded by dragline excavator, and the adjoining land was thus provided with an adequate outfall for all the ditches and tile drains leading into the main channel (1).

RELATION OF TYPES OF FARMING TO SOILS

A comparison between the map of the types of farming (Map 23) and Dougall's map of the soils of the Hartlepools region reveals the following features:

(i) a broad belt of fattening farms, about four miles wide, and halfway between West Hartlepool and Sedgefield, corresponds in a remarkable fashion with the occurrence of the Haswell Series of soils, which are shallow clay loams over yellowish clays and need careful cultivation where arable farming is practised;

(ii) cash cropping-with-fattening farms correspond with (a) lighter soils such as the Hart Series, the Herrington Series, the Improved Haswell Series, and the Layton Series, in a north-south belt just west of the Hartlepools towns from Crimdon Dene to Wolviston; (b) lighter land north-west of Sedgefield along the road to Durham (Herrington Series); (c) lighter soils of the Layton and Improved Haswell Series from Butterwick and Oldacres to Carlton; (d) the heavier but fertile Dalton Series above the well-drained Magnesian Limestone from Fishburn to Trimdon Colliery and Trimdon Grange:

(1) Wear and Tees River Board, Annual Reports .

(iii) rough grazing shared in "stints" by stock farmers along the coast of Tees Bay between Port Clarence and Seaton Carew occupies the reclaimed alluvium whose water-table is so high that the area is marshy in winter.

(iv) the greatest belt of woodland in the region, namely that on the Home Farm, Wynyard, is entirely upon the heavier soils of the Haswell Series, and occupies to some extent slopes too steep for cultivation, especially in the Newton Hanzard Plantations and in Close Wood where the North Burn flows in a ravine.

(v) the cluster of fattening farms around Cowpen Bewley lies on the clay loams of the Darlington Series, with some of the best arable land in the region immediately to the west corresponding to the light soils of the Layton and Hart Series. Where the Darlington Series gives way to the Improved Haswell Series to the east there is a switch in land use from permanent grass to arable, which forms a belt across Middle Belasis Farm (now part of the vast Saltholme Farm), the southern ends of Earl's Nook Farm, Coleman's Hook Farm, Manor Farm, and Little Marsh Farm, to Saltholme itself. It is worth recording that this same belt was arable land in the early 1930's when the Land Utilisation Survey was made, at the time of minimum arable distribution.

(vi) in the north-west corner of the region between the **Trimdons** and Thornley the extremely diverse types of farms to be found correspond with the many small pockets of soil types. Arable land, and especially that under potatoes, tends to keep to those soils like the Boldon and Herrington Series which are free-draining. Fields here may occasionally suffer from subsidence and also from "shakes" or cracks which develop in the Magnesian Limestone so close to the surface here on the edge of the escarpment. While the removal of the underlying coal may allow a whole field to gradually sink, the shakes are responsible for long narrow trenches which the farmer fills with rubble over which soil is scraped.

(vii) in the south-west corner of the region mapped another belt of fattening farms from Carlton through Redmarshall towards Sadberge lies on the heavier soils of the Carlton Series and the alluvium of the Newbiggin district.

(viii) south-west of Sedgefield yet another fattening district corresponds to the Darlington Series of medium-working clay loams and extends westwards on to the alluvial soils of the Morden, Bradbury and Preston Carrs.

The potato crop is, more than any other in the Hartlepools region, the arbiter in the classification into farm types. Since its contribution to gross output per acre is so large, and since many farms feed a substantial proportion of the corn they grow, it is mainly those farms which grow a moderate acreage of potatoes as well as having about half their total acreage under cereals which are classified as cash-cropping-with-fattening farms. It is because the potato crop is generally grown on soils of lighter texture that there is this correspondence between the distribution of cash-cropping farms and that of the lighter soils. Corn crops do very well on the heavier land providing that the proper cultivations and fertilizers are applied, and a very high percentage of the farms grow cereals, mainly for fodder, but with a substantial amount also for sale to the merchants.

On the heavier soils in the centre and west of the Hartlepools region potatoes are notably absent apart from the small plot each farmer grows for his own consumption. The lack of villages on the broad band of the Haswell Series of soil between West Hartlepool and Sedgefield has also meant that there is a chronic shortage of labour for the potato harvest. Yet even on the margins of Stockton, where labour is easy to obtain, potatoes are traditionally not grown and it would appear that the heavy soils are to blame.

On the other hand when a large-scale farmer such as J.H. Thompson can organise mobile squads of labour, transported from the colliery villages by lorry, to pick potatoes, even farms in the Haswell soil zone can and do grow this crop. Yields are lower on the whole in the heavier soil districts, however, and the lack of farms which grow potatoes in these areas reveals the relative unprofitability of this crop. One farm, White Hurworth, east of Trimdon, grew 55 acres of potatoes in 1957 under a new occupier, but this was soon entirely abondoned in favour of a corn and leys rotation.

AGRICULTURAL POTENTIAL OF THE SOILS OF THE HARTLEPOOLS REGION

While the heavier soils of the region, greatest in extent between Sedgefield and the A.19 road, retain their moisture well, even in the driest springs and warmest summers, this appears to be their sole advantage over the lighter soils for arable farming. Most farmers prefer the land from Hart to Wolviston, and the belt from Thorpe Thewles to Sedgefield, and refer to it as first-class tillage land.

The whole region, however, can grow excellent grass and has a fine tradition as a fattening district, which has been enhanced since ley farming and chemical fertilizers were introduced. The intensity of stocking on grazing pastures has risen steadily till some districts are now feeding one grazing unit (i.e. five ewes with lambs, or 1.2 milk cows) on less than an acre in June, when grass feeding alone is the rule. On sandy and gravelly patches a dry spring may cause some "burning-up" of pasture and the lowering of hay yields, but such weather is usually accompanied by cloudy dull skies and low temperatures, so that grass is rarely in short supply. The wartime ploughing-up campaign has been beneficial in allowing some tenancy agreements on the preservation of old pastures to be ignored, and ploughing then re-seeding has improved much inferior grassland.

Chapter 2

THE CLIMATE OF THE HARTLEPOOLS REGION

The scope of the present enquiry includes the geographical variation of climatic phenomena over a small region inland from the Hartlepools on the coast of south-east Durham, and the factors which cause this variation.

It is first necessary to discuss the material available for the study of the climate. Daily weather records are kept in this region at several places but they vary in their range and reliability. For this reason a close scrutiny and criticism may be useful.

At Middleton St. George R.A.F. aerodrome, five miles east of Darlington, a highly accurate and detailed record is kept, with hourly readings of pressure, wind, temperature, cloud, visibility and humidity. A staff of servicemen and civilians maintain an all-day weather look-out, primarily for aviation purposes, but also to supply the public with meteorological forecasts and reports. Monthly publications by the Meteorological Office include summaries of these readings, which date from 1952.

At West Hartlepool an officially approved meteorological register is kept by Mr. H. Lamb, the Lynn St. jeweller. Readings are taken only at 9.00 a.m. each day. Wind, pressure, and sunshine are recorded at the Lynn Street premises, the former by wind-vane alone, and the others by approved instruments. Temperatures and rainfall are read from instruments kept in an open space immediately west of the West Hartlepool railway station. The Meteorological Office also publishes these figures monthly. They date from 1951, though simple 9.00 a.m. temperature readings go back to the early years of the century.

A similar officially approved daily record is kept at Redcar, under the care of the municipal parks department, the instruments being housed behind the council offices. These figures are also published by the Meteorological Office and date from 1939.

The Billingham works of Imperial Chemical Industries maintains daily records of temperatures and rainfall, and continuous anemometer records for wind. These last-named are published by the Medical Officer of West Hartlepool as part of his annual report. These figures may also be regarded as reliable.

At Hartlepool Lighthouse Mr. H. Carter has kept records of temperature, pressure, winds, rainfall and the state of the sea, as part of his duties for the Harbour Engineer's Department, since 1924. Fog records have been kept since 1950. These records must be treated with caution for the following reasons:

(a) Since all the work is done by one man occasional gaps appear, sometimes due to illness, sometimes due to holidays when the deputy keeper fails to maintain Mr. Carter's high standard of instrument care.

(b) The maximum and minimum thermometers are kept in a small louvred screen hung on a north-facing wall, and not in a Stevenson screen away from all buildings.

(c) The rainfall gauge is not of the standard pattern and moreover is placed on the flat roof of a ten-foot high building near the top of the cliffs. Over-exposure is highly probable.

Fog records are also kept by the Tees Conservancy Board at the South Gare Lighthouse, near Redcar. The fog-horn is in operation for all the period during which visibility is less than one mile, and a log is kept of the times when the horn is in operation by a staff who work in pairs on a shift system.

Rainfall records of a high standard of accuracy are kept by the Hartlepools Water Company at West Hartlepool (Lancaster Road), at Hart Reservoir, at Crookfoot Reservoir, and at Hurworth Burn Reservoir. These records date from 1864 at

Lancaster Road and are published annually in "British Rainfall" by the Meteorological Office.

Officially approved records for places further afield are available for Dishforth R.A.F. aerodrome in the Vale of York, for Houghall School of Agriculture near Durham, and for Durham Observatory (lately taken over by the University Department of Geography). All these are published monthly by the Meteorological Office.

It is unfortunate that no temperature or wind statistics exist for the East Durham Plateau. The writer felt it desirable to carry out further investigation in order to relate the climate of the Plateau to that of the rest of the Hartlepools region. Temperature traverses were thus made under varying weather conditions with this aim in view, and a portable Stevenson screen was built and stationed first at Greenside Farm on Trimdon Hill at a height of over 600 feet above sea level and about seven miles inland, and then at Sedgefield at a height of 330 feet above sea level and about ten miles inland. These short term records can be compared with those from the permanent stations on the lowlands. A third temporary station was adopted at Whelly Hill Farm, Hart (440 feet).

Temperature traverses which have been made to compare the lowlands with the East Durham Plateau have revealed some interesting details. The traverses were carried out by car, using a screened mercury general-purpose thermometer fixed to the roof of the vehicle, mostly during the hours of darkness. Readings were taken only when the car was stationary, and each traverse was run over twice and the two readings averaged for each place.

Short term temperature readings were also gathered by the writer from Stevenson screens he erected at Seaton Carew and at West Hartlepool Grammar School (Brinkburn), the former at 20 feet above sea level and 600 yards from the sea, and the latter at 70 feet above sea level and 1½ miles from the sea.

While a truly comparative record for the East Durham Plateau awaits the establishment of weather stations on a permanent basis these short term readings may be used as indicators of the possible temperature variations, in differing circumstances, between the higher and lower ground within the Hartlepools region. There can be little doubt that temperature differences between the two have important effects in the agriculture of the area, for example in delaying the harvest at the higher altitudes, and in retarding the spring flush of grass on the Plateau farms.

CLIMATIC FACTORS

The region occupies the north-eastern end of a lowland extending from the Vale of York and also the south-east facing dip-slope of the East Durham Plateau. The extent to which this position affects the area's climate hinges largely on the contrasts between land and sea. The districts nearer the sea are more liable to have their temperatures modified than those inland. Maritime influence reduces significantly the range of temperatures at the coast, and another aspect which has been investigated is the effect on temperatures, and on rainfall, of winds blowing off the sea.

The shelter offered by the Yorkshire Moors and the Pennines is another result of the area's position. Although England is narrowest in this region, which might therefore be expected to have more westerly characteristics than other parts of the east coast, the rainfall, it has been found, is more in keeping with east coast regimes. This suggests that considerable shelter is given by the Pennines and Lake District mountains to the west. Adiabatic warming and consequent drying of the winds descending from these uplands may be expected and does in fact occur when the wider European pressure systems produce westerly winds.

The maritime position is also responsible for unusually detailed fog records because the economic circumstances of the region warrant two busy ports, at Hartlepool and Middlesbrough. This part of the North Sea contains the coldest water (1) and sea-fogs are inevitable in winter with any calm anticyclonic weather, or in autumn with a sluggish drift of air from the warmer land. An excellent example of the latter was seen on the evening of Sunday, November 3rd, 1963, from the cliffs south of Blackhall. The writer found it interesting to trace the variation of sea-fog across Hartlepool Bay and Teesmouth. One problem raised by this cold coastal water is whether it affects the rainfall of the Hartlepools region at times of onshore winds by condensing moisture into droplets before reaching land.

The second climatic factor to be considered is the region's own topography. The gentle rise to north and west from the Tees lowlands, at less than 100 feet, to the East Durham Plateau, which exceeds 600 feet at Trimdon and Thornley, will tend to create differences in temperature and rainfall which cut across those imposed by increasing latitude and greater distance from the sea.

It has been found, in fact, that the rainfall at the higher stations tends to be heavier over the year (e.g. West Hartlepool, at 35 feet, averaged 22.72 inches from 1952-60, while Hurworth Burn Reservoir, at 357 feet, averaged 24.35 inches in the same period) though sheltered places, even at higher altitudes, may be drier than lowland stations (e.g. Hart Reservoir, at 172 feet, averaged 22.39 inches from 1952-60.

A small but significant reversal of this position occurs in the summer months when lowland stations, provided that they lie inland, have a higher rainfall than upland stations (e.g. Middleton St. George, at 114 feet, averaged

(1) G. Manley. Some Notes on the Climate of N.E. England. Quarterly Journal of the Royal Meteorological Society, 1939.

7.63 inches in June, July and August between 1952-60, while Hurworth Burn Reservoir averaged 7.43 inches in the same period). There is a correlation between this and the greater number of thunderstorms experienced in the lowland interior in these months. The coast, being cooled by sea-breezes at this time of year, has far less convectional rain (West Hartlepool 6.77 inches) although having actually two more rain-days on the average than inland places.

Thus the factors of position and topography tend to be dominant at different times of the year, the former in summer, the latter in winter.

The effect of topography on temperature has been more difficult to assess in the absence of long term records on the East Durham Plateau, but the fact that harvests there can often be a fortnight later than on the Tees lowlands suggests that cooler conditions are the result of higher altitude. Experimental observations given on Pages 33-36 confirm this.

It may be observed here that the marked flatness of the Tees lowlands allows the effects of maritime influence to be seen more easily than on the East Durham Plateau where altitude is a complicating factor.

On the other hand, temperature inversion may more readily be observed on the Plateau dip-slope whose valleys are narrow and steep-sided enough to act as frost-pockets in winter. Hurworth Burn and Amerston Gill run in such valleys, and during December, 1961, an unusually severe month, tests were made to see to what extent frosty air collected in them on calm nights. Air temperatures far below those on the adjoining slopes and hill-tops were found in the Hurworth Burn valley. On two occasions this temperature inversion lasted all through the succeeding day.

The topography is also undoubtedly responsible for fog patterns, especially when radiation fog has formed. A sharp edge to the fog-sea which sometimes floods the Tees lowland has been found on ascending the dip-slope of the East Durham Plateau. Although tracing the edge of a fog-sea at ground level in winter can be a hazardous enterprise on the roads, much information can be gained by telephoning ahead along the lines of possible traverses. Several cases have been found during the 1961-62 winter where the lowland is fog-bound but the higher ground is free from fog. Contributory factors to this state of affairs would seem to be the inversion of temperatures on the lowland and in addition the heavy atmospheric pollution from the urban and industrial districts of the lower area.

Another way in which the relief of the landscape modifies the climate is in the length of time for which snow lies. Higher areas, and especially north-facing slopes, as would be expected.carry snow far longer than the lower districts. During the 1961-62 winter snow lay on the East Durham Plateau a week longer than on the Tees lowland, and on north-facing slopes three weeks longer.

Apart from position and topography a third factor affects the climate of the Hartlepools region. It is industrialisation and urban development. Man-made climatic phenomena such as domestic and commercial smoke can supply the tiny nuclei which aid fog development in conditions of high humidity and calm air. Comparisons have been made by the present writer between the fog records at Hartlepool and South Gare (Redcar), and there can be little doubt that the greater atmosphere pollution coming down the Tees valley from the Stockton-Thornaby-Middlesbrough complex of industry is responsible for the higher incidence of fog at South Gare.

Moreover, the urban areas on certain occasions become several degrees (Fahrenheit) warmer than the surrounding rural areas. This is best seen in calm spells, since on windy days the mixing of rural and urban air leads to the dispersal of the urban warmth and the contrasts are less apparent. Results of the writer's investigations at West Hartlepool suggest that this urban area does develop a heat-island in winter, and that this extra warmth is due to the urban and industrial environment. Within the heat-island minor warm and cold spots exist.

That such local variations can be significant is borne out when one considers the higher relative costs in West Hartlepool compared with Hartlepool of freeing the roads from frost, ice and snow, or the difficulties of milk collection from upland farms cut off by deep snow drifts while lowland farms are clear of snow.

TEMPERATURE

Table 1 includes temperature means for West Hartlepool for the period 1951-61 and illustrates urban coastal conditions in S.E. Durham.

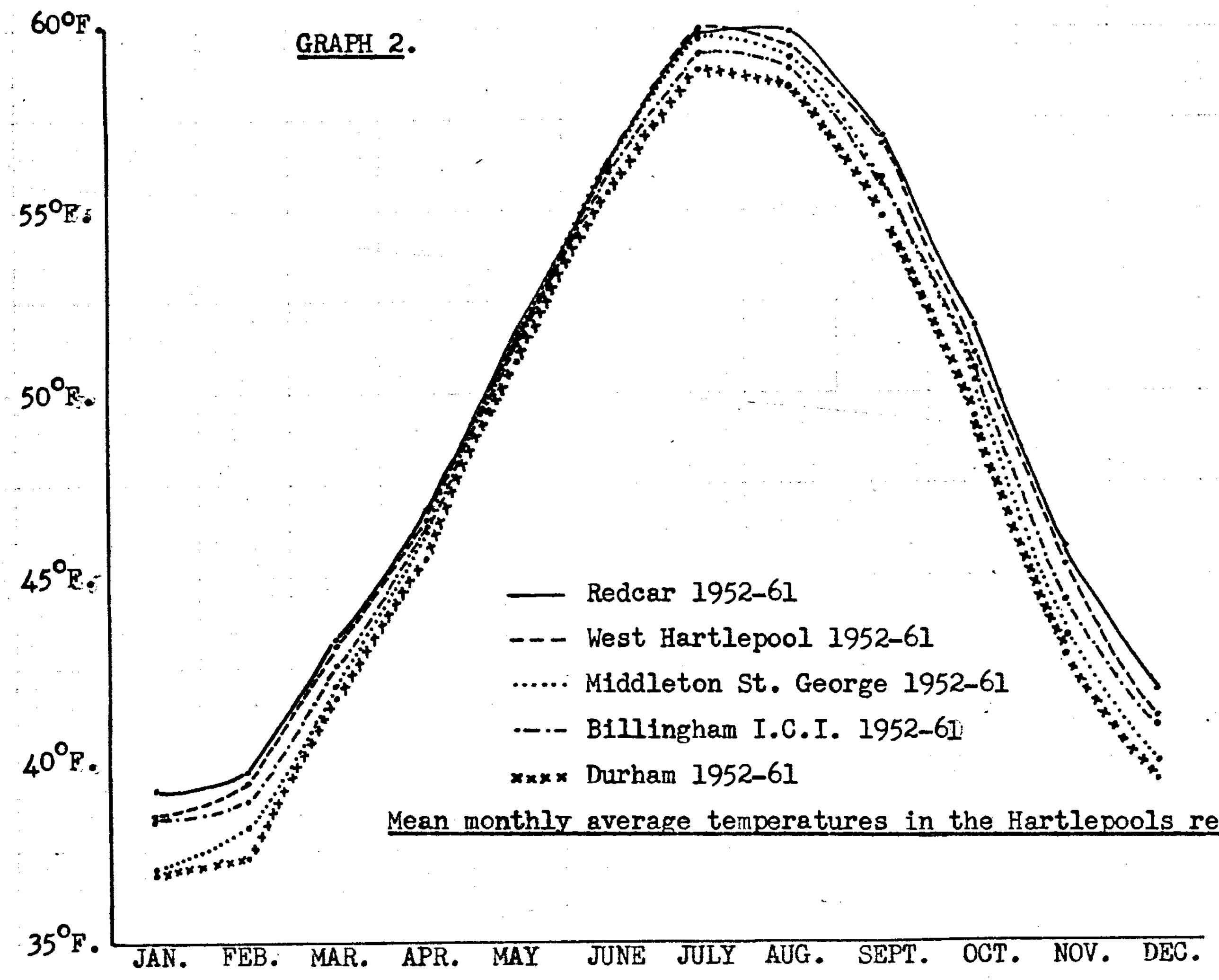
Monthly means range from 38.5°F. - 60.0°F., exemplifying a mean monthly seasonal range of 21.5°F. The monthly means of the daily maxima (43.2°F - 66.3°F). and of the daily minima (33.8°F. - 53.8°F.) give a better indication of monthly ranges of temperature, and the extremes recorded for each month since 1951 (14°F. and 16°F. in February and January, and 91°F. in August) reflect the potential severity of the climate. Air frosts have been recorded in every month from October to April, and only the months June to September have been frost-free. Ground frosts may occur in all months except from June to September, and the months December to February, inclusive, record a mean frequency of 36 out of a mean annual total of 51 days with frost. In this respect, however, West Hartlepool does not experience unduly severe conditions. Sheffield for the period 1921-49 records a mean of 65 days with frost; Oxford (for the period 1920-49) records 83 days, and at the other extreme Holyhead records only 26 days. Middleton St. George, only fifteen miles to the south-west, has 36 days with ground frost, taking the average of the period 1952-61. This serves as an excellent index to the control exerted by the sea on the climate of the region.

Monthly means for long periods of years mask what amount to a considerable and significant variety of day to day temperature ranges. The significance of these is demonstrated by a study of the daily maximum and minimum temperatures for Hartlepool for the same winter months in successive years (1946-47) and 1950-51). Graph 1 shows that in 1946, a warm cyclonic open winter, the February daily minimum readings were for a long spell far above the mean monthly minimum, and once even above the mean monthly maximum temperature. 1947 on the other hand was phenomenal for the prolonged and severe cold weather experienced and for the long duration of a snow cover. From the early snows on 21 January until the "great thaw" on 16 March the maximum daily temperatures on most days were below the mean monthly minimum, and for certain spells the temperature remained below freezing point both by day and night.

Graph 1A again reveals the eccentric movements of the temperatures and the dissimilarity of consecutive winters. 1950 ended with a cold spell when both maximum and minimum temperatures were below the monthly means. The variation in the daily range of temperature also stands out on this graph, being only 2°F. on 17 December, 1950, but 21°F. on 25 December, 1951. The 1951 graph exemplifies the alternating dominance of contrasting air masses, warm from the south-west, and cold from the north. The big dip in the December temperatures, notably from the 11th to the 13th, was caused by northerly winds of Arctic origin as a depression lay over Norway, while the upward recovery after the 14th December followed a change to south-west winds as Atlantic depressions moved east.

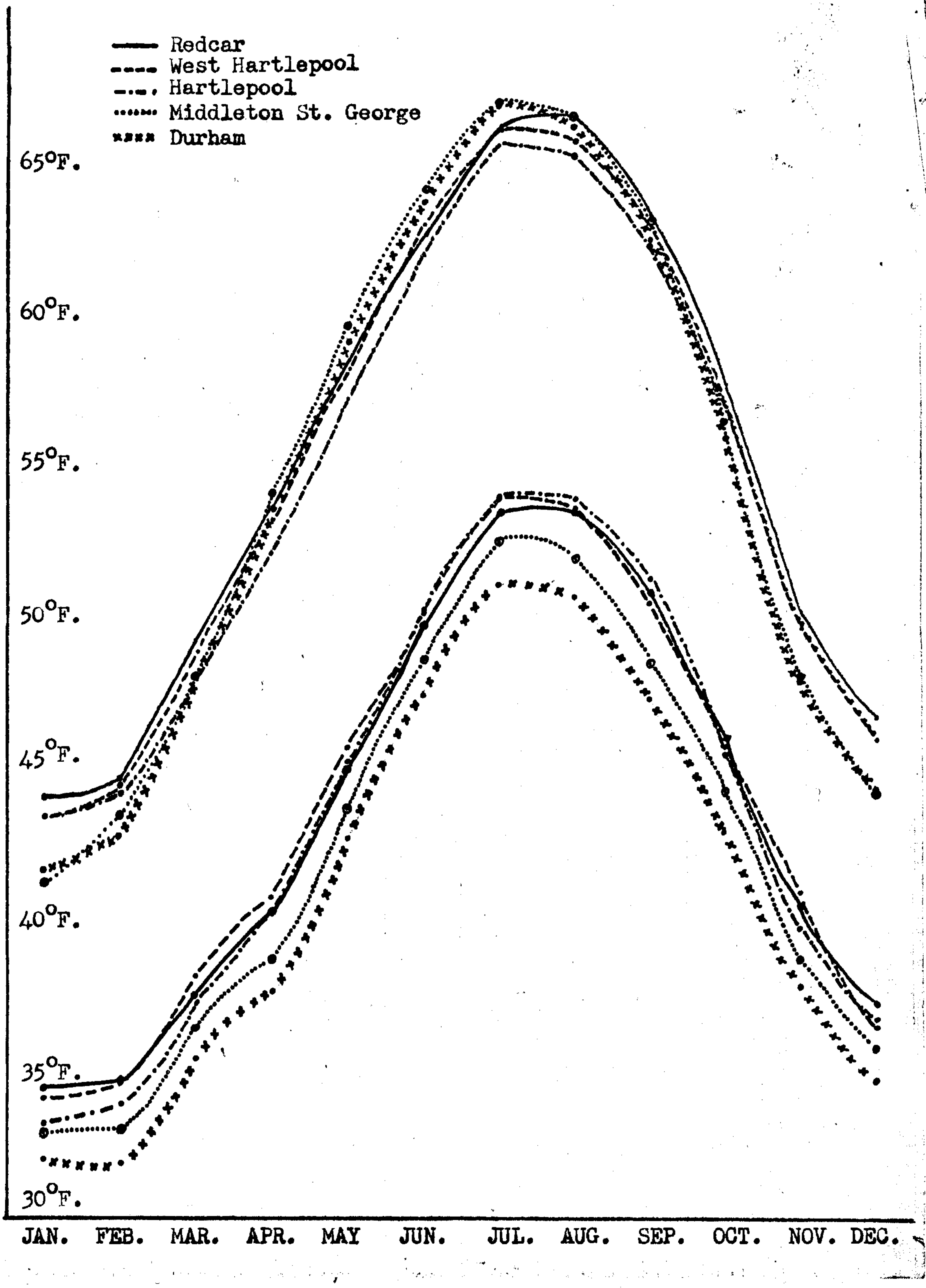
Within the Tees lowland several interesting contrasts appear between inland and coastal places. Graph 2, showing the mean monthly temperatures, brings out the fact that the coastal stations are warmer than inland stations, though this is less apparent in summer than in winter. Graph 3, showing mean monthly maximum

GRAPH 2.



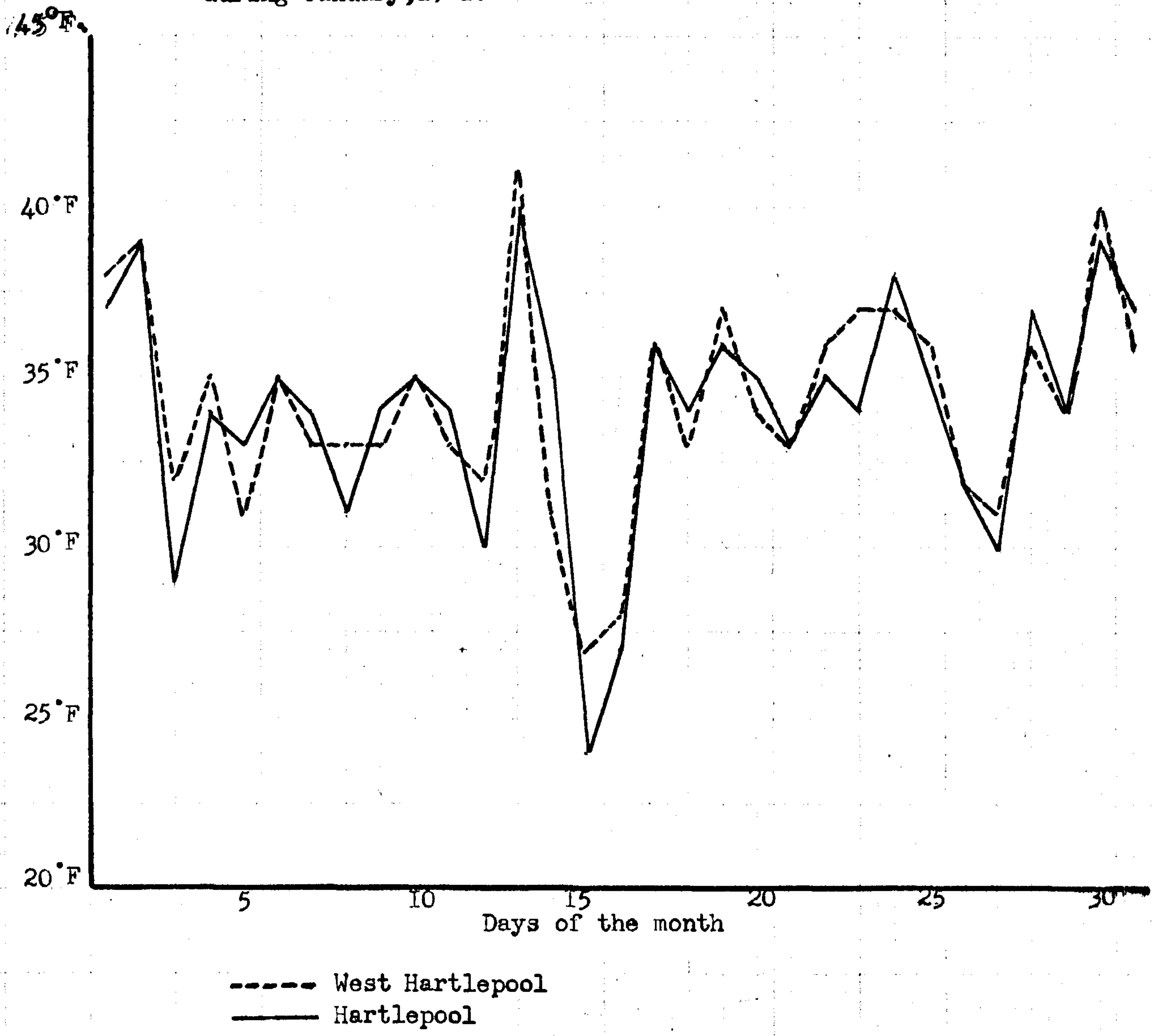
Mean monthly average temperatures in the Hartlepools region.

GRAPH 3. Mean monthly maximum and minimum temperatures in the Hartlepools region, 1952-1961.



GRAPH 4.

Minimum daily temperatures at Hartlepool and West Hartlepool during January, 1961.



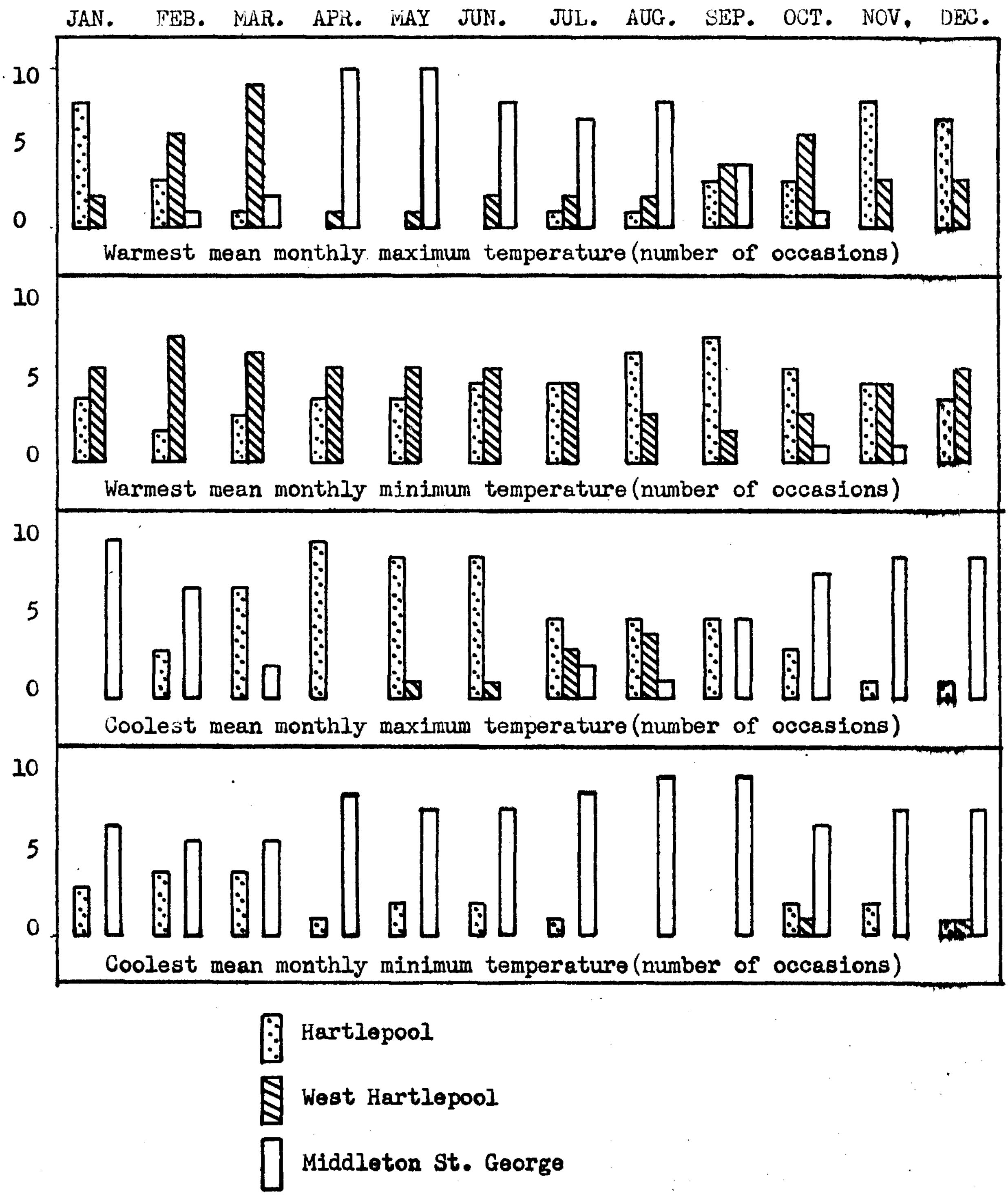
and minimum temperatures, reveals that although Middleton St. George has lower minimum temperatures than the coast all the year, maximum temperatures rise there more quickly in spring, and the interior stays warmer than the coast till September. The warming influence of the sea is therefore at its peak from November till March. From March to July cool north-east winds maintain relatively low temperatures at the coast, while the interior, rather more sheltered from this cooling influence, can benefit to a greater extent from increasing insolation at this time of year. Graph 3 also makes very clear the exposed position of the cliff-top lighthouse at Hartlepool, in so much as from March to July the maxima are significantly lower than at the other coastal stations.

The warmest station from October to February is Redcar, despite the fact that during this period it received less sunshine than the other stations (see Page 43). This again demonstrates the warming influence of the sea.

As far as minimum temperatures are concerned, there is more disparity between winter at West Hartlepool and at Hartlepool than one would expect, with the former averaging about one degree Fahrenheit higher, in January and slightly more than this in November. Urban warmth must be responsible for this, since the West Hartlepool thermometers are kept close to a large built-up area. The greatest differences in the minima of these two stations occur, however, when easterly air from the continent is crossing the area. Graph 4 shows the minimum temperatures of both stations during January 1961. The first difference, on the 3rd and 4th, was due to northerly winds with squally wintry showers; dips in the Hartlepool graph on the 8th and 12th were the result of cold fronts moving south-east from Scotland, the steep drop on the 25th accompanied east and south-east winds blowing from an anticyclone on the continent; the final disparity, on the 23rd, was also due to this dry easterly air stream. Thus it appears that whenever cold air masses are predominant Hartlepool lighthouse with its exposed

GRAPH 5.

Comparison of temperature conditions at West Hartlepool, Hartlepool, and Middleton St. George, 1952-1961.



cliff-top site is more sensitive of extremes.

Graph 5 shows these facts in a different way by giving the number of occasions when each of three stations has had coolest or warmest maxima and minima. The following points emerge:

(a) Warmest maxima

Hartlepools has the warmest afternoons from November to January showing the warming maritime influence at its greatest during these months. In February and March West Hartlepool's urban warmth is the predominant factor, while from April to August the "continental" warmth of the inland station, Middleton St. George, keeps maxima higher than at the coast.

(b) Warmest minima

The greater night warmth of West Hartlepool lasts from December to June but it is most striking in February and March. This may be related to the higher frequencies of strong cold northerly winds from February to May, but another factor is the man-made heat emanating from the built-up area in which the West Hartlepool recording station is situated. It is rather striking to find a reversal of the positions of West Hartlepool and Hartlepool in this matter of night warmth in winter after November 1959. The following figures show that Hartlepool was warmer in 1960 and 1961:

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1960	Hartlepool	36.3	35.0	40.0	42.3	43.4	53.2	53.9	53.3	54.1	48.2	39.2	35.5
	W. Hartlepool	35.9	35.3	39.2	41.9	47.3	52.2	52.8	52.7	50.9	47.7	39.0	35.8
1961	Hartlepool	34.1	39.4	41.4	42.9	46.4	52.9	53.4	53.9	55.4	46.4	40.2	33.1
	W. Hartlepool	34.0	38.6	40.8	43.0	45.5	50.9	52.2	52.5	52.2	45.9	38.9	32.3

A large block of densely packed slum property was demolished in the neighbourhood of the West Hartlepool recording station in 1959 and it may well be that the loss of so many chimneys has been the cause of the relative fall in the minima here. The corresponding figures for the two previous years are appended for the sake of comparison:

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1958	Hartlepool	31.2	32.2	30.9	37.9	42.7	46.9	52.1	53.7	52.0	44.5	37.5	35.5
	W. Hartlepool	32.7	34.6	33.7	39.5	44.1	48.9	52.9	53.8	53.3	45.7	38.6	37.0
1959	Hartlepool	28.6	35.3	39.1	40.2	43.7	50.2	55.9	57.0	52.8	48.9	40.9	39.1
	W. Hartlepool	30.6	37.4	40.0	42.3	45.6	50.9	54.9	55.2	50.3	48.3	46.7	38.4

The occurrence may be entirely fortuitous yet temperatures taken in the empty space left where the slums formerly stood have shown that this patch is cooler by night than the surrounding built-up area. It is in fact a cold spot in the heart of West Hartlepool.

(c) Coolest maxima

The graph's most impressive column is that for April when the cliff-top site at Hartlepool is exposed to cool north and north-east winds from the sea. The chilling influence of these winds can be seen in the whole spring season from March to June. The April figures for Hartlepool and West Hartlepool are given to show the extent of this cooling in stations only a mile apart:

	Hartlepool	West Hartlepool		Hartlepool	West Hartlepool
1951	49.6	50.2	1957	51.8	53.4
1952	54.2	55.0	1958	50.7	51.8
1953	49.7	50.3	1959	52.0	55.4
1954	51.5	52.2	1960	53.4	55.2
1956	49.0	49.2			

In the winter months the inland station is coolest by day due to its relative remoteness from the warming maritime air. Just how much cooler than the coast

TABLE I

West Hartlepool, Church Street - Latitude 54.41' N.Longitude 1.12' W.Altitude 30ft.

	J	F	M	A	M	J	J	A	S	O	N	D
Mean monthly Temperature (1951-61)	38.5	39.4	43.1	46.6	51.5	56.4	60.0	59.5	56.8	51.1	45.3	41.1
Mean of daily maxima (1951-61)	43.2	44.4	48.4	52.9	57.6	62.7	66.3	65.6	63.0	56.8	49.7	45.9
Mean of daily minima (1951-61)	33.8	34.5	37.7	40.5	45.3	50.0	53.8	53.4	50.6	45.3	41.0	36.3
Absolute max. temp. (1951-61)	58	61	70	69	75	81	80	91	78	72	62	59
Absolute minima (1951-61)	16	14	19	28	34	38	43	41	34	27	25	21
Mean number of days with ground frost (1951=61)	14	12	4	4	1	0	0	0	0	1	5	10
Mean number of days with fog (1951-61)	6	5	4	1	0+	0+	0+	1	1	3	4	5
Mean monthly hours of bright sunshine (1956-61)	57.5	62.2	97.8	139	194.2	[illegible]	149.9	155	121	94.7	54.7	28.8
Mean number of days with rain (1951-61)	18	15	13	12	11	13	15	16	13	15	16	16
Mean number of days with snow (1951-61)	5	7	4	1	0	0	0	0	0	0	0	2
Mean number of days with snow lying (1951-61)	4	6	2	0	0	0	0	0	0	0	0	1
Mean number of days with thunder (1951-61)	0+	0+	0+	0+	1	1	2	2	0+	0+	0+	0
Mean monthly rainfall in inches 1949-61)	2.27	1.55	1.27	1.21	1.62	1.71	1.17	2.81	1.81	2.12	2.52	2.19

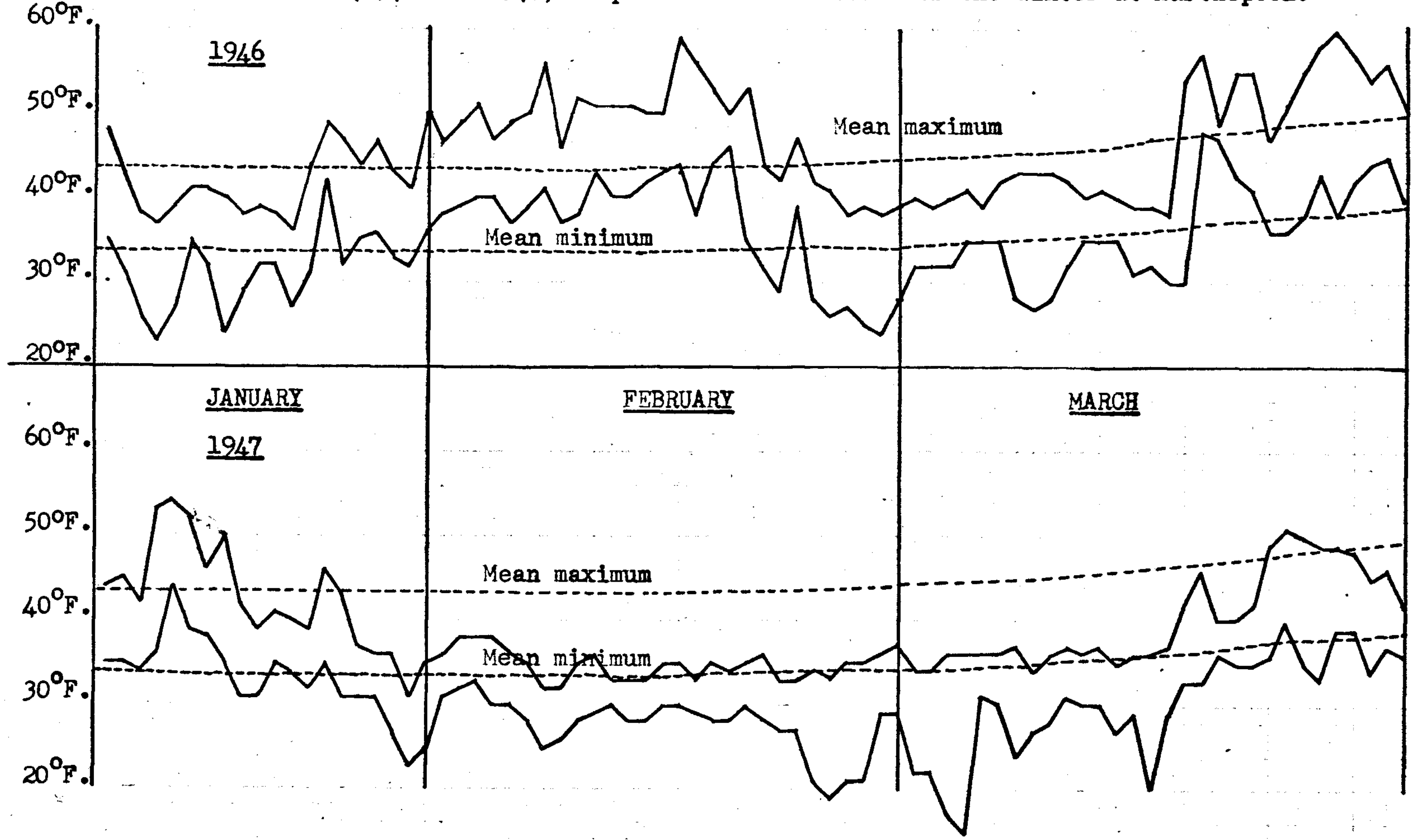
TABLE 2

Middleton St. George R.A.F. aerodrome - Latitude 54.31' N. Longitude 1.26' W.

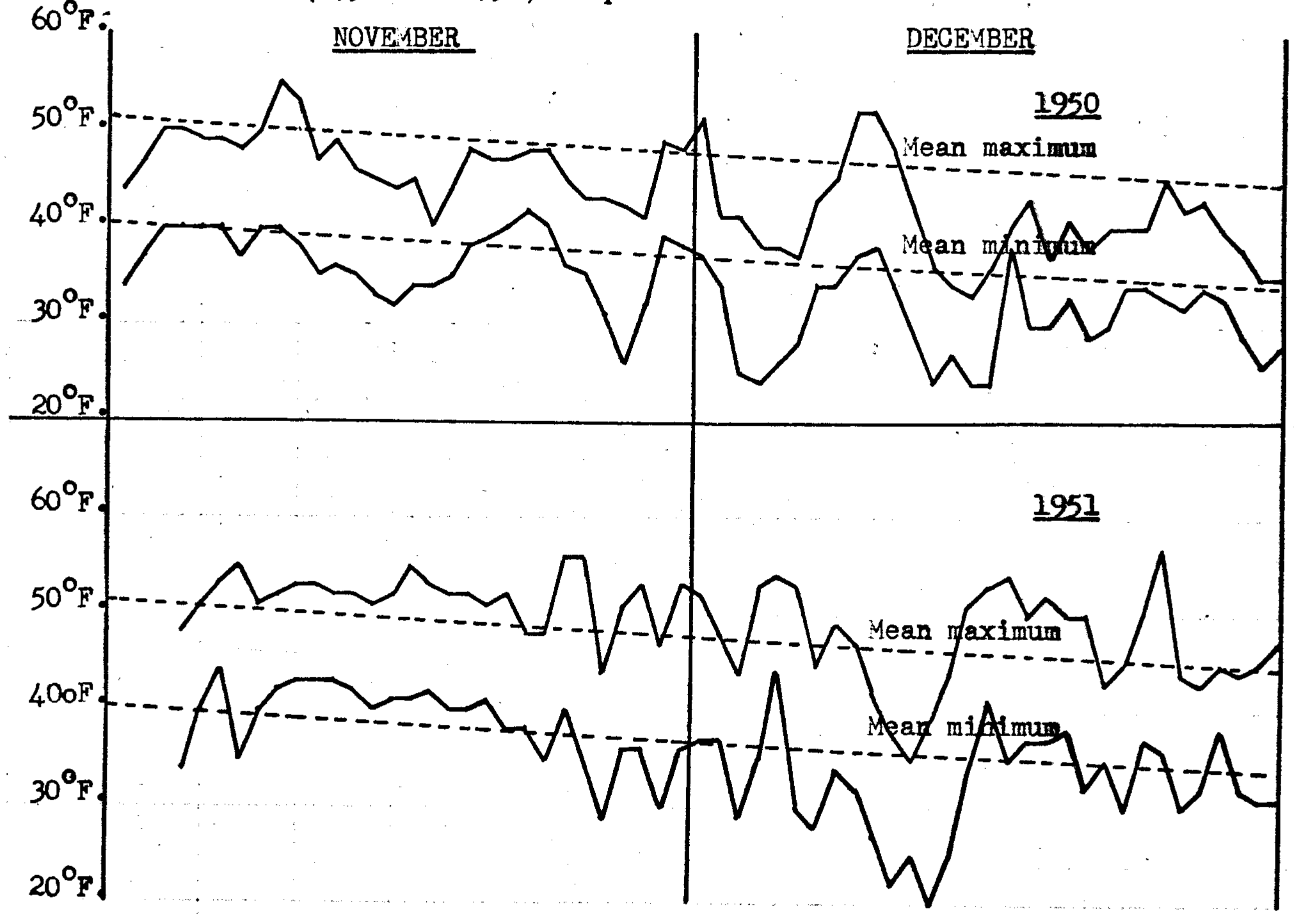
Altitude 114 feet - Averages of period 1952-61.

	J	F	M	A	M	J	Jy	A	S	O	N	D
Mean monthly temperature in °F.	37.0	38.2	42.1	46.2	51.6	56.3	59.7	59.2	55.7	50.3	43.3	39.9
Mean of daily maxima	41.2	43.4	47.9	53.9	59.6	64.0	66.9	66.5	63.0	56.3	47.9	44.1
Mean of daily minima	32.8	33.0	36.3	38.6	43.6	48.5	52.4	51.8	48.4	44.2	38.6	35.7
Mean number of days with ground frost	19	15	12	8	4	0+	0	0	1	4	10	13
Mean number of days with fog (1952-61)	1.8	3.3	3.1	0.4	0.8	0.9	0.3	0.4	0.8	3.1	3.1	4.1
Mean monthly hours of bright sunshine	57.6	67.3	102.8	142,7	191,8	172	163	156.6	129	99.6	57.3	37.6
Mean number of days with snow	8.4	8.8	3.9	0.5	0.2	0	0	0	0	0.1	0.8	4.4
Mean number of days with snow lying	7.0	7.8	2.1	0	0	0	0	0	0	0	0	1.7
Mean number of days with thunder	0	0	0	0.4	1.8	1.5	3.8	3.1	0.7	0.5	0.1	0
Mean monthly rainfall (inches)	2.04	1.44	0.93	1.16	1.49	2.00	2.43	2.97	1.87	2.07	2.11	1.88

GRAPH 1. Daily maximum and minimum temperatures at Hartlepool in successive winters (1946 and 1947) compared with the means for the winter at Hartlepool.



GRAPH 1A. Daily maximum and minimum temperatures at Hartlepool in successive winters (1950 and 1951) compared with the means for the winter at Hartlepool.



is shown in the following comparison with Redcar:

1958-59		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Middleton St. George		56.9	46.5	43.9	38.2	45.0	49.5
Redcar		58.7	49.4	46.0	41.1	46.9	51.0
1959-60	Middleton St. George	61.2	49.1	45.9	42.5	43.2	46.4
	Redcar	61.1	51.5	47.7	45.4	44.8	46.3
1960-61	Middleton St. George	54.2	47.5	42.2	41.9	49.0	54.1
	Redcar	55.2	49.7	44.9	43.9	50.0	55.6

West Hartlepool is slightly cooler than Redcar in this matter of winter maxima but even so it is usually more than I°F. warmer than Middleton St. George.

(d) Coolest minima

Graph 5 shows that Middleton St. George is cooler at night on most occasions throughout the year. The extent of the difference may be judged by comparing Middleton St. George and West Hartlepool minima.

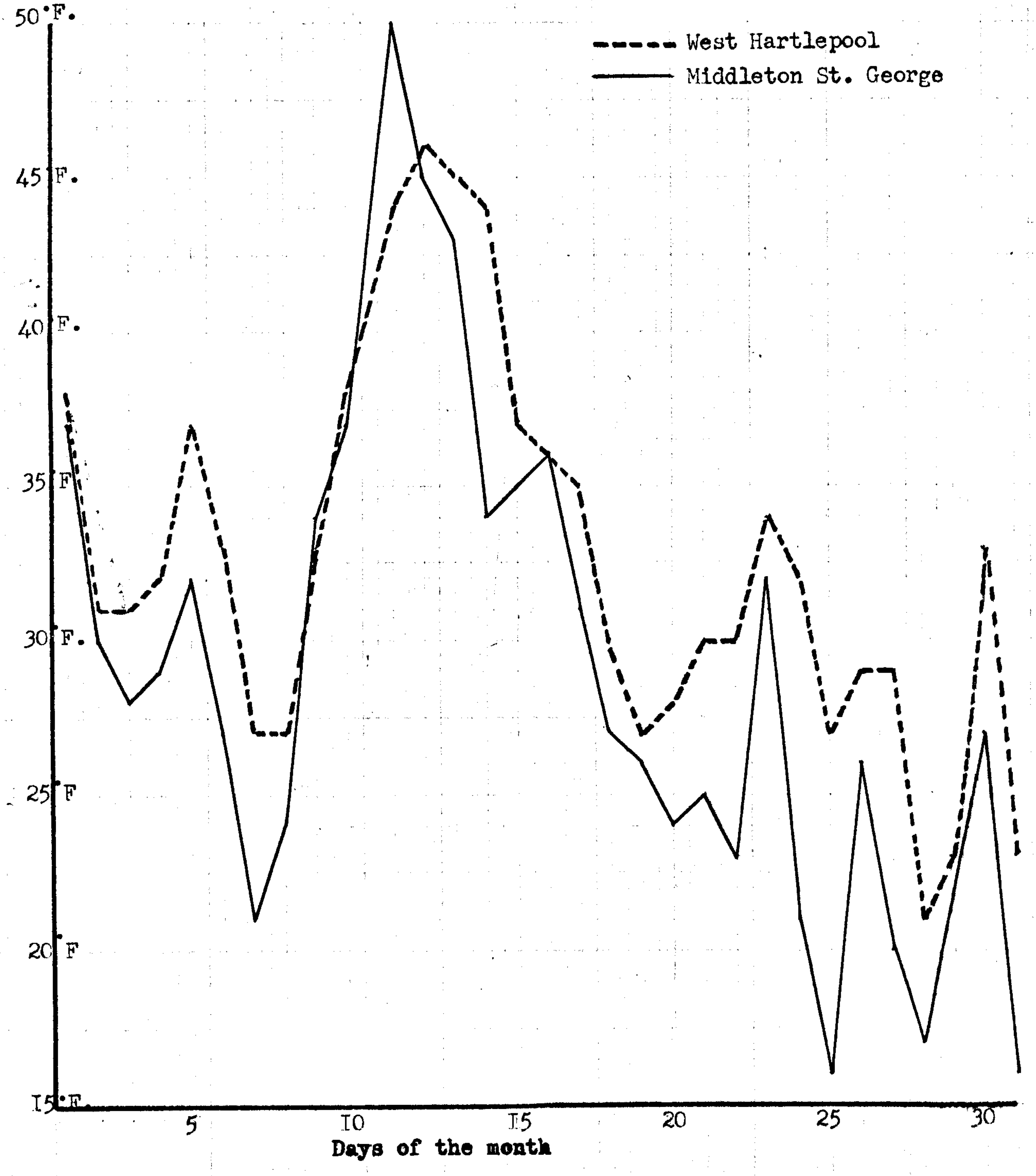
1952	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.
Middleton St. George	31.6	32.7	37.3	39.7	46.6	48.9	54.0	52.2	45.9	42.3	34.6	33.5
West Hartlepool	32.1	33.6	38.3	41.1	47.5	50.3	54.8	54.4	47.1	44.5	37.0	33.6
1953												
Middleton St. George	35.2	35.7	34.4	36.0	45.7	49.1	52.5	52.8	50.1	41.2	43.2	40.1
West Hartlepool	35.5	36.8	35.4	38.1	47.6	50.5	53.9	54.0	51.6	43.5	43.0	41.4

Apart from November, 1953, which was a freakishly warm month, West Hartlepool has minimum temperatures higher than Middleton St. George throughout the year, by about I°F. in winter and by about 2°F in summer.

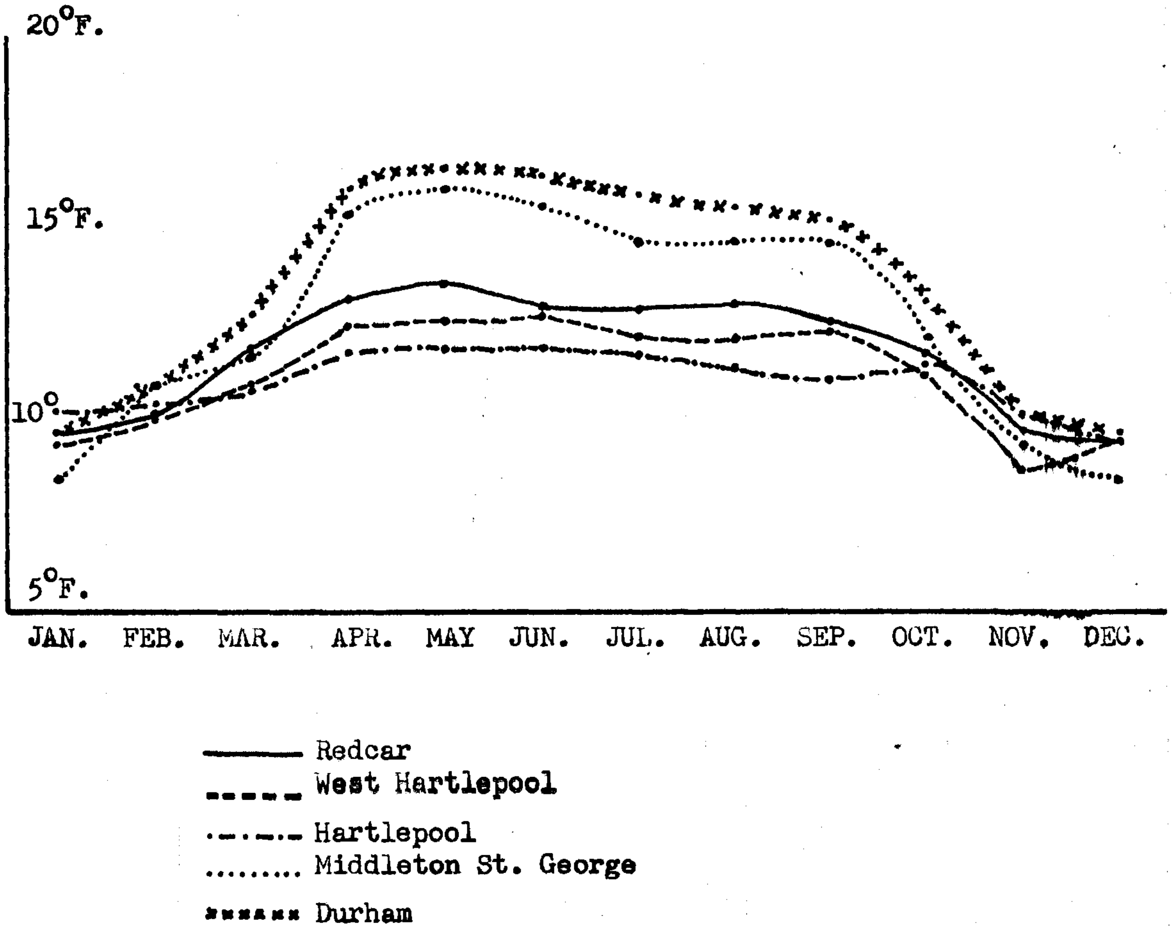
A closer scrutiny of the daily temperatures, however, shows that the averages conceal some considerable contrasts. For example, in December, 1961, there was one night when the minima at West Hartlepool and Middleton St. George differed

GRAPH 6.

Minimum Daily temperatures at Middleton St.George and West Hartlepool during December,1961.



GRAPH 7. Range of temperature at stations in the Hartlepools region (with Durham for comparison). Differences between mean monthly maxima and minima, 1952-1961.



by as much as 11°F., during a spell noted as one of the coldest Christmas periods of the century (see Graph 6).

RANGE OF TEMPERATURES

Graph 7 shows the relative equability of the coastal stations. The mean daily range of temperature at Hartlepool is from 9.3°F. in December to 11.8°F. in May and June, whereas West Hartlepool has a smaller range in winter and a greater range in summer. Redcar also displays these maritime characteristics of equability. Inland, however, Middleton St. George follows a modified pattern, with smaller ranges in winter, and larger ranges in summer (e.g. only 8.4°F. in December and January, but 16°F. in May). Durham, cut off from the sea by the East Durham Plateau, has a range of 9.6°F. in December and January, but 16.5°F. in May, over the same period. West Hartlepool's night warmth in November shows up well on this graph. Graph 7 suggests that of the three coastal stations Hartlepool is more truly maritime than West Hartlepool or Redcar, although Graph 3, showing a maximum temperature at Redcar retarded until August, suggests that the sea at Redcar is more effective than at the others.

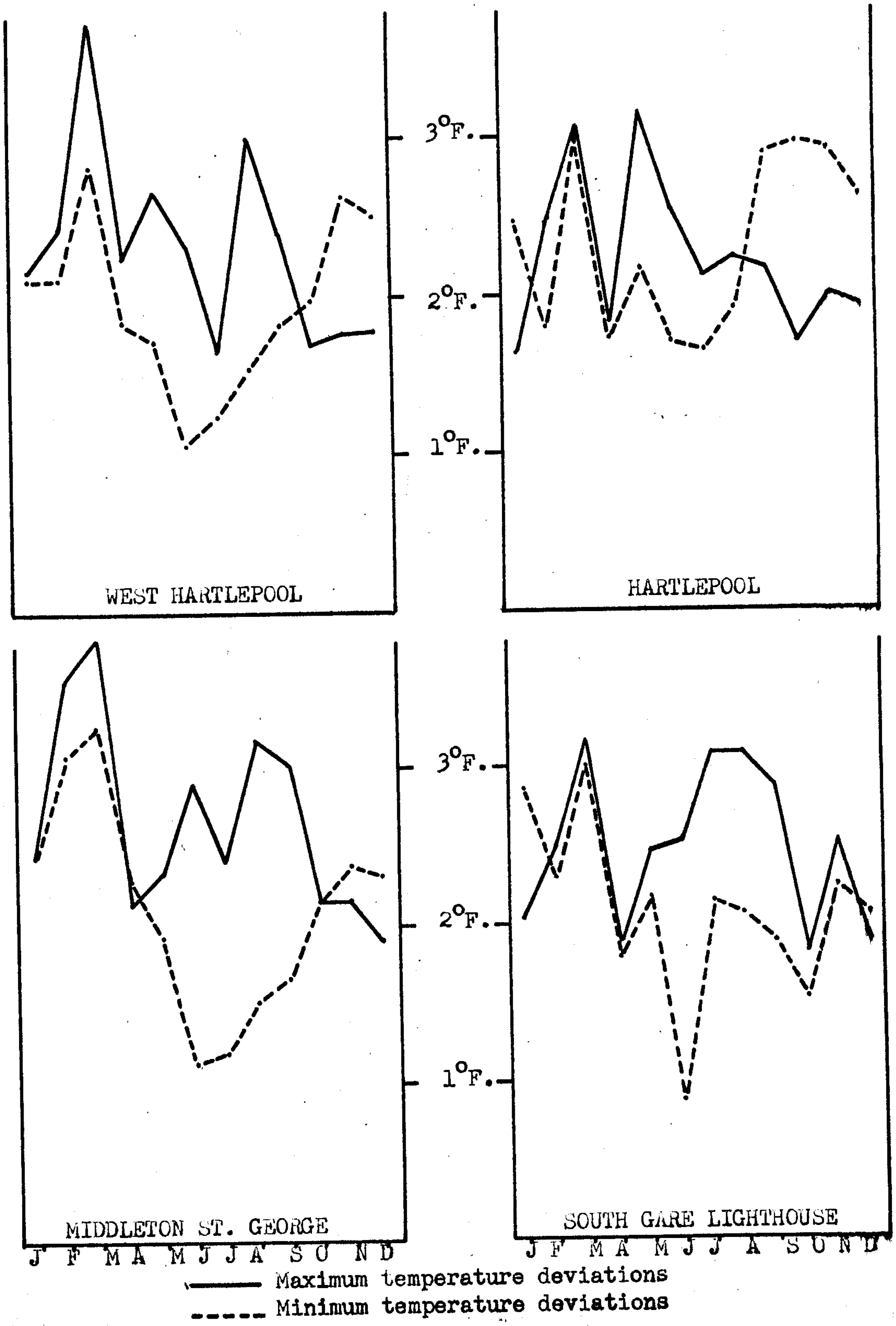
An analysis of standard deviations from the mean monthly maximum and minimum temperatures at four lowland stations does not reveal any significant deviation - that is, none of the deviations from the average is other than what might be expected in a run of temperatures over ten years. The standard deviations were calculated following normal statistical analysis from the formula:

$$s = \sqrt{\frac{(x - \bar{x})^2}{n}}$$

where s = standard deviation, x = any monthly mean temperature, $\bar{x}$ = mean of the total number of monthly mean temperatures, n = total number of temperatures being used. This formula gives due weight to the extreme values of deviation.

One interesting point is that for most of the year deviations of the maximum

GRAPH 8. Standard temperature deviations, 1951-1960.



temperatures exceed those of the minimum temperatures, whereas from October to January the deviations of the minima are as great or greater. March is the most variable month as Graph 8 shows, with a standard deviation of over 3°F. for both maximum and minimum temperatures at Hartlepool, Middleton St. George, and South Gare Lighthouse at Redcar (this last thermometer is unscreened and has therefore been ignored for all purposes except deviation calculations). At West Hartlepool the variation of March minima is less than 3°F., another index of its urban warmth. Summer nights vary less than winter nights but no such clear distinction can be made for maximum temperatures. At South Gare the April and October maxima show the least variation; at Middleton St. George, April and October to December; at Hartlepool, January, April and October; and at West Hartlepool, July and October to December.

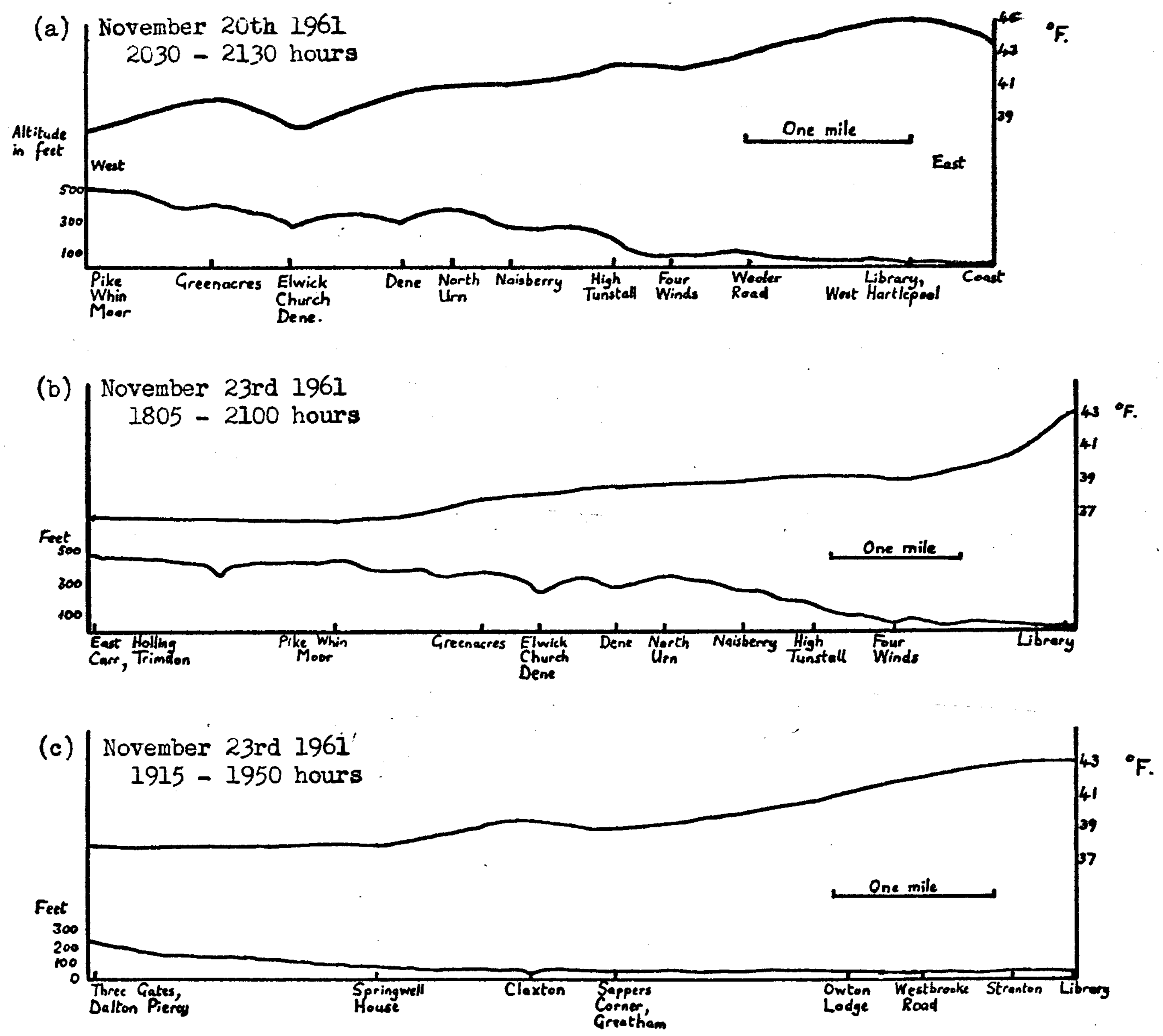
EXPERIMENTAL WORK ON TEMPERATURES

Since comparisons between the East Durham Plateau and the Tees lowland with regard to temperatures are impossible because of the unfortunate lack of recording stations in the former area, the writer felt it necessary to conduct some experiments in the hope that any temperature differences would quickly be revealed. At first temperature traverses by car were carried out and later Stevenson screens were constructed and erected at Whelly Hill Farm (440 feet above sea level) near Hart, at Greenside Farm (600 feet) near Trimdon, at Sedgefield, and at Seaton Carew, after first being tested against a normal Stevenson screen at West Hartlepool Grammar School.

Details of the traverses are given first:

Method: a mercury general purpose thermometer, calibrated in °F., was screened in a cardboard tube of diameter 1" so that the bulb was shielded and the temperature could be read down to the 10°F. mark. Corks drilled to hold the

GRAPH 9. Temperature traverses in the Hartlepools region.



thermometer fitted tightly inside the short cardboard tube. The thermometer was attached to the end of a wooden holder on the roof of a car in such a position as to be clear of heat from the car and at the same time easily and quickly visible from ground level. Most of the traverses were made during the hours of darkness and the thermometer read with the aid of a torch. Readings were taken only when the car was stationary, and each traverse was run over twice and the two readings averaged for each place.

Some of the results are appended:

Graphs which compare plateau with lowland:

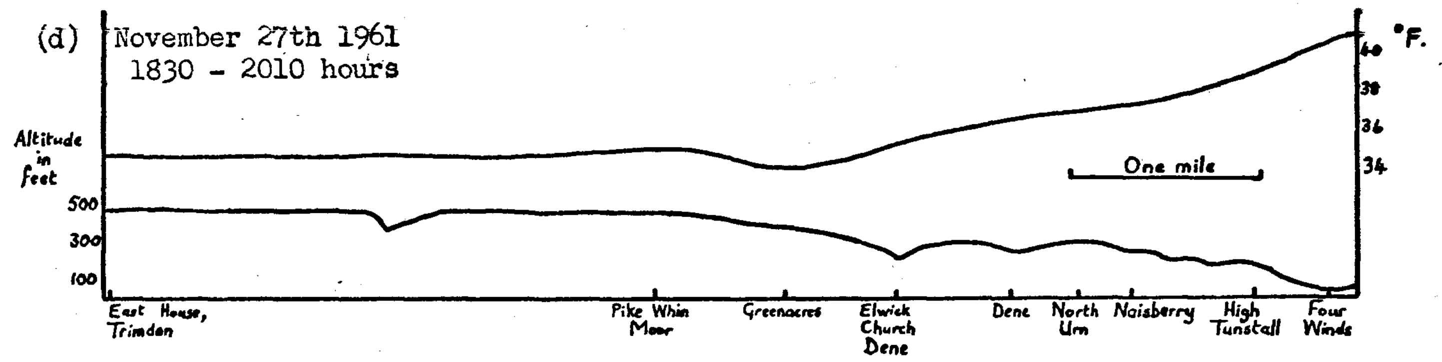
9a. 20th Nov. 1961. 2030-2130 hrs. 5 mile traverse from plateau east to coast through central West Hartlepool. Cold, cloudless, calm. Good radiation conditions. "Heat island" found in W. Hartlepool built-up area. Temperature inversion in narrow dene at western end of Elwick village (250') and to lesser extent at Four Winds, in shallow depression at foot of plateau slope. Low temperature at Church Bridge, Elwick, probably due to katabatic inversion as cold air flowed down from Throston Moor to north and Whangdon and Beacon Hill to west.

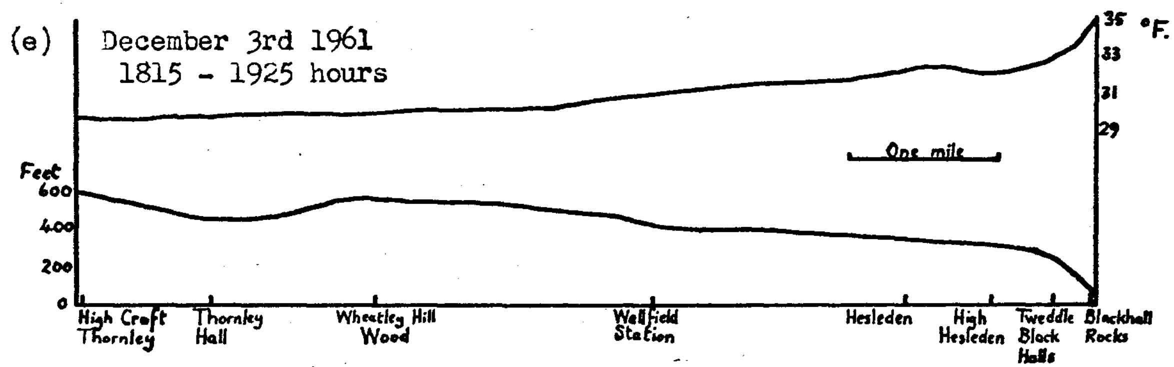
9b. 23rd Nov. 1961. 1805-2100 hrs. 6 mile traverse from plateau to centre of West Hartlepool. Cold, cloudless, slight S.W. breeze. Normal lapse-rate fall of temperature to West Hartlepool, where heat island more pronounced than on 20th Nov. - 4^{o}F. warmer at public library than at town perimeter (cp. 2^{o}F. on 20th Nov.). Difference possibly due to heat blowing east to library on this occasion, or to inflow of cool air on 20th Nov. when inversion noted.

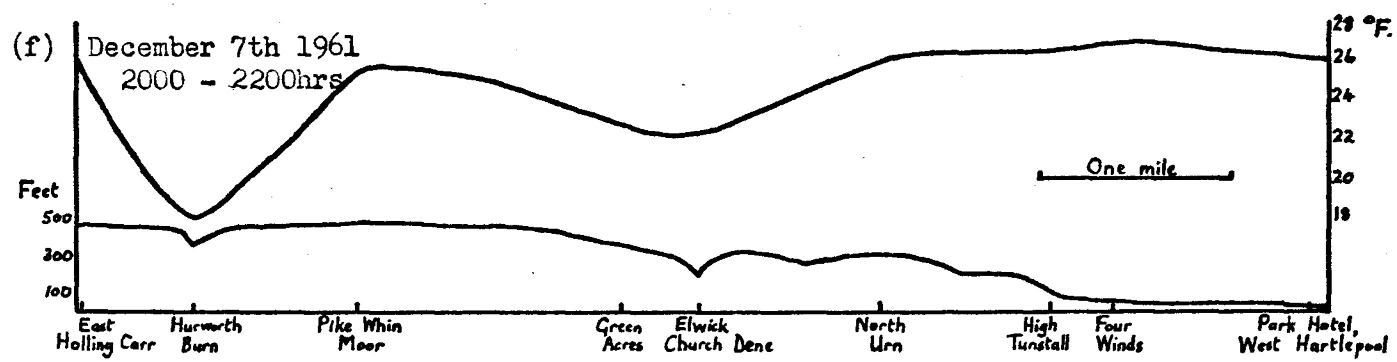
9c. 23rd Nov. 1961. 1915-1950 hrs. 6 mile traverse down plateau dip-slope from Dalton Piercy to Greatham, then back to West Hartlepool from south. Rise in temperature in valley of Greatham Beck reflected well sudden drop in altitude.

9d. 27th Nov. 1961. 1830-2010 hrs. 6½ mile traverse from plateau east to edge

GRAPH 9. Temperature traverses in the Hartlepools region.







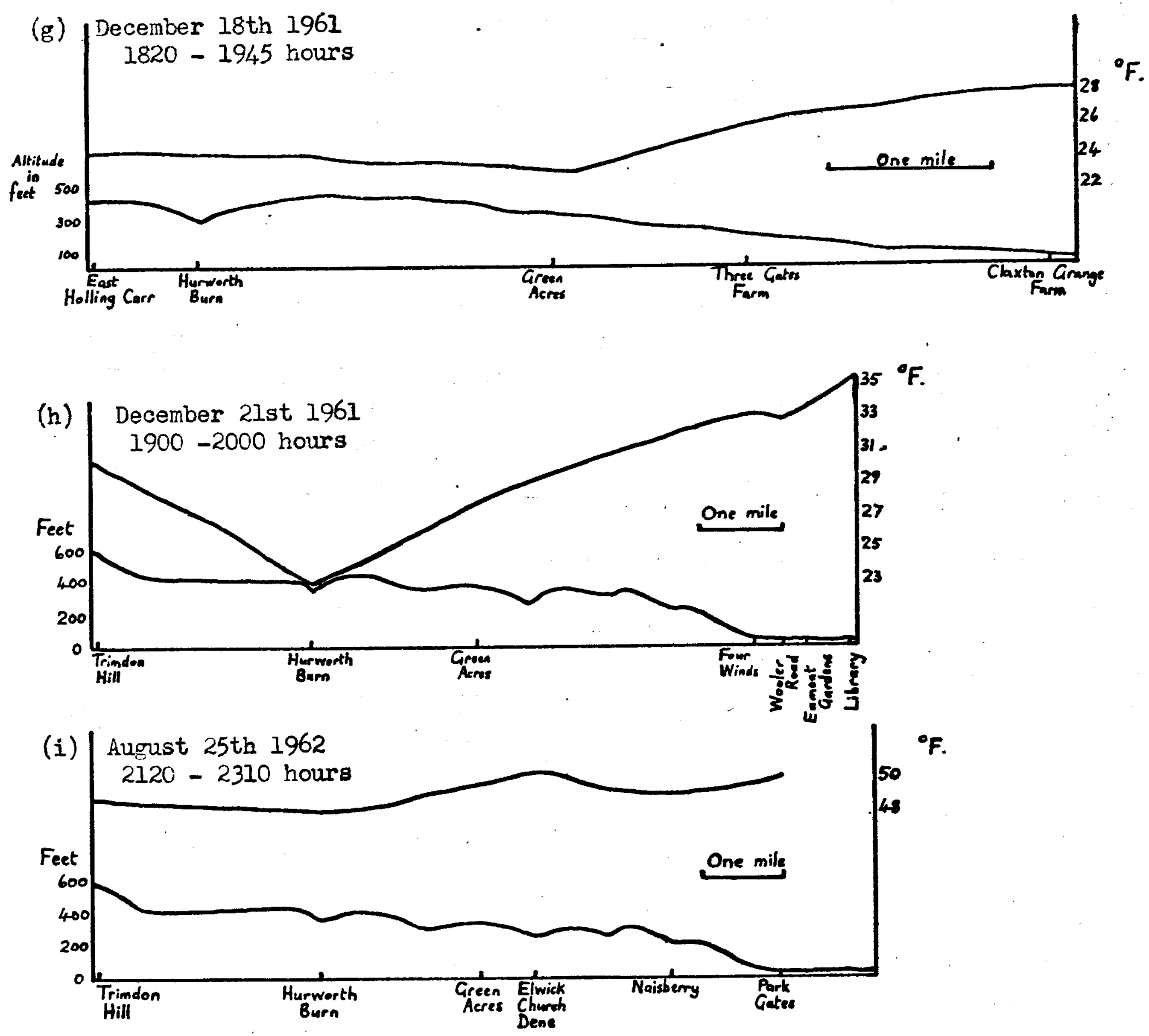
of W. Hartlepool. Coldest night of month. Cloudy. Rain had just stopped. Calm. Pocket of cooler air near Greenacres Farm, west of Elwick, possibly beginning of flow of cold air into Church Bridge Dene, because outward leg temperature in Dene 38°F. compared with 35°F. at Greenacres, while return leg temperature 30°F. at both places. Inversion possibly cause of collapse of W. Hartlepool temperature from 41°F. on outskirts to minimum of 29°F. later.

9e. 3rd Dec. 1961. 1815-1925 hrs. 6¼ miles, across plateau to coast at Blackhall Rocks. Dry, frosty, cloudless, slight N. breeze. Warming influence of sea well shown by increase of temperature of 5.3°F. in fall of only 600' from Thornley to Blackhall Rocks.

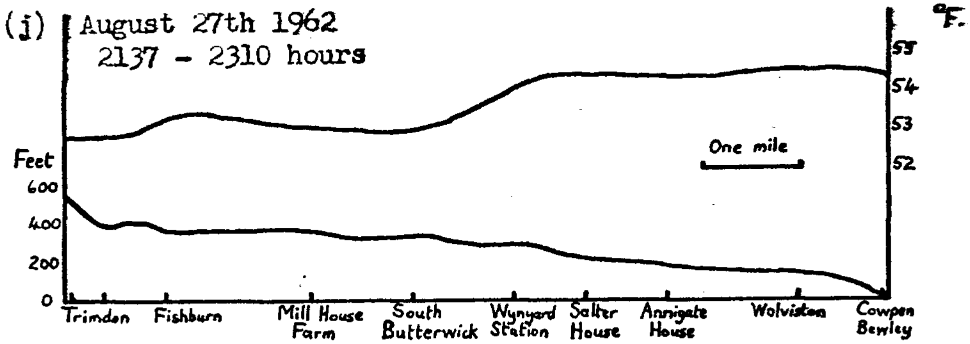
9f. 7th Dec. 1961. 2000-2200 hrs. 6½ miles from plateau east to centre of West Hartlepool. Dry, frosty, cloudless, little air movement. Good radiation. Striking inversions of temperature found in Hurworth Burn valley and in Church Bridge Dene, Elwick. Although 26°F. at 400' level on each side of Hurworth Burn, only 18°F. recorded at valley bottom. On return leg of traverse temperature was rising during a 15 minute spell at a road junction at 400', and a ten minute period near Greenacres Farm. Possibly due to colder air sliding downhill from summits. In Church Bridge Dene temperature 22°F. on both legs. Elimination of West Hartlepool's heat island was an interesting feature of traverse, temperatures being equal at centre and perimeter - though minima that night of 26°F. at Brinkburn (west perimeter) and 27°F. in Church St. (centre) retained semblance of a warmer centre.

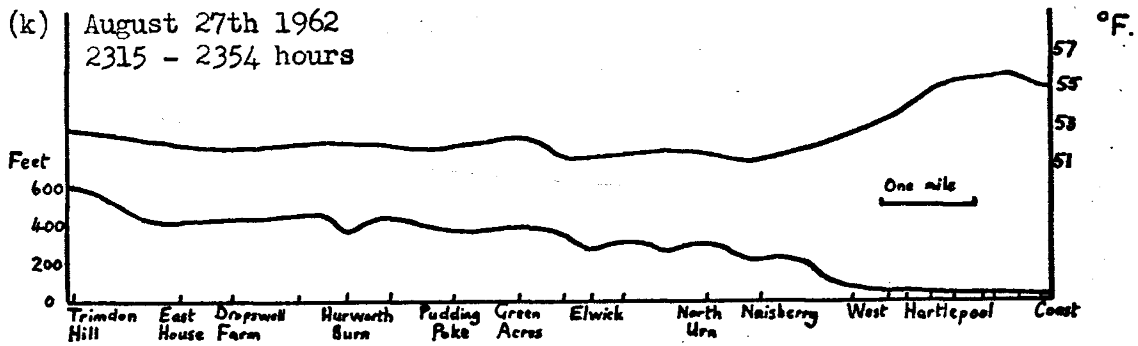
9g. 18th Dec. 1961. 1820-1945 hrs. 6 mile traverse from plateau down dip-slope between Trimdon and Greatham. Dry, frosty, dense fog on lower ground only, light S.W. breeze. Fall of 5°F. in 200' from Claxton Grange Farm to Greenacres Farm. Air movement prevented inversion (lowland minimum that night 26.4°F. at Middleton St. George, 27°F. at West Hartlepool).

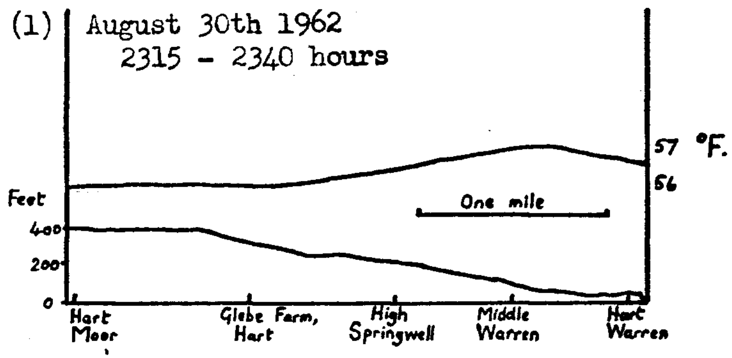
GRAPH 9. Temperature traverses in the Haftlepools region.



GRAPH 9. Temperature traverses in the Hartlepools region.







9h. 21st Dec. 1961. 1900-2000 hrs. 9 mile traverse, from Trimdon Hill to centre of West Hartlepool. Dry. frosty, cloudless, calm. Radiation conditions. Temperature inversion found at Hurworth Burn and also in hollow between Wooler Road and Four Winds at West Hartlepool. Difference of 5°F. between 400 foot level on plateau and 90' on edge of town.

9i. 25th Aug. 1962. 2120-2310 hrs. Dry, clear, with light S.W. wind. 9 mile traverse from Trimdon Hill (600 feet) to western edge of West Hartlepool. Church Bridge Dene a warm spot in sheltered hollow. Much less difference between plateau and lowland than in winter (1.3°F. compared with up to 5°F.).

9j. 27th Aug. 1962. 2137-2310 hrs. 9½ mile traverse from Trimdon Hill to Cowpen Bewley (two miles from Teesmouth). Dry, overcast, good visibility, light S.W. wind. Small difference (1.9°F.) between 600' level and 50'. Warm spots where shelter from breeze at Hope House and Salter House.

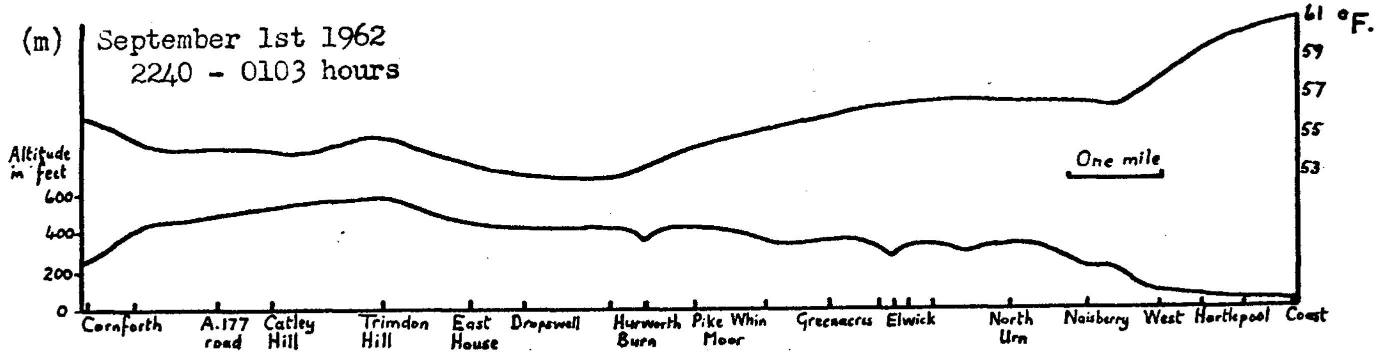
9k. 27th Aug. 1962. 10 mile traverse from Trimdon Hill to coast at West Hartlepool. 2315-2354 hrs. Warmer on plateau top than on slopes from 300' to 200' but heat island at West Hartlepool. Again a smaller difference between plateau and lowland than in winter.

9l. 30th Aug. 1962. 2315-2340 hrs. 3 mile traverse from Hart Moor(400') to sea at Hart Warren. Dry, clear, calm. Normal fall of temperature with altitude till sea where cooling effect gave difference of only half a degree, compared with Middle Warren. In Crimdon Dene bottom of gorge 0.7°F. cooler than top.

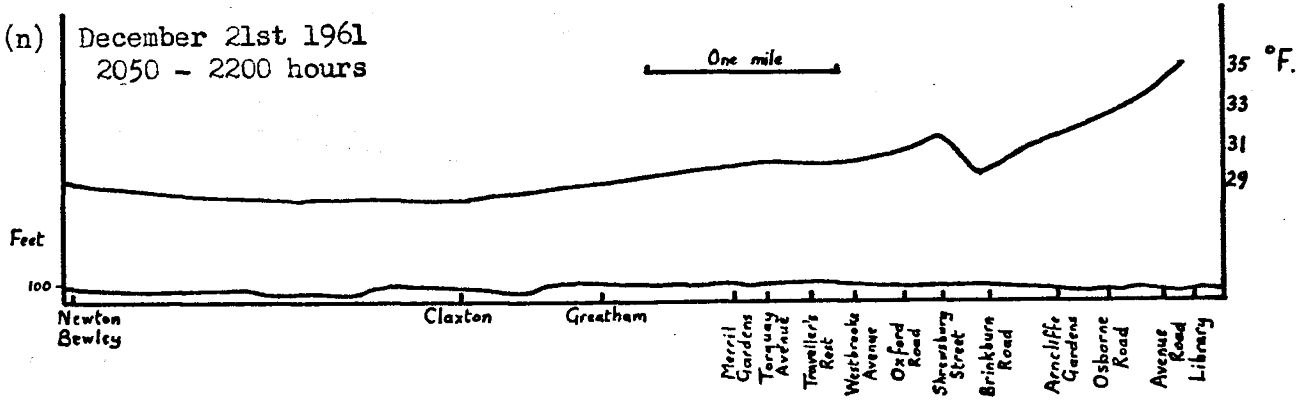
9m. 1st Sept. 1962. 2240-0103 hrs. 12½ mile traverse from scarp foot at Cornforth to coast at West Hartlepool. Dry, clear, calm. Exceptions to normal lapse rate at Trimdon Hill (warmer) and plateau east of Trimdon (cooler). Heat island at West Hartlepool strongly developed, reaching coast at Seaton Carew (influence of heat from steel works?). Taking Pike Whin Moor and Four Winds as typical of plateau and lowland respectively, temperature difference was

GRAPH 9. Temperature traverses in the Hartlepools region.

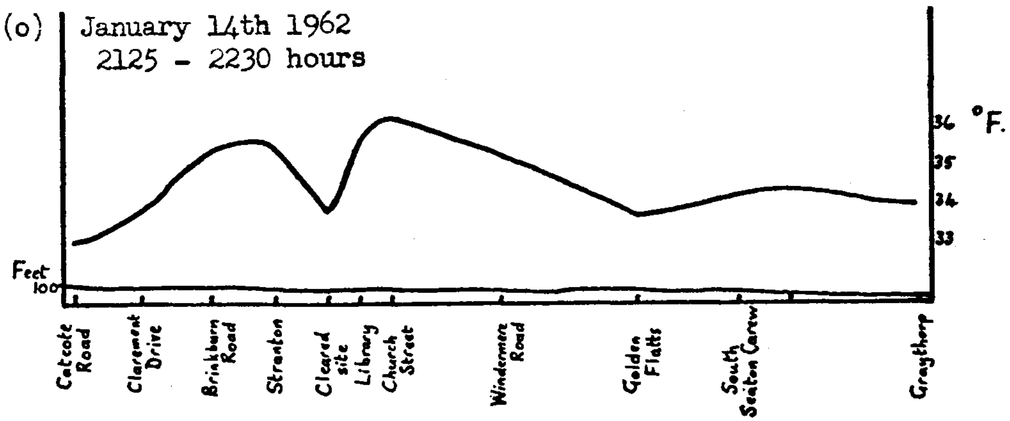
(m) September 1st 1962
2240 - 0103 hours



(n) December 21st 1961
2050 - 2200 hours



(o) January 14th 1962
2125 - 2230 hours



3.1°F., more than that found in windy conditions, but less than in winter.

Graphs which compare town with country:

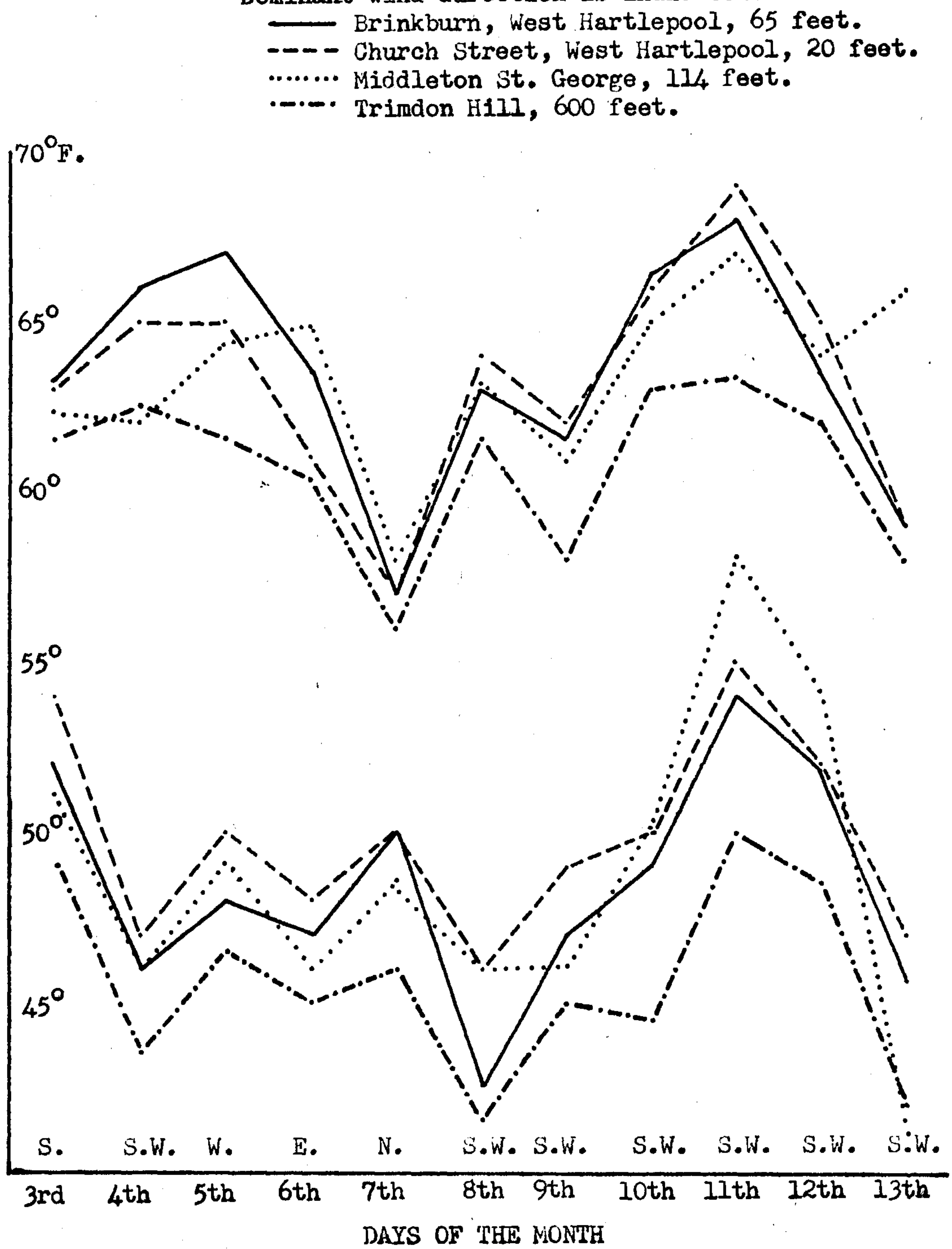
9n. 21st Dec. 1961. 2050-2200 hrs. From Newton Bewley to centre of West Hartlepool. Dry, frosty, clear, calm. Inversion found near Newton Bewley where gravel pit floor 2.2°F. cooler than roadway 50' higher. Temperatures rising towards town but heat island interrupted where open spaces existed, e.g. south of Traveller's Rest Inn, (cemetery opposite allotments), and in Burn Valley Gardens (park). Town centre about 7°F. warmer than rural areas to south.

9o. 14th Jan. 1962. 2125-2230 hrs. Traverse taken from western perimeter of West Hartlepool through centre to coast, then south to Seaton Carew and Graythorpe. Intermittent showers (but thermometer kept dry), overcast, westerly breeze of 5 knots. Main feature was cold patch in space left by demolition of slum property - lack of urban heat and little shelter, so temperature 2°F. lower than in surrounding built-up area.

Conclusions: while inferior as a method of comparing temperatures for plateau and lowland to the permanent Stevenson screen, the traverse is useful in covering a wider range of micro-climatic sites. The changes within a short period at any one spot are also revealed, and this may prove particularly valuable in a study of inversion and the flow of katabatic winds. It is clear that frost hollows are frequent across the undulating dip-slope of the East Durham Plateau, and that all fields are not equally suitable for stock in winter. The heat island found in the built-up area of West Hartlepool is evidence that urban screen temperatures are not necessarily typical of the rural areas near the town. Farms usually are a degree or two cooler even at the same altitude than the towns they surround.

Winter temperature differences between the plateau and the lowland seem

GRAPH 10. Comparison of maximum and minimum temperatures in the Hartlepools region, August 1962. Dominant wind direction is indicated.



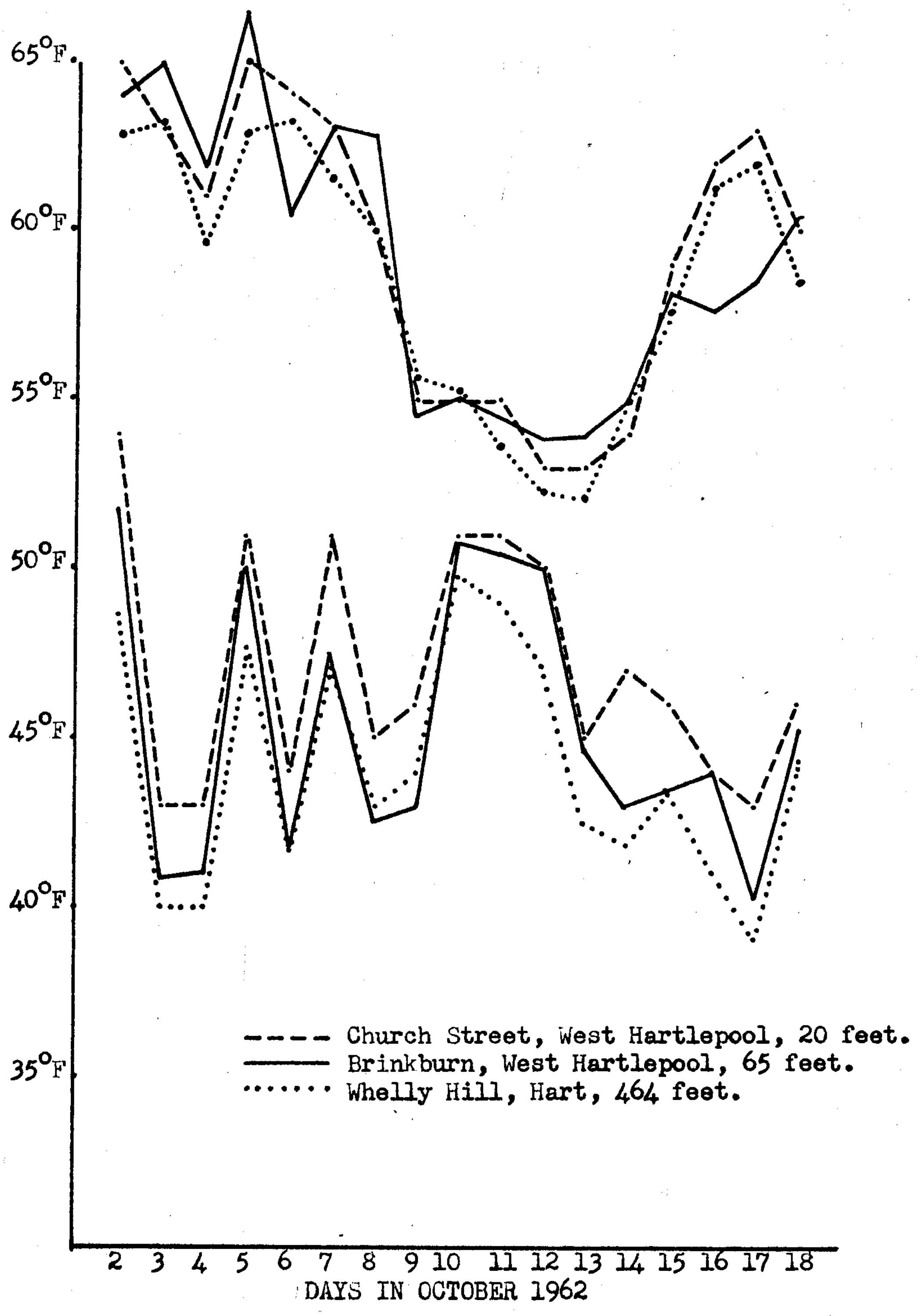
greater than those in summer. In summer the normal lapse rate of temperature with altitude prevails, but in winter the decrease with height is greater, except when inversion has taken place.

A Stevenson screen was also constructed for the sake of experimental comparisons between the plateau temperatures and those on the lowland. After being tested against a normal long-established screen the new screen was first set up at Greenside Farm, near Trimdon, at over 600 feet above sea level, and about seven miles inland. Graph 10 shows an eleven day record from this screen compared with maximum and minimum temperatures for Middleton St. George (Tees lowland interior), Brinkburn (western perimeter of West Hartlepool), and Church Street, West Hartlepool (¼mile from sea). The graph also indicates the wind prevailing during each of the eleven days.

With a S.W. wind, which is the most frequent, Trimdon Hill is cooler than the other three areas both by night and day, sometimes by as much as three or four degrees (F.). When a sea-breeze blows, however, the coastal stations are cooled to a greater extent than inland stations, so that for example, on the afternoon of Aug. 6th, 1962, Middleton St. George was 3.8°F. warmer than West Hartlepool (Church St.), and even Trimdon Hill despite its 600 feet, was only 0.5°F. cooler. A cool north wind on Aug. 7th has a similar effect on maximum temperatures, and in addition made the minima at Brinkburn and Church Street equal, when usually they are higher at the latter.

Another factor to be considered is the force of the wind and the exposure of the various sites. On 4th, 5th and 11th Aug. fresh to strong winds were blowing and this was reflected to a marked degree at the exposed hill-top farm at Trimdon, where the maximum temperatures for those days were lowered relatively to the maxima at West Hartlepool. On the 13th Aug., a day of light variable airs and long periods of calm, with generally 3/8 to 5/8 cloud cover, the maximum

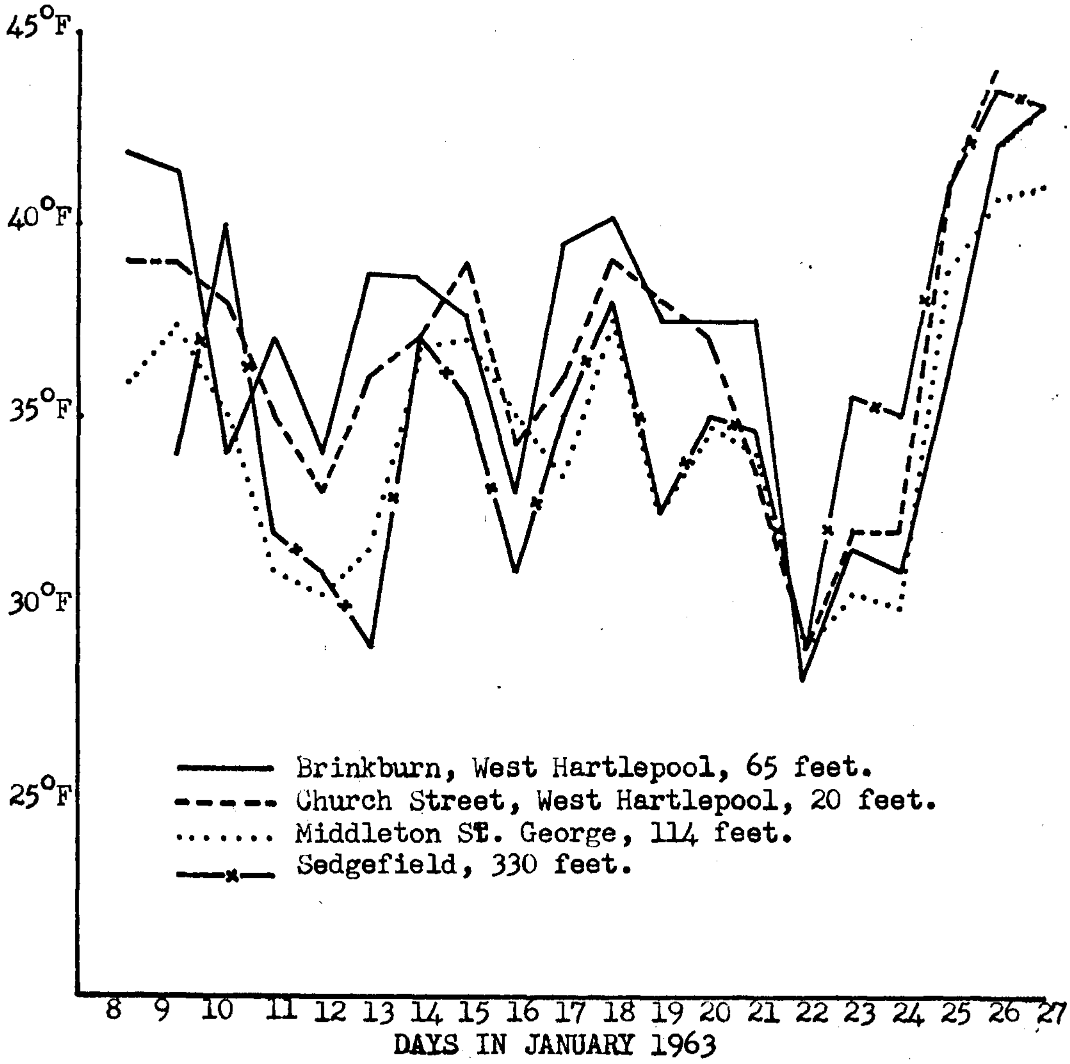
GRAPH 11. Comparison of maximum and minimum temperatures in the Hartlepools region, October 1962.



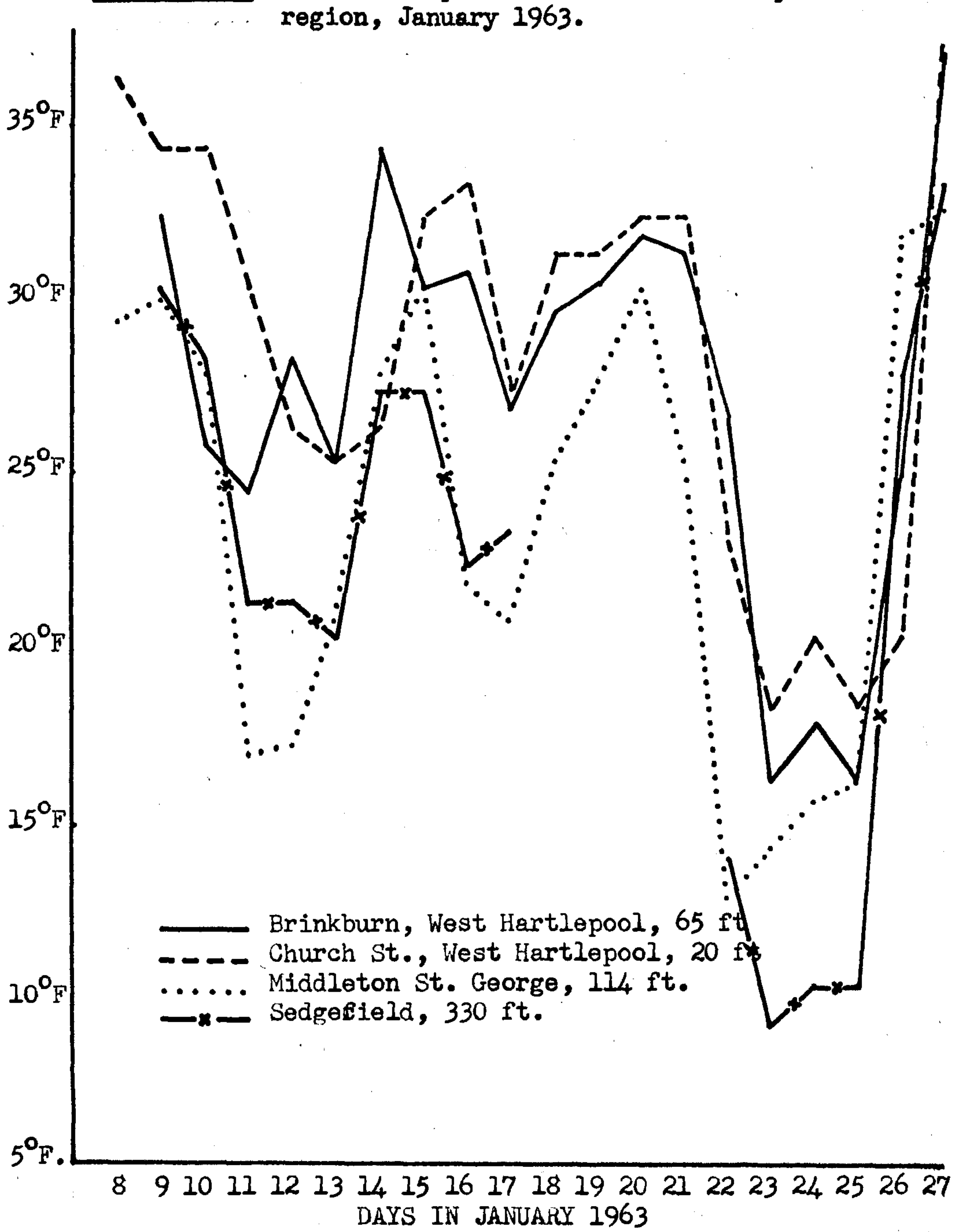
temperature at Middleton St. George was 65.9°F., seven degrees warmer than at the coast. Between 10.00 a.m. and 11.00 a.m. the temperature rose by no less than 4.5°F. at the former, which was not parallelled at West Hartlepool or at Trimdon. The previous night (12-13th Aug.) was marked by an unusually low minimum temperature at Middleton St. George compared with the other three stations. Thus in calm conditions the Tees lowland interior manifests a striking degree of continentality not matched on the uplands of the East Durham Plateau, which appears to form a distinct climatic "watershed" between the lowlands of the middle Wear and the lower Tees. The temperatures that day at Durham were identical with those at Middleton St. George: maximum 66°F., and minimum 41°F., while at Trimdon the figures were 58°F. and 42°F.

The same screen was next set up at Whelly Hill Farm, near Hart, at 440 feet above sea level, and about three miles inland, at the end of August, 1962. It was found during September and October that while winds from the sea reduce the temperature near the coast by two or three degrees Fahrenheit, leaving Whelly Hill Farm this amount warmer, the general situation is that the plateau over 400 feet is two or three degrees cooler than the lowland. On the 13th Sept. 1962, for example, a N.E. wind kept down the temperature at West Hartlepool to 58°F., while at Whelly Hill it reached 59.1°F. despite the greater altitude. On 9th and 10th October afternoon temperatures were higher at Whelly Hill than at West Hartleppol when sea fog blanketed the lowland coast and a slight breeze blew from the sea. By 11th Oct. the fog had extended to cover the plateau and the afternoon maxima had again resumed their normal decrease with altitude. The calm cloudless conditions of the nights of 7th and 8th October, 1962, resulted in inversion of temperatures, Whelly Hill being warmer than Brinkburn, nearly 400 feet lower. But, as Graph 11 shows, both maxima and minima at Whelly Hill are more usually lower than those on the lowland by 2°F.

GRAPH 12(a). Maximum temperatures in the Hartlepools region, January 1963.



GRAPH 12(b). Minimum temperatures in the Hartlepools region, January 1963.



The Stevenson screen was next erected at Sedgefield at the beginning of November, 1962. This station stands at 330 feet above sea level, and about ten miles inland on the dip-slope of the East Durham Plateau four miles south-east of the escarpment. Graph 12 compares the readings obtained during January 1963 at this new station with those for Middleton St. George, Church Street in West Hartlepool, and Brinkburn on the western outskirts of West Hartlepool.

This period was exceptionally cold with biting winds mainly from the quarter between north-west and north-east, though the coldest spell was associated with winds from W.S.W. (22nd to 25th). The most outstanding feature of this period was the contrast between the coast and the inland stations by night. Middleton St. George was colder than Brinkburn on every night except the 10th, the differences being greatest on the 11th (8°F.), the 12th (11°F.), and the 22nd (14°F). Sedgefield shared this night continentality with temperatures often five to eight degrees below those at the coast.

Although Sedgefield is 216 feet higher than Middleton St. George the minimum temperature there was higher on several occasions in January 1963, for example on the 11th (by 4°F.), on 12th (by 4°F.), and 17th (by 2.5°F). This was due to inversion of temperature on calm nights. The more usual situation is for Sedgefield to be a degree cooler, but from 23rd to 25th January Sedgefield was five or six degrees colder, with a minimum of just under 9°F. It may be reasonable to postulate a temperature difference of up to ten degrees between the Tees lowlands and the higher parts of the East Durham Plateau under extreme conditions in winter, with corresponding results on soils and vegetation, for it is not so much the average conditions butthe extremes which determine the evolution and survival of organisms.

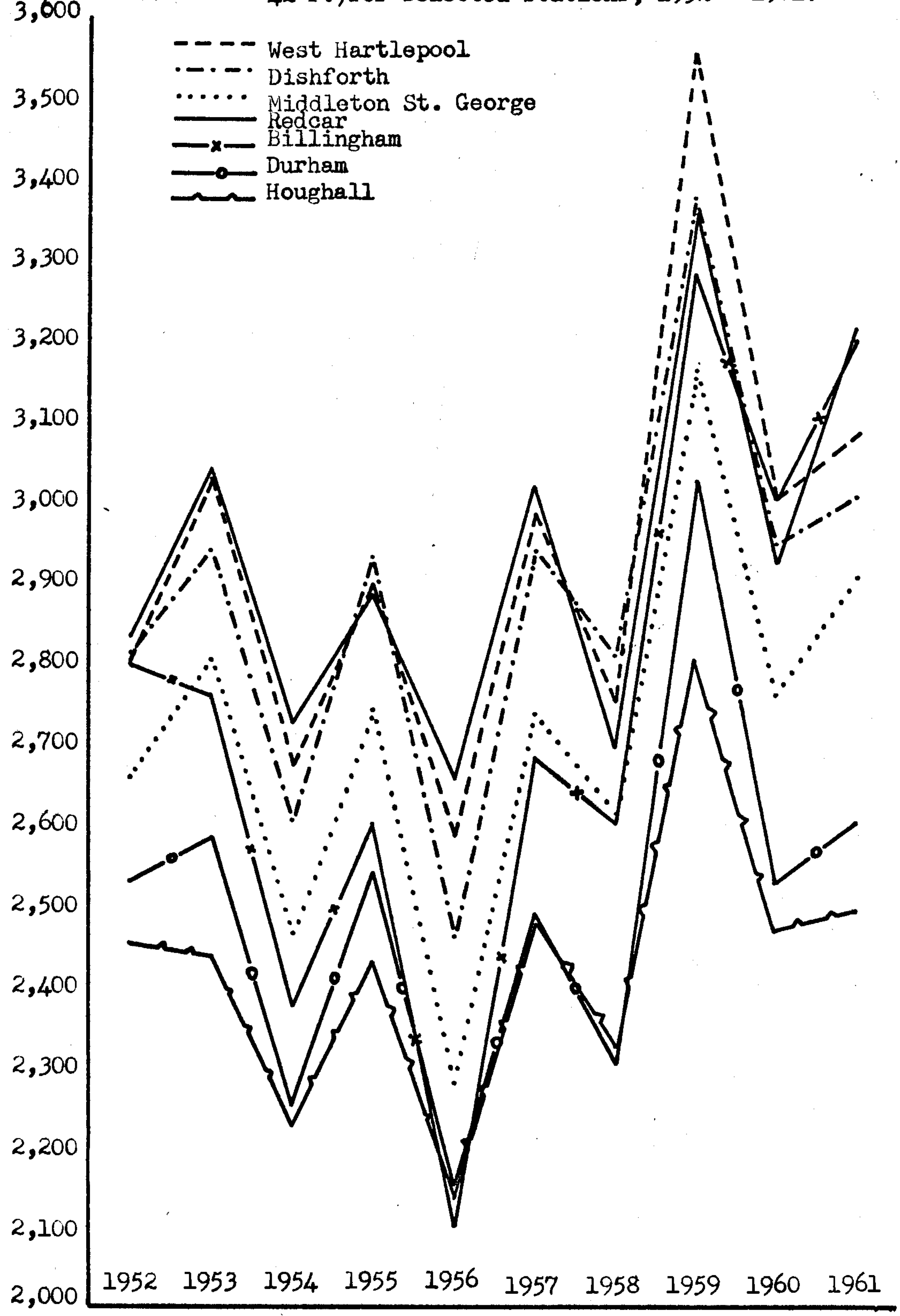
A fresh Stevenson screen was erected in the middle of February, 1963, at Seaton Carew, 20 feet above sea level and about 600 yards from the shore in a residential area with much open space. Temperatures here were regularly one or two degrees above those at Brinkburn, two miles to the north-east and a mile and a half inland. When the wind swings into the north to north-east quarter, however, the coastal station is about one degree cooler than Brinkburn.

Conclusions: The East Durham Plateau has temperatures lower than those of the Tees lowlands, usually by some 2°F., but under certain conditions exposure due to altitude causes greater cooling on the higher ground. When air from the North Sea is crossing eastern Durham this exposure is most marked, and the Plateau suffers more cooling than districts equally far inland but sheltered by their lowland situation. During winters of heavy snowfalls and prolonged low temperatures such as 1946-47 and 1962-63 the Plateau may retain its snow cover for several days after the lowlands and the immediate coastal fringe. In calm conditions in winter the air on the southern part of the Plateau has a tendency to flow down the dip-slope into the Tees lowlands as a katabatic wind, producing inversion of temperature and often fog. The lowest temperatures are then found inland towards Darlington, the coast benefitting from maritime warmth.

ACCUMULATED TEMPERATURES AND THE GROWING SEASON

The growing season, the period during which the mean daily average temperature rises above 42°F. is an excellent index of micro-climatic conditions. It lasts on the average from late March to late November in the Tees lowland, about 250 days. The following table gives the length of the growing season at Hartleppol between 1946-61.

GRAPH 13. Annual accumulated temperatures (day-degrees over $42^{o}F.$)for selected stations, 1952 - 1961.



1946 Mar.19 - Dec. 2 = 258 days.	1954 Mar.21 - Nov.14 = 238 days.
1947 Apr. 6 - Nov.14 = 223 days.	1955 Apr. 1 - Dec. 8 = 252 days.
1948 Mar. 8 - Nov.21 = 259 days	1956 Mar.21 - Nov.10 = 234 days.
1949 Apr. 3 - Nov.14 = 226 days	1957 Mar. 8 - Dec. 1 = 269 days.
1950 Mar.16 - Nov.11 = 240 days	1958 Apr.13 - Nov. 9 = 211 days.
1951 Apr. 4 - Nov.25 = 236 days	1959 Feb.21 - Nov.30 = 283 days.
1952 Apr. 4 - Nov. 7 = 218 days	1960 Apr. 3 - Nov.17 = 229 days.
1953 Mar.23 - Dec.24 - 276 days	1961 Feb. 6 - Dec. 1 = 299 days.

16 year average = 247 days.

Graph 13 shows annual accumulated temperatures (day-degrees over $42^{\circ}F.$) from 1952-61 for stations in the lowland between Dishforth and Hartlepool. The urban sites at Redcar and West Hartlepool have the greatest totals since their night temperatures do not fall to the same extent as those elsewhere. At the inland stations, Middleton St. George and Dishforth, the totals reflect their 30 mile difference in latitude. It is worth observing that there is less difference between the coast of S.E. Durham and Dishforth than between the former and the Wear valley stations on the other side of the East Durham Plateau such as Durham and Houghall. In this respect the plateau is a significant climatic barrier while the Vale of York and the Tees lowlands are closely akin.

A month by month analysis of accumulated temperatures over $42^{\circ}F.$ reveals that the inland stations begin their growing season later than at the coast. Although the annual total at Dishforth is lower than at West Hartlepool, warmer growing conditions exist at the former from April to August, which must suit agriculture better. The nearer the sea the larger the proportion of the accumulated temperatures which lies outside the growing season of the spring-sown crops, On the other hand, perennial crops like grass must do better in the coastal areas, and allow grazing both earlier in spring and later in autumn.

The following figures, calculated by the writer from 1952-61 temperatures, illustrate this point:

Accumulated temperatures over 42°F.

	J	F	M	A	M	J	J	A	S	O	N	D	Year
West Hartlepool	3	6	66	149	303	436	556	545	441	287	111	19	2924
Redcar	4	9	65	145	299	425	553	555	450	303	100	27	2934
Billingham	-	9	54	129	291	419	537	525	417	266	77	17	2740
Middleton St. George	-	5	46	128	298	428	547	534	411	257	49	9	2702
Dishforth	1	5	46	153	333	464	576	556	431	260	50	9	2883
Houghall	-	-	32	99	269	403	514	494	373	216	24	1	2424

For a crop like wheat which is sown in autumn the accumulated temperatures late in the year are more valuable. Taking the wheat-growing seasons as from November 1st to the following August 31st, and the total of accumulated day-degrees needed by wheat as 1,961°F. with a deviation of $\pm$8% (1), it will be seen that the Tees lowland is perhaps surprisingly suitable for successful wheat cultivation in most years, though perhaps not so wholly suitable as east and central Yorkshire. It must be remembered that the first three stations in the column above are urban in character and therefore tend to be warmer than the adjacent countryside which actually grows the wheat. Nevertheless there is adequate warmth, even when such allowances have been made, for wheat cultivation. Right up on the highest parts of the East Durham Plateau at about 600 feet, however, as much as 600 day-degrees may be short compared with the lowland totals, so that these upland areas can only be considered as marginal for wheat at the best. The following are the accumulated temperatures for the wheat season at various stations:

(1) Wilfred Smith, An Economic Geography of Great Britain, 1950.

West Hartlepool (average 1953-61)		2195°F.
Middleton St. George "	"	2025°F.
Dishforth "	"	2174°F.

The upland farmers inevitably leave their harvest till late September and in this way gain a further 300 day-degrees which makes all the difference to the ripening process.

SUNSHINE

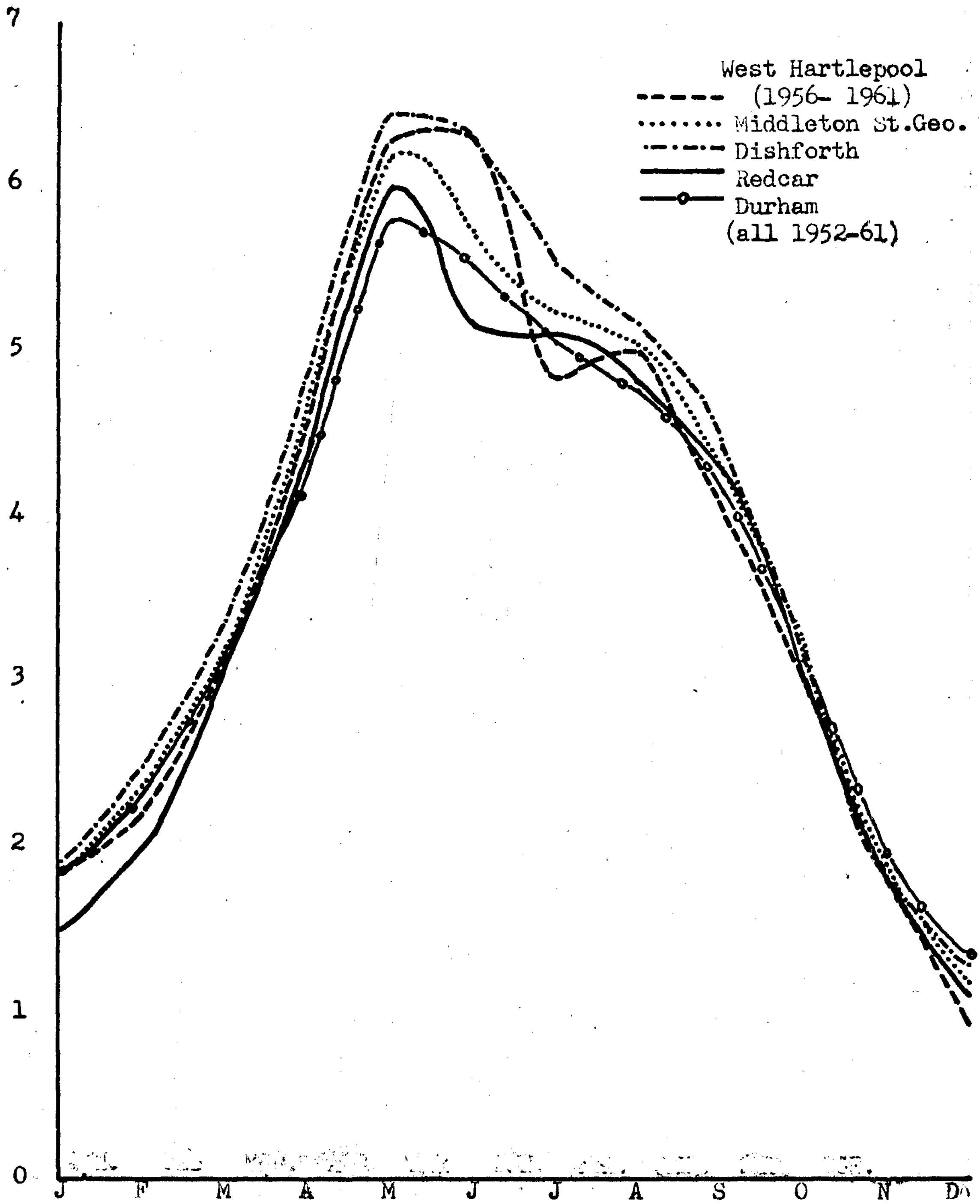
Records of sunshine are kept at West Hartlepool (since 1956), at Redcar, at Middleton St. George (since 1952), and at Dishforth (since 1952). The following table includes these and also, for the sake of comparison, Durham's record and the theoretical maximum of sunshine for 54°N.

Averages of bright sunshine : mean monthly total of hours

	J	F	M	A	M	J	J	A	S	O	N	D	Year
West Hartlepool (1956-61)	58	62	98	140	194	188	150	155	121	95	55	29	1345
Middleton St. George (1952-61)	58	67	103	143	192	172	163	157	129	100	57	38	1378
Redcar (1952-61)	47	56	98	134	186	155	158	150	128	93	54	34	1293
Dishforth (1952-61)	60	69	104	147	200	188	172	161	133	97	56	41	1428
Durham (1952-61)	58	66	100	131	180	166	157	148	125	98	59	41	1329
Lat. 54° possible	246	271	365	419	493	509	511	458	381	326	256	229	4464

As the months are not all equal lengths it is advisable to compare them on the basis of mean daily readings:

GRAPH 14. Mean monthly averages of mean daily sunshine (in hours) at selected stations.



(Hours per day)	J	F	M	A	M	J	Jy	A	S	O	N	D
West Hartlepool (1956-61)	1.85	2.19	3.15	4.65	6.27	6.26	4.38	5.01	4.06	3.06	1.82	0.93
Middleton St. George (1952-61)	1.86	2.38	3.21	4.76	6.19	5.73	5.25	5.05	4.30	3.21	1.90	1.18
Redcar (1952-61)	1.51	2.00	3.15	4.48	5.99	5.17	5.11	4.84	4.27	3.01	1.81	1.11
Dishforth (1952-61)	1.92	2.47	3.35	4.91	6.45	6.28	5.54	5.19	4.42	3.13	1.87	1.32
Durham (1952-61)	1.87	2.34	3.21	4.36	5.81	5.53	5.08	4.77	4.16	3.16	1.95	1.33

These figures are shown on Graph 14. Bearing in mind the relatively short period covered by the available records, it is nevertheless striking to find the maximum monthly sunshine totals in May rather than in June. The long-term Durham record from 1906-35 has a well defined June maximum (5.82 hours average) compared with equally lower May (5.16 hours) and July (5.14 hours) figures. This modern anomaly is due to a remarkable replacement of June by May as the most sunny month of the year. The 62 year record at Durham shows that on the average May is sunnier than June once every three years (1886-1947) and that the nearest to this modern run of sunny Mays was 1914-23 when six years out of ten show May as their sunniest month. The long-term annual total, it may be added, has little difference from the 1952-61 total (3.60 hours compared with 3.63 hours respectively).

While all the stations show a decrease in sunshine from May to August, West Hartlepool has an unusually dull July. This may be due to the large amount of cloud accompanying the sea breeze which is a feature of the coastal climate in July. The West Hartlepool sunshine record, however, dates only from 1956, and it is fairer to compare 1956-61 records throughout:

West Hartlepool	4.83	hours	per	July	day
Middleton St. George	4.97	"	"	"	"
Durham	4.47	"	"	"	"
Tynemouth	4.88	"	"	"	"
Gateshead	4.99	"	"	"	"
Redcar	4.88	"	"	"	"

This shows that the coastal stations receive only about 9 minutes less sunshine a day than inland stations with the exception of Durham which gets about 24 minutes less than the coast.

In addition to July the whole of the period when the sea breeze is blowing (May to August) is less sunny at the coastal stations than inland. Graph 14 shows that Redcar is less sunny than Middleton St. George and Dishforth all the year but the difference is least in spring and autumn. Despite the lengthening of the period during which theoretically the sun can shine, the total hours of sunshine remains low over the Tees lowland in summer. Cloud cover increases in summer and the Middleton St. George figures for 1952-61 show that June, July, August, and September are the most cloudy months of the year. The appended figures give the mean monthly number of occasions when cloud amount at 9.00 a.m. and 3.00 p.m. has been 6-7 oktas or 8 oktas (overcast):

	9.00 a.m.		3.00 p.m.	
	6/7	8	6/7	8
January	12	8	10	10
February	11	9	11	9
March	10	11	11	10
April	12	9	13	8
May	13	9	13	8
June	13	9	14	8
July	15	9	15	8
August	14	8	15	8
September	13	7	15	7

		9.00 a.m.		3.00 p.m.
October	13	8	14	6
November	12	9	12	9
December	13	7	13	8

The occasions when the coast is sunnier than inland occur when thundery conditions in the Tees plain and Vale of York lead to an excess of cloud there; or when cyclonic storms give cool wet weather which tends to be cloudiest to the west. Good examples of the former are July and August, 1956, and of the latter August 1957 and July 1961.

On some occasions West Hartlepool and Redcar are the least sunny spots on the whole east coast of Britain, for example February 1956, April 1957, June 1957, February 1958, and July 1958. The neighbouring coastal strips to north and south are usually sunnier than the Teesmouth region. When westerly winds cross the area the Tees lowland acts as a channel for cloud but the North Yorkshire Moors to the south and the East Durham Plateau to the north to a lesser extent appear to disperse to some degree the cloud they force upwards. Redcar sometimes benefits from a northward extension of the Whitby-Scarborough sunny strip and on such occasions forms a marked contrast to West Hartlepool. Examples of this include November 1959, July 1960, February 1961, June 1961, September 1961, and December 1961, when a large proportion of southerly winds predominated, thus bringing Redcar within the rain-shadow of the highland to the south.

March has the greatest average of overcast mornings and overcast afternoons which reflects the large amount of cloud brought by the persistent north-east winds at this time of the year. In March 1960, a month with only 61 hours of sunshine at Middleton St. George, there were 13 mornings completely overcast, 14 mornings almost overcast, 13 afternoons completely overcast and 13 afternoons almost overcast, due to winds which for three days out of every four blew from between north and east. This was the dullest March in the Tees lowland between 1952-61 but at the same time the area west of the Pennines was enjoying its normal amount of sunshine (e.g. Bolton 106% of average; Silloth 100%). In 1954 March had 17 overcast mornings, and in 1959 16 mornings were completely overcast.

February can be similar to March, as in 1956 when predominantly easterly winds allowed Redcar an average of only 1.10 hours of sunshine a day, and West Hartlepool 1.46 hours, while Sellafield (Cumberland) had 3.48 hours and Bolton 2.91 hours.

The sharp increase in insolation from February to May is of great importance to plant growth and while the prevalence of winds from the sea during this period has a retarding effect it must not be forgotten that much of the land north of the Tees has a southerly aspect which can take the fullest benefit of the sunshine. This alleviates to a marked degree the worst effects of the cold polar air brought by winds in the north to east quarter.

Another factor which affects sunshine on Teesside is the intermittent escape of chemical fumes from the Billingham works of Imperial Chemical Industries. No official records of this chemical haze exists but it is a familiar phenomenon accompanied by what is variously described as a "fish smell" or a "tomcat smell" in the local press. In 1962 there had been five major outbreaks by August, on April 26, May 3, June 15 and July 24, with the last on August 6. On May 3 haze blotted out the sunshine on Teesside and as far west as Sadberge. On July 24 the smell plus haze was reported in the press as covering over 60 square miles between Teesside and west of Darlington, blanketing a belt of country roughly five miles wide from Billingham. On

August 6 a beautiful sunny morning was brought to an end by the westward spread of the haze which reached Croft, 14 miles from Billingham, by lunch-time. The R.A.F. meteorological office at Middleton St. George reported that the air stream was northerly up to about 2.00 p.m. when it veered north-east. A sea breeze, observed by the present writer, began to blow westwards at West Hartlepool about noon, replacing a breeze from the north-west. The haze along the Tees intensified about 4.00 p.m. and at 5.30 p.m. was "very brown and quite thick".

FOG

Statistics for fog are extremely difficult to obtain. The Meteorological Office figures give only the number of days when fog is recorded at 9.00 a.m. More satisfactory are fog-horn operation hours such as those kept at light-houses at Hartlepool and South Gare, Redcar. Mean monthly totals of fog-hours from 1956-60 at these places are appended:

	J	F	M	A	M	J	Jy	A	S	O	N	D	Year
Hartlepool	71	69	49	21	17	28	26	32	37	73	95	90	608
South Gare	122	95	65	38	31	40	35	45	60	93	118	124	866

A longer term record at Hartlepool runs as follows:

(1950-61)	J	F	M	A	M	J	Jy	A	S	O	N	D	Year
Fog-hours	81	59	68	15	25	26	16	25	26	68	79	96	584

Averages of fog-days (days having fog at 9.00 a.m.) are more widespread:

(1952-61)	J	F	M	A	M	J	Jy	A	S	O	N	D	Year
West Hartlepool	4.9	4.3	3.8	0.9	0.2	0.4	0.4	0.7	0.9	2.9	4.3	5.3	29.0
Redcar	1.5	1.5	2.0	0.8	0.3	0.4	0.3	0.8	1.0	2.5	1.9	2.6	15.6
Middleton St. George	1.8	3.3	3.1	0.4	0.8	0.9	0.3	0.4	0.8	3.1	3.1	4.1	22.1
Dishforth	3.4	3.9	4.4	0.6	0.1	0.1	0.0	0.5	1.8	5.3	5.3	6.0	31.4

The marked contrast between winter and summer months stands out from both the fog-horn figures and the 9.00 a.m. readings, the October to March half of the year having 88% of the foggy mornings at West Hartlepool, 77% at Redcar, 84% at Middleton St. George, and 90% at Dishforth. This is a result of the lower temperatures and higher relative humidity in winter; it is interesting that relative humidity is no less inland than at the coast at this season, so that with their lower winter temperatures inland places may be expected to have more fog. This is certainly true as far as Redcar, Middleton St. George and Dishforth are concerned, but West Hartlepool has more fog in January and February than any of them. Atmospheric pollution and the mixing of the cold waters of the River Tees with the relatively warmer sea water may explain this. Confirmatory evidence is offered by the South Gare fog statistics, which exceed those of Hartlepool in all months; fog at South Gare may develop with the help of a steel works only a mile to the south and with the Tees washing its shores. Redcar stands only three miles from the mouth of the Tees but the river and tidal currents run north into Hartlepool Bay and this preserves Redcar from the majority of the sea-fogs, which only rarely creep inland. More investigation could be carried out to discover the relation between river and sea temperatures and its effect on fog.

There are two types of fog that affect the Tees lowland and to a lesser extent the East Durham Plateau. The first is radiation fog which occurs when the ground has lost so much heat that the overlying air is chilled and its moisture condenses as soon as the dew-point is reached. This type is experienced more often inland than on the coast on account of the lower minimum temperatures away from the sea. When radiation fog occurs both inland and at the coast the inland fog is denser and clears more slowly (e.g. Nov. 19, 1960; Dec. 18, 1961). It must be made clear that this type of fog is distinct from sea fog, though at times the two overlap. In early 1952, for instance, while sea fog at Hartlepool was present for only 33 hours in January, 48, in February, and 46 in March, West Hartlepool was having one of its foggiest winters, with 4 fog-days in January, 5 in February, and 6 in March.

The second type of land fog is advection fog caused when damp air is cooled on moving across a surface cooler than itself. This type is common in winter when warm fronts invade suddenly, or when snow is lying, but it can also form on summer evenings and may be seen creeping inland across the flat marshy pastures south of Greatham, and up the long straight streets of West Hartlepool. Atmospheric pollution is again a factor in the formation of such fog and the Hartlepools towns are not only ringed by works chimneys on the seaward side but are densely built up in their residential sections. The annual reports of the Medical Officer for West Hartlepool give the following figures of deposits of solids in tons per square mile:

	1953	1954	1955	1956	1957	1958	1959	1960
Grantully Hospital	219	154	123	229	208	308	225	289
Dyke House School	-	161	274	-	-	-	215	262
Golden Flatts School	-	-	-	-	-	296	265	355
Gray Art Gallery	-	-	-	-	-	247	202	-
Rossmere School	-	-	-	-	-	205	-	262

(Years left blank are incompletely recorded in respect of at least one month)
These enormous quantities of material are deposited but there is a further airborne fraction which is blown out to sea or inland, and is never measured. All the urban areas on Teesside suffer similarly and Billingham, Stockton, Thornaby and Middlesbrough are usually worse than the Hartlepools. As might be expected the winter months experience the heaviest deposition.

The dip-slope of the East Durham Plateau contrasts with the Tees lowland because it usually lies above the level of the lowland fog. A good example of this was seen on a temperature traverse on the evening of December 18, 1961, from West Hartlepool up the dip-slope. At the coast at 7.00 p.m. temperatures of 28°F. in West Hartlepool and 29°F. in Greatham were accompanied by dense fog with a visibility of only twenty yards. 200 feet higher, at Three Gates Farm, Dalton Piercy, the temperature was 26°F. and the moon was just visible above the fog. At Greenacres Farm, west of Elwick, at 330 feet, there was no fog and the temperature was 23°F. with a cloudless sky overhead. Telephone calls to Redcar South Gare lighthouse and to Middleton St. George R.A.F. aerodrome confirmed that the whole Tees lowland was full of fog. On the A.19 road, cars were emerging suddenly from a blanket of fog to the lower side of North Lane, Elwick, to find themselves in brilliant frosty moonlight. The fog lifted at West Hartlepool after 9.30 p.m. but not inland, and after a clear night returned at 9.00 a.m. even more densely.. The minimum temperature that night was 27°F. at West Hartlepool (Church Street) and 28°F. at Hartlepool lighthouse. The occasion is quoted to show that there can be distinct local differences in fog distribution with the lowlands being inundated while the higher ground is above fog level.

A third type of fog, hill fog, is less in evidence in the Hartlepools region. Unfortunately there are no records of fog from the dip-slope of the Plateau but it is doubtful if at altitudes of at most, 600 feet, true hill fog of the Pennine type will occur. When fog obscures the Plateau it is usually part of a widespread regional fog cover involving most of the county. Adiabatic heating of air descending from the Pennines evaporates hill fog by the time such air reaches East Durham. During anticyclonic conditions, however, such as often obtain in autumn, the Plateau can develop a much denser fog cover than the Tees lowland. The present writer has frequently noted the rapid dispersion of fog with decreasing altitude from the dip slope of the Plateau. In September 1962, for example, several traverses by car on successive calm foggy days along the A.19 road from Sheraton to Wolviston established a distinct difference between visibility of 50 yards at the 400 feet level on the Plateau and visibility of up to half a mile at the 50 feet level on the lowland.

This in respect of fog there are distinct local differences of climate between the Tees plain and the East Durham Plateau, the former accumulating more fog during radiation conditions in cold winter anticyclones, the latter during calm damp summer and autumn weather.

Compared with neighbouring Yorkshire the Tees lowland receives only a slight amount of fog since there are no hill-basins or hollows resembling for example Sheffield. Moreover the warming influence of the sea on night temperatures in winter reduces the possible occurrences of radiation fog. On the occasions of West Hartlepool's worst foggy months, January 1953 (11 fog-days) and March 1953 (11 fog-days), Pontefract had 14 and 18 respectively, and Wakefield 12 and 17 respectively. Gateshead on Tyneside is also far more foggy than any Teesside station, though its site, at 509 feet, renders comparison with lowland stations difficult.

RAINFALL

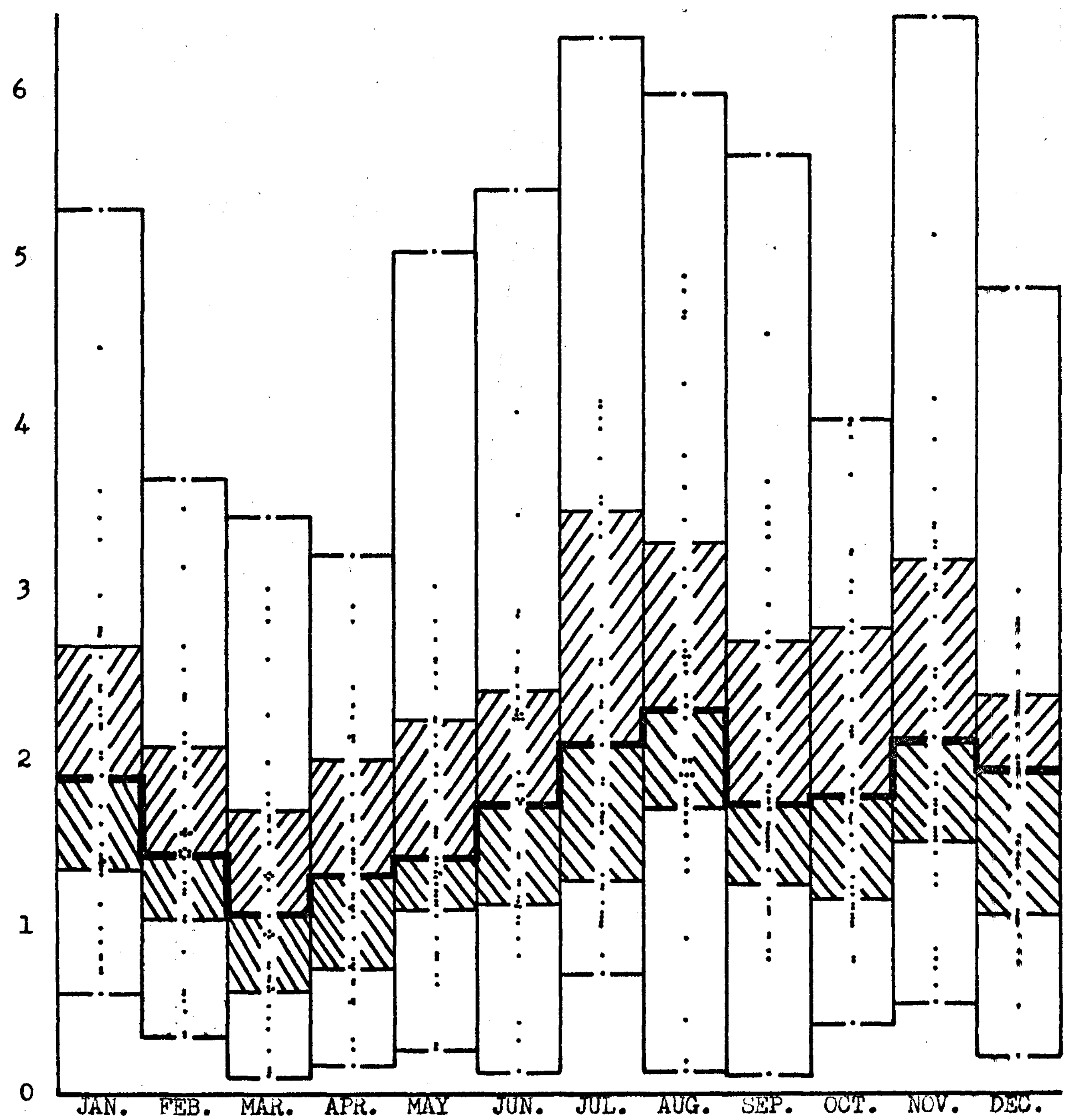
The Tees lowland shares with eastern Scotland and eastern England the following characteristics:

(a) a low average annual rainfall compared with the west coast and the Pennines;

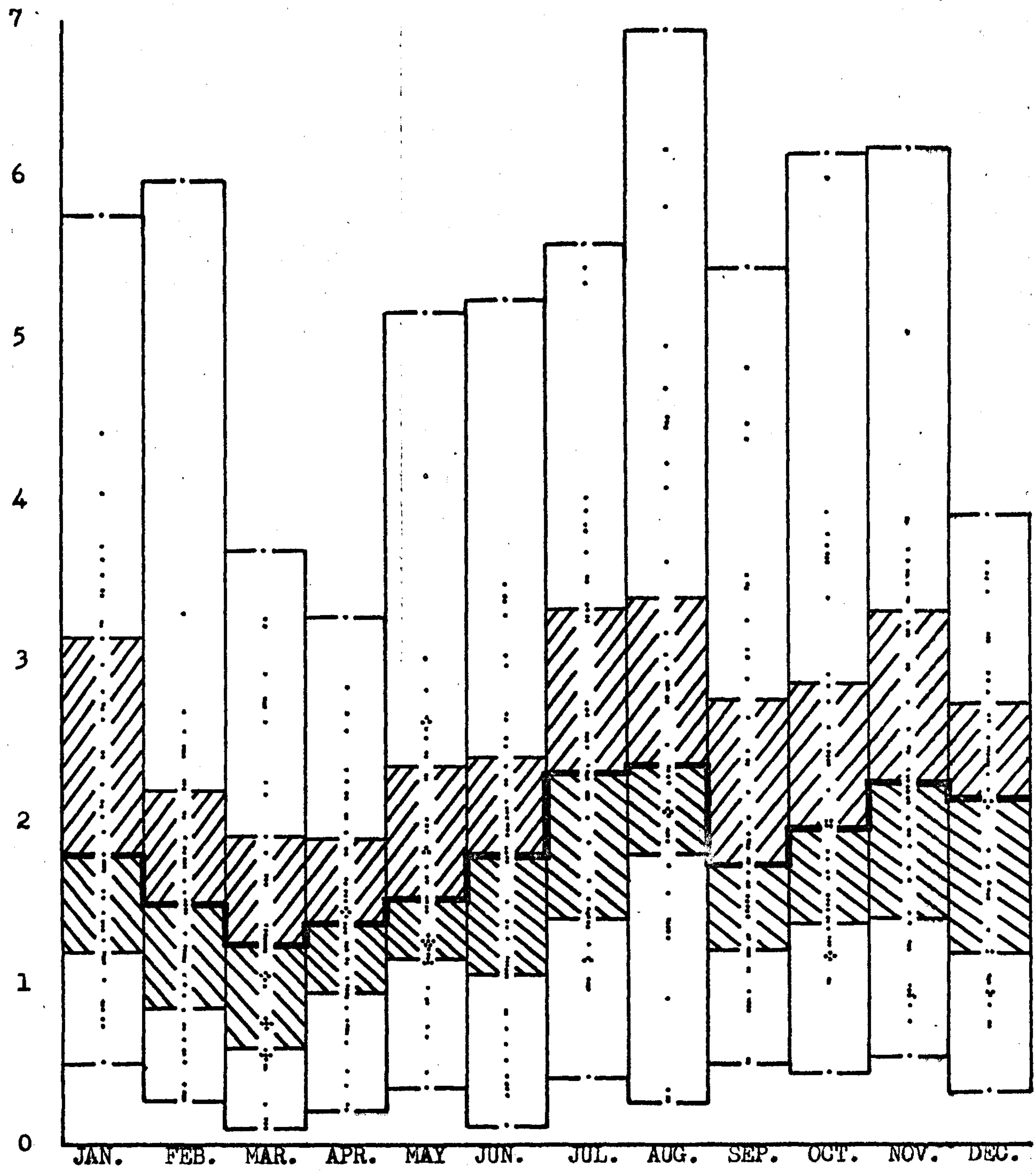
(b) a burst of heavier summer rainfall due to thundery conditions which increase the July and August averages to the highest of the year;

(c) a dry spring with a higher proportion of winds from the north-east quarter than at other times of the year.

GRAPH 15. Rainfall at Hartlepool lighthouse 1924-1960(in inches).
Median values and interquartile ranges are indicated.



GRAPH 16. Rainfall at West Hartlepool, 1916 - 1960 (in inches).
Median values and interquartile ranges are indicated.



These characteristics are shown in Graphs 15 and 16, and also in the following table:

Median values of monthly rainfall totals in inches.

	J	F	M	A	M	J	Jy	A	S	O	N	D
West Hartlepool (1916-60)	1.80	1.50	1.25	1.38	1.53	1.81	2.30	2.33	1.75	1.97	2.24	2.14
Hartlepool (1924-60)	1.90	1.45	1.08	1.33	1.42	1.75	2.09	2.30	1.75	1.79	2.13	1.95

The graphs indicate how great the monthly variations may be over a period of 45 years (West Hartlepool) and 37 years (Hartlepool). Median and quartile values are also indicated, drawing attention to rainfall "probabilities" in each month. The much wider range in wetter as compared with drier years is immediately evident in a comparison of the separation of the upper and lower quartiles in each month except June and December.

The graphs also show the small spread of the April totals and the wide spread of the August totals peculiar to the east coast of England.

EXTREMES OF PRECIPITATION

Record falls for the West Hartlepool area are taken from the Water Company statistics which go back to 1864:

January	Maximum	5.79	inches	(1948)	Minimum	0.03	inches	(1905)
February	"	5.99	"	(1941)	"	0.28	"	(1920)
March	"	4.74	"	(1909)	"	0.09	"	(1938)
April	"	3.27	"	(1947)	"	0.20	"	(1954)
May	"	5.18	"	(1932)	"	0.35	"	(1959)
June	"	5.25	"	(1928)	"	0.12	"	(1925)
July	"	5.59	"	(1930)	"	0.40	"	(1935)
August	"	7.47	"	(1900)	"	0.26	"	(1933)
September	"	5.46	"	(1918)	"	0.33	"	(1906)
October	"	6.52	"	(1903)	"	0.43	"	(1947)
November	"	6.18	"	(1950)	"	0.52	"	(1894)
December	"	5.64	"	(1915)	"	0.32	"	(1941)

From these extremes April appears as the month with the lowest maximum and November as that with the highest minimum.

Extreme records of drought at West Hartlepool are more remarkable that those of wet spells, as the following figures show:

Longest dry spell (period having no day with as much as 0.04 inches of rain):

42 days from 11.1.43 to 24.3.43

Longest absolute drought (15 days when no day has as much as 0.01 inches of rain):

26 days from 4.4.54 to 29.4.54

Longest partial drought (29 days when average is less than 0.01 inches):

78 days from 27.2.38 to 15.5.38 when total rain was 0.46 inches.

Highest precipitation in one day : 2.66 inches on 19.2.41 (snow).

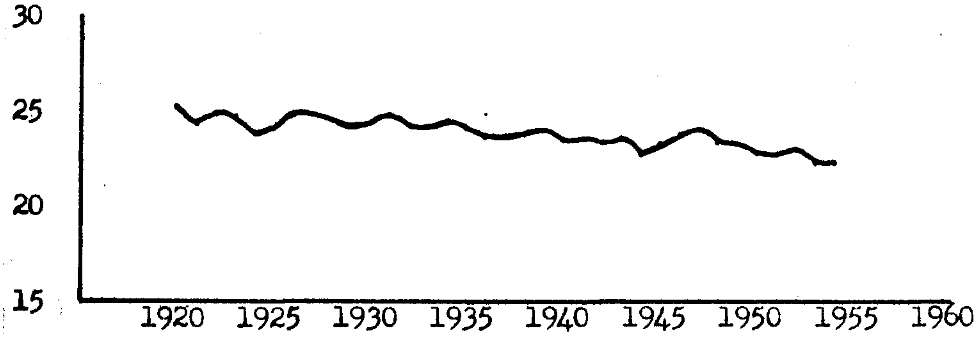
Highest actual rainfall in one day : 2.60 inches on 13.6.28

This is a reflection on the overall dryness of the climate of Teesside.

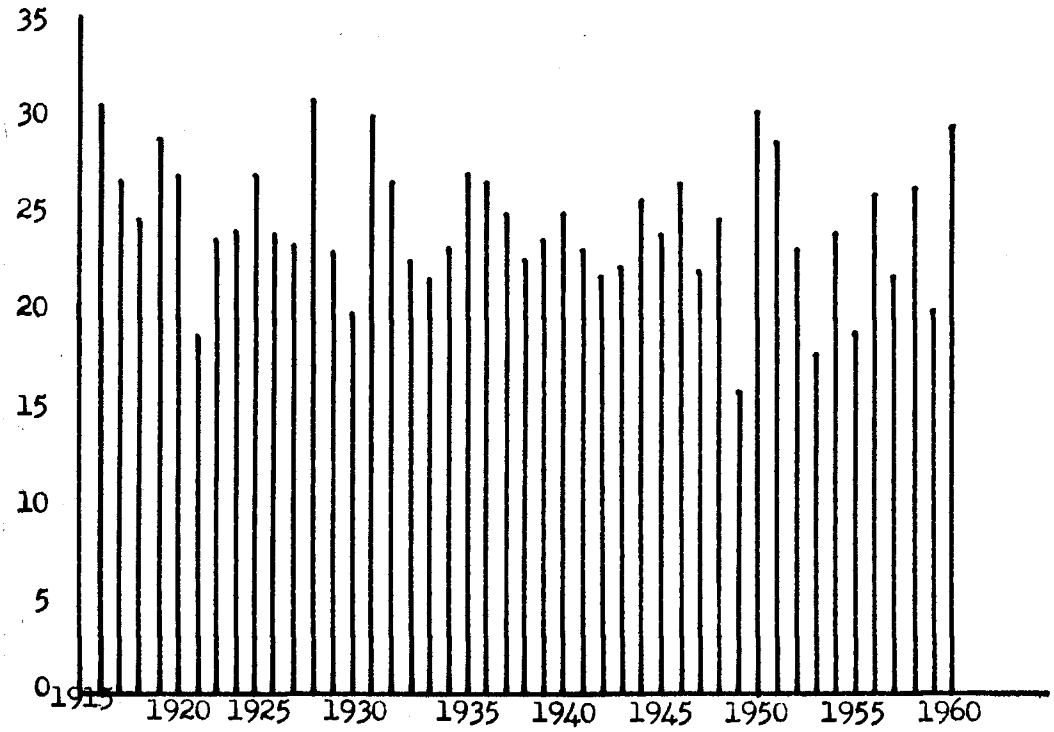
AVERAGES OF PRECIPITATION

The averages of monthly rainfall at West Hartlepool over the 35 year period

GRAPH 17(a). Ten yearly running means of annual precipitation at West Hartlepool(in inches).



GRAPH 17(b). Actual precipitation at West Hartlepool(Water Company, Lancaster Road) from 1916 - 1960 (in inches).



1916-1950 are given in the following table:

(in inches)	J	F	M	A	M	J	Jy	A	S	O	N	D
Lancaster Road	2.19	1.53	1.38	1.53	1.79	1.75	2.53	2.66	2.08	2.30	2.43	2.04
Hurworth Burn	2.34	1.79	1.58	1.66	1.86	1.80	2.63	2.72	2.26	2.50	2.61	2.22

The averages for the 35 year period 1926-60 are slightly different as the following figures show:

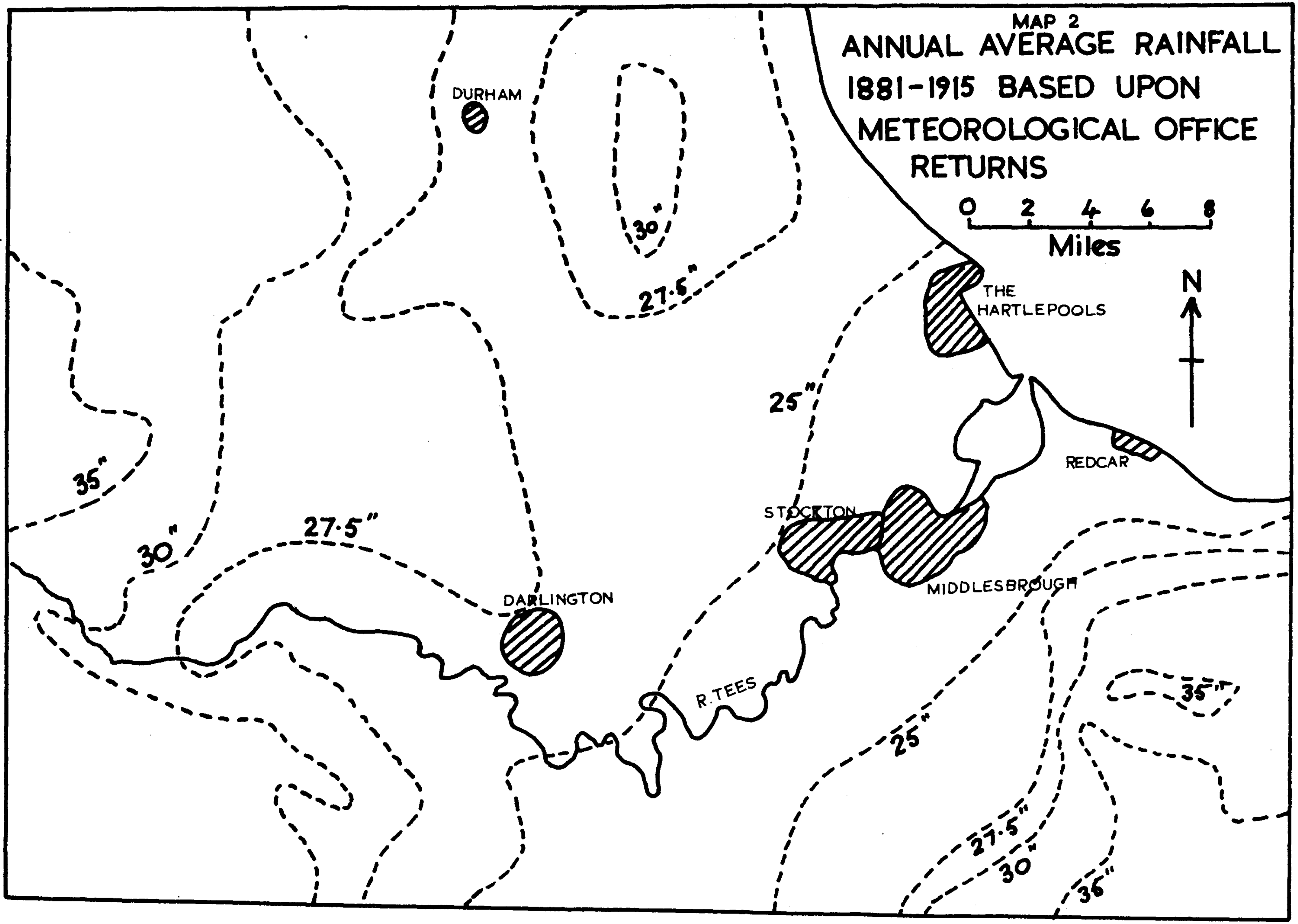
	J	F	M	A	M	J	Jy	A	S	O	N	D
Lancaster Road	2.23	1.60	1.29	1.35	1.70	1.95	2.38	2.56	2.06	2.18	2.51	1.89
Hartlepool Lighthouse	2.07	1.54	1.28	1.37	1.62	1.95	2.47	2.57	1.93	2.05	2.41	1.76

There seems to have been a decrease in the total rainfall which is largely seen in the spring and late summer figures. Graph 17 shows ten-year running means of rainfall totals at West Hartlepool from 1920-54. From this a rather erratic dry trend can be discerned, the means falling from just over 25 inches in 1920 to almost 22 inches in the mid-1950's.

A comparison of twelve stations which record rainfall is possible for the years 1952-61:

<u>Mean monthly rainfall in inches</u>

	J	F	M	A	M	J	Jy	A	S	O	N	D	YEAR
Hartlepool Lighthouse (30')	2.15	1.43	0.98	1.01	1.11	1.78	2.10	2.34	1.75	1.89	1.74	1.78	20.06
West Hartlepool (Church St. 30')	2.47	1.62	1.15	1.11	1.35	1.91	2.21	2.46	1.92	2.26	2.02	2.05	22.53
West Hartlepool Water Works(35')	2.45	1.56	1.15	1.18	1.42	1.94	2.30	2.51	2.03	2.34	2.02	2.05	22.95
West Hartlepool Park (100')	2.47	1,73	1.11	1.19	1.40	2.14	2.37	2.57	2.07	2.42	2.14	2.14	23.75
Hart Reservoir (172')	2.34	1.58	1.16	1.11	1.49	1.94	2.30	2.56	2.03	2.25	1.99	1.89	22.64
Crookfoot Reservoir (293')	2.33	1.74	1.19	1.20	1.36	1.99	2.56	2.91	2.00	2.56	2.13	2.13	24.10
Hurworth Burn Reservoir (357')	2.32	1.71	1.18	1.21	1.60	1.92	2.43	3.03	2.07	2.60	2.14	2.06	24.27
Billingham I.C.I. (40')	2.22	1.48	1.04	1.06	1.37	1.97	2.40	2.77	1.97	2.28	1.92	1.88	22.36


MAP 2
ANNUAL AVERAGE RAINFALL
1881-1915 BASED UPON
METEOROLOGICAL OFFICE
RETURNS
0 2 4 6 8
Miles
N
DURHAM
30"
27·5"
35"
30"
27·5"
DARLINGTON
25"
THE
HARTLEPOOLS
REDCAR
STOCKTON
MIDDLESBROUGH
R. TEES
25"
35"
27·5"
30"
36"

	J	F	M	A	M	J	Jy	A	S	O	N	D	YEAR
Redcar (25') Municipal Bldgs	2.38	1.46	1.18	1.06	1.22	2.07	2.50	2.43	1.91	2.35	2.09	2.00	22.65
Middleton St. George R.A.F. (114')	2.05	1.45	0.93	1.17	1.49	2.00	2.44	2.69	1.97	2.15	1.87	1.88	22.09
Dishforth R.A.F. (106')	2.31	1.70	1.23	1.52	1.54	1.90	2.48	3.08	2.17	2.41	2.14	2.28	24.76
Durham Observ. (336')	2.32	1.69	1.12	1.18	1.92	1.95	2.07	3.10	1.96	2.51	1.89	2.21	23.92

These figures show several significant contrasts over this ten year period: (a) between upland and lowland stations all the year, but especially in October when Hurworth Burn and Crookfoot Reservoirs are easily the wettest stations. At this time of year orographic influence is at its greatest and in very wet spells the excess of upland rain is even more pronounced, for example October 1960 when Hurworth Burn had 8.91", Crookfoot 8.17", West Hartlepool 5.99", and Middleton St. George 4.98"; then in August 1956 the corresponding figures were 8.84"; 6.86"; 6.52"; and 6.04"; while September 1952 had 5.50" at Hurworth Burn, 4.50" at Crookfoot, 4.61" at West Hartlepool, and 3.90" at Middleton St. George.

It must be pointed out that the siting of the rainfall gauges at Hurworth Burn and Crookfoot Reservoirs is in somewhat sheltered north-south valleys, which will tend to reduce rainfall. The figures for these two stations cannot therefore be regarded as totally representative of the plateau as a whole, but as rather on the low side. At the Hurworth Burn Reservoir (357 feet) high ground almost surrounds the rain gauge site, with Stob Hill (430 feet) to the west, Catley Hill(440 feet) to the north, Farden Hill (480 feet) to the east, and Cole Hill (410 feet) to the south-east. Crookfoot Reservoir occupies the dip between Cole Hill and Stotfold Moor which rises to 430 feet at Beacon Hill, so the gauge, down at 293 feet, is quite sheltered.

Hart Reservoir (172 feet) is sheltered by a steep slope to the west and by gentler slopes to north and south to such an extent that the lowland station

West Hartlepool has more rain from October to January.

On the other hand the effects of topographic exposure can be seen in the rainfall of the Ward Jackson Park, West Hartlepool, which stands on a gentle eminence west of the town, and consequently catches more rain than the two lower town gauges. In June it is actually wetter that the upland valleys.

While the validity of the Hartlepool lighthouse data is suspect because the gauge is on a ten-foot high flat roof, with the lighthouse and coastguard lookout affording some shelter to the north, a shower-by-shower comparison with West Hartlepool stations does show a consistently lower rainfall at Hartlepool even when there is no perceptible wind. In 1961 a comparison of the wettest days of the months shows that in no case did Hartlepool have more rain than West Hartlepool.

	J5	F8	M29	A1	M31	J10	Jy12	A22	S2	O19	N11	D4
West Hartlepool	0.68	0.24	0.42	0.47	0.61	0.88	1.26	0.53	0.40	1.54	0.24	0.40
Hartlepool	0.57	0.24	0.27	0.47	0.35	0.62	1.17	0.26	0.34	1.33	0.17	0.34

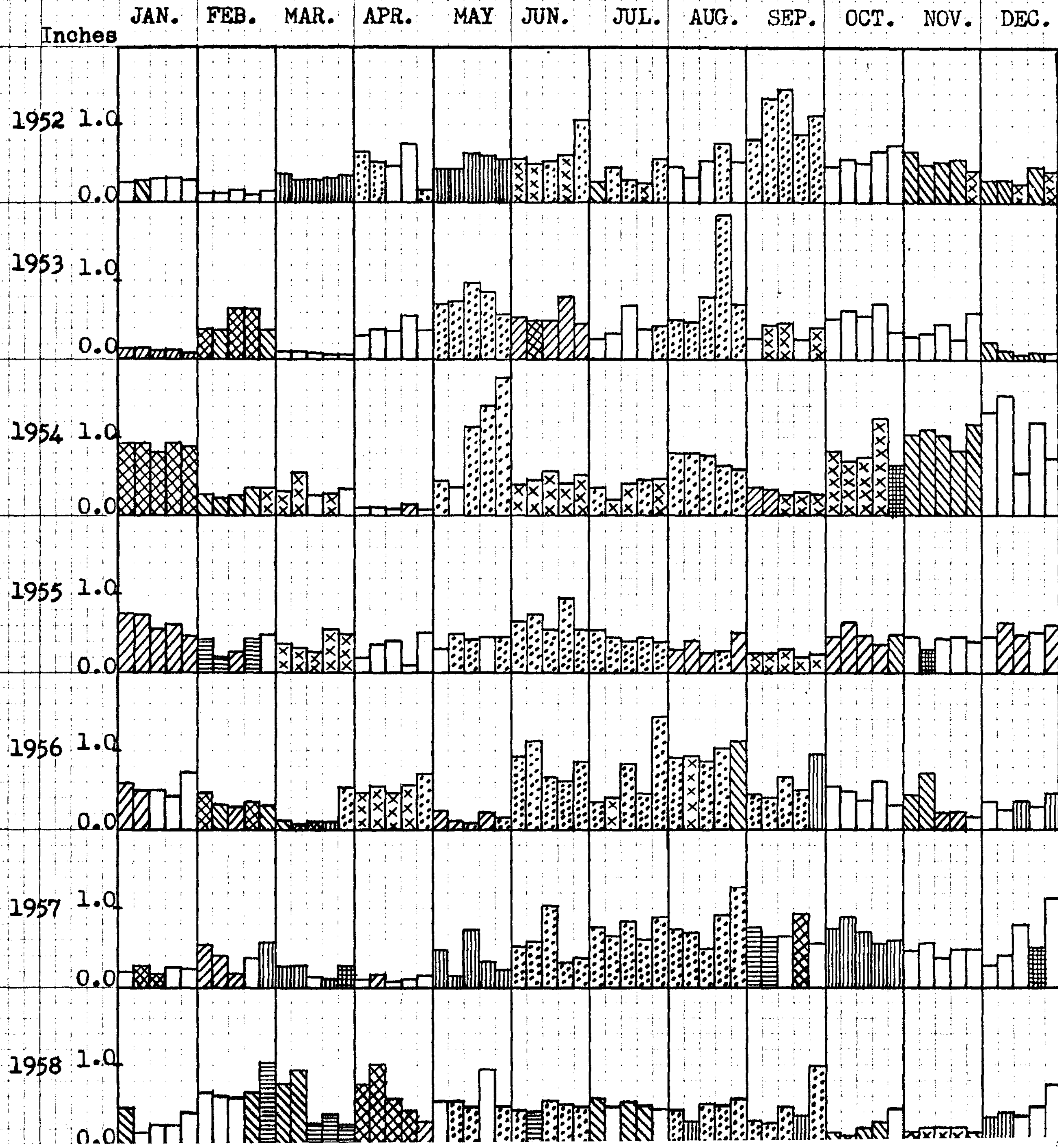
The number of rain-days (days when at least 0.01" of rain fell) may also be compared to show that Hartlepool missed many showers altogether, while in July and August it had some extra showers compared with West Hartlepool:

1961	J	F	M	A	M	J	Jy	A	S	O	N	D
West Hartlepool	22	12	7	21	8	11	12	17	13	17	15	14
Hartlepool	17	12	7	17	8	10	16	18	12	18	10	13

Despite the extra rain-days in July and August, however, Hartlepool had less rain in these months than West Hartlepool.

(b) As far as the lowland stations are concerned those at the coast, Redcar and West Hartlepool, are wetter from October to March than Middleton St. George. This period is that when cyclonic rainfall is most marked, coming from any point of the compass, but mostly from between south and west, as the wind

GRAPH 18. Most rain in one day (in inches) for every month 1952-1961 at West Hartlepool, Redcar, Middleton St. George, Durham and Dishforth. The wind direction associated with the rain is indicated. Columns in order named above.



records for these stations indicate. It is surprising, therefore, to find an increase in precipitation towards the north-east, which might reasonably be expected, as a leeward area, to be drier. The excess at the coast is probably due to those storms from the north-east quarter which bring considerable precipitation to only the coastal strip, in the form of showers. This is much more obvious when snow falls, since the depth of the fall can be traced inland across the lowland, and the extent to which it peters out can be noted.

A good example of this occurred on Sunday, March 4th, 1962, when eight inches of snow fell along the coast of south-east Durham, while at Sedgefield, only eight miles inland, none fell. Sunday, 9th. March, 1958, was the occasion of a similar fall, with fourteen inches of snow at Redcar and West Hartlepool. Another case in point was Thursday, 14th. February, 1963, with cold north-east winds bringing coastal snow only.

In the absence of self-recording rainfall instruments in the Hartlepools region an attempt has been made in Graph 18(1)to show the large differences between the amounts of precipitation which fall on the wettest day of the month at West Hartlepool, Redcar, Middleton St. George, Durham and Dishforth. Since

(1) Graph 18 also shows the dominant wind of the day of the month having the most precipitation. This is somewhat unsatisfactory as a guide to the synoptic situation but the area covered is so small that the wind direction may be taken as similar at each station at any one time. The difficulties of allocating rainfall to any one synoptic situation are in any case very great: (a) the complexity of many synoptic situations - e.g. warm fronts moving east may turn and move back during rain; (b) a warm front and a warm sector are often responsible for continuing rain without any break, and the exact type of rain is therefore hard to distinguish; (c) situations may change as they cross the country, e.g. fronts over the west coast may become occlusions over the east coast; (d) thunderstorms in maritime tropical air are sometimes due to warm

Precipitatinn in inches on certain dates at Tees lowland stations.

Date	West Hartlepool	Redcar	Middleton St. George	Wind direction
Jan. 20, 1954	0.92	0.92	0.81	S.W. 3 knots
Jan. 10, 1955	0.78	0.77	0.40	S. 15 knots
Feb. 22, 1955	0.43	0.20	0.06	N.N.E. 6 knots
Jan. 7, 1956	0.59	0.49	0.00	N.
Feb. 12, 1956	0.46		0.08	N. 15 knots
Nov. 28, 1956	0.44	0.74	0.01	W.S.W. 13 knots
Feb. 14, 1957	0.55	0.40	0.18	N.
Sept. 20, 1957	0.75	0.61	0.18	E.
Jan. 21, 1958	0.45	0.10	0.10	N.
Feb. 9, 1958	0.67	0.62	0.59	S.S.E. 4 knots
Mar. 9, 1958	0.75	0.93	0.07	N.N.W.16 knots
Jan. 21, 1959	0.80	0.70	0.74	N.N.W. 3 knots
Oct. 26, 1959	0.46	0.41	0.02	S.S.W.23 knots
Nov. 15, 1959	0.52	0.30	0.39	N.E.
Dec. 4, 1959	0.65	0.73	0.10	N.N.W.10 knots
Jan. 28, 1960	0.93	0.97	0.74	E.N.E.15 knots
Feb. 25, 1960	0.66	0.30	0.41	S.E. 20 knots
Oct. 9, 1960	1.01	0.89	0.79	N.E. 14 knots
Dec. 20, 1960	0.62	0.50	0.14	N.N.W.17 knots
Jan. 5, 1961	0.68	0.40	0.50	S.S.E.17 knots
Mar. 29, 1961	0.42	0.46	0.36	W.S.W.10 knots
Oct. 19, 1961	1.54	1.48	0.28	N.N.W.20 knots

(1) continued.

sector fronts or cold fronts, and may be accompanied by neither thunder nor lightning.

(c) A third contrast occurs in summer. The 1952-61 averages reveal that Middleton St. George is wetter than the coast from May to August. Graph 18 indicates that the falls in this period are much heavier and are of a thundery character. The warmer summer afternoons inland usually produce greater convection and consequently heavier showers than at the coast. The coast also experiences fewer thundery days than inland; West Hartlepool and Redcar have an average of less than seven days with thunder between May and August, Middleton St. George over ten days, and Dishforth over eleven days.

The coast, however, is wetter at Redcar in June and July than even the inland stations, but it is clear that this is due to some exceptionally heavy thunderstorm "cloudbursts" such as that of July 10th, 1960, when 1.74 inches of rain fell, rather than to the number of thundery days.

In addition to thundery showers the inland stations receive more rain than the coast from cyclonic fronts which in summer tend to come from between south and west, thus leaving the coast in a drier leeward position.

(d) Because of the factor mentioned in (c) there is a contrast between the precipitation of the cooler and warmer halves of the year. In the period

May to October there occurs 54.6% of West Hartlepool's annual rainfall (using the 1952-61 averages). Inland the proportion is higher, at 57.7%. In the period June to August the proportion is 29.4% at West Hartlepool and 32.3% inland. The difference between the rainfall of the two halves of the year increases westwards to the Pennines according to Watson ("A Physical Land Classification of North East England", 1950).

There is also a difference in the character of the rainfall of the two seasons, the heavy showers of short duration in summer thundery spells contrasting with the lighter prolonged rainfall of the cooler season. Graph 18 shows the much higher frequency of very wet single days in summer than in winter.

(e) Finally there is a strong contrast between the dryness of spring and the wetter conditions of the rest of the year. The driest months are February, March and April, a period when there is an increasing proportion of winds from between north-east and south-east. Weather from this quarter is usually cloudy but seldom gives much precipitation except the fine drizzle from low stratus cloud known as "haar". Cool dry north-easterly weather is often continuous for days in May, June and even July, but the thunderstorms of these months add to the precipitation totals in a way that is impossible in the cooler spring months. When the dry spell of spring lasts into May farmers may be seriously embarrassed by the low yield of hay; otherwise this dry period is of great value in allowing the land to dry out as temperatures rise and insolation increases.

Associated with the variation in rainfall distribution is a variation in the number of rain-days. The following table shows the broad conformity from Whitby to Durham which is only to be expected in averages of this particular feature. Individual monthly totals, however, show wide variations which reflect the hit-and-miss character of showers:

Mean monthly number of rain-days for 1952-61

	J	F	M	A	M	J	Jy	A	S	O	N	D	Total
West Hartlepool	19	15	13	12	11	14	15	16	13	16	16	17	177
Middleton St. George	18	14	12	11	11	13	15	15	14	15	16	17	171
Redcar	19	15	13	12	11	13	15	16	14	16	17	18	179
Houghall	17	15	13	12	12	13	15	15	14	15	16	18	175
Whitby	18	15	11	10	11	12	14	14	13	16	16	17	167
Dishforth	17	14	11	11	11	14	14	15	14	15	16	18	170

The differences between the number of rain-days in the dry spring and the wet summer are so small that these figures only confirm that the summer rains are of a heavier nature than those at any other time of the year.

An examination of the deviations in the number of rain-days per month at West Hartlepool reveals that November, December and January are the months with the least deviation between 1951-61.

Annual frequency (in years) of rain-days per month at West Hartlepool (1951-61)

	0-4	5-9	10-14	15-19	20-24	Over 25
January	0	0	1	6	4	0
February	0	1	4	3	3	0
March	1	2	2	5	1	0
April	0	2	7	1	1	0
May	0	5	3	3	0	0
June	0	1	7	2	1	0
July	1	1	3	4	2	0
August	0	2	1	5	3	0
September	1	2	5	2	1	0
October	0	2	4	3	1	1
November	0	0	4	4	3	0
December	0	0	5	3	3	0

July appears as the most erratic summer month while both March and September have experienced exceptionally dry years. October, however, is the only month in this eleven year period to have more than 25 rain-days, the occasion being the record-breaking wet October of 1960.

SNOWFALL

It is in its snowfall that the coastal belt differs most from the inland stations in the Tees lowland. The differences lie in both the incidence of the snow and its amount. The direction from which the snow comes is all-important; if it comes from the sea then the coast is quickly covered while inland areas may escape altogether. Snow coming from an inland direction, however, which is more frequent, often does not reach the coast, or reaches it in such small amounts that the warming sea influence melts it, as it falls. Redcar receives even less snow than the Hartlepools on account of the shelter afforded by the North Yorks Moors to south and south-east. The following table gives a ten-year record for three stations in the Tees lowland and one in the Vale of York for comparison:

Mean number of days with a fall of snow or sleet, 1952-61

	J	F	M	A	M	J	Jy	A	S	O	N	D	Total
West Hartlepool	6.0	7.3	3.2	0.9	0.1	0	0	0	0	0	0.2	2.6	20.3
Redcar	3.0	4.4	2.0	0.3	0	0	0	0	0	0	0.3	1.2	11.2
Middleton St. Geo.	8.4	8.8	3.9	0.5	0.2	0	0	0	0	0.1	0.8	4.4	27.1
Dishforth	9.4	8.9	3.8	0.3	0.2	0	0	0	0	0	0.8	4.4	27.8

With the exception of Redcar the figures in this table are typical of lowlands in northern England (cp. Rotherham 27 days; Houghall 24 days).

More snow falls at the end of winter than at the beginning because of the greater frequency of 'instability' showers in February and March. The first fall is usually in November and the last in April, with an occasional day in

May, but March is the month with the record for heavy falls (e.g. 1958 and 1962) though the extreme record for a single fall is held by February (1941) when snow lay three feet deep in West Hartlepool.

Snow does not usually lie for very long in the Hartlepools region because of the threefold influence of the proximity of the sea, the low altitude, and the southerly aspect of most of the slopes. When heavy falls do occur in March the sun has gained sufficient height to be able to melt the snow quickly. It is only the combination of a March 'easterly spell' and the strato-cumulus cloud it brings which allow the snow to remain, as it did in 1947, 1956, and 1963. The monthly frequency of days with snow lying at 9.00 a.m. at West Hartlepool is given in the following table:

Mean number of days with snow lying at West Hartlepool, 1951-61

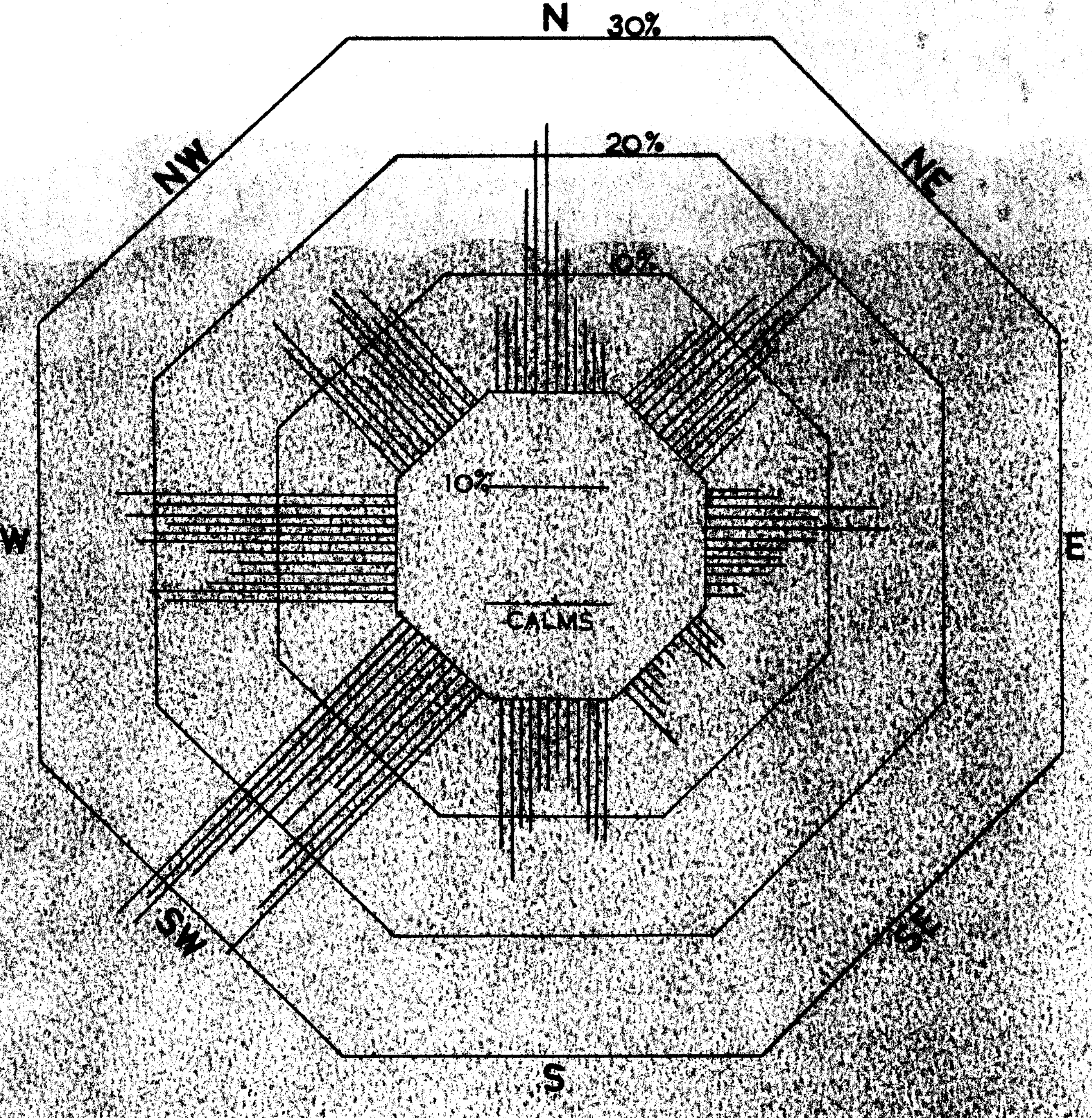
J	F	M	A	M	J	Jy	A	S	O	N	D	Total
4	6	2	0	0	0	0	0	0	0	0	1	13

Since the officially approved records at West Hartlepool began in 1951 the worst spells of lying snow were 16 days in February 1955, 18 days in February 1956, and 33 days from 1st February to 5th March, 1963. But for a short break from 26th January this last snow cover could have lasted for 50 days because snow lay from 10th-26th January 1963, and there were in all 65 days with a snow cover between November 1962 and March 1963.

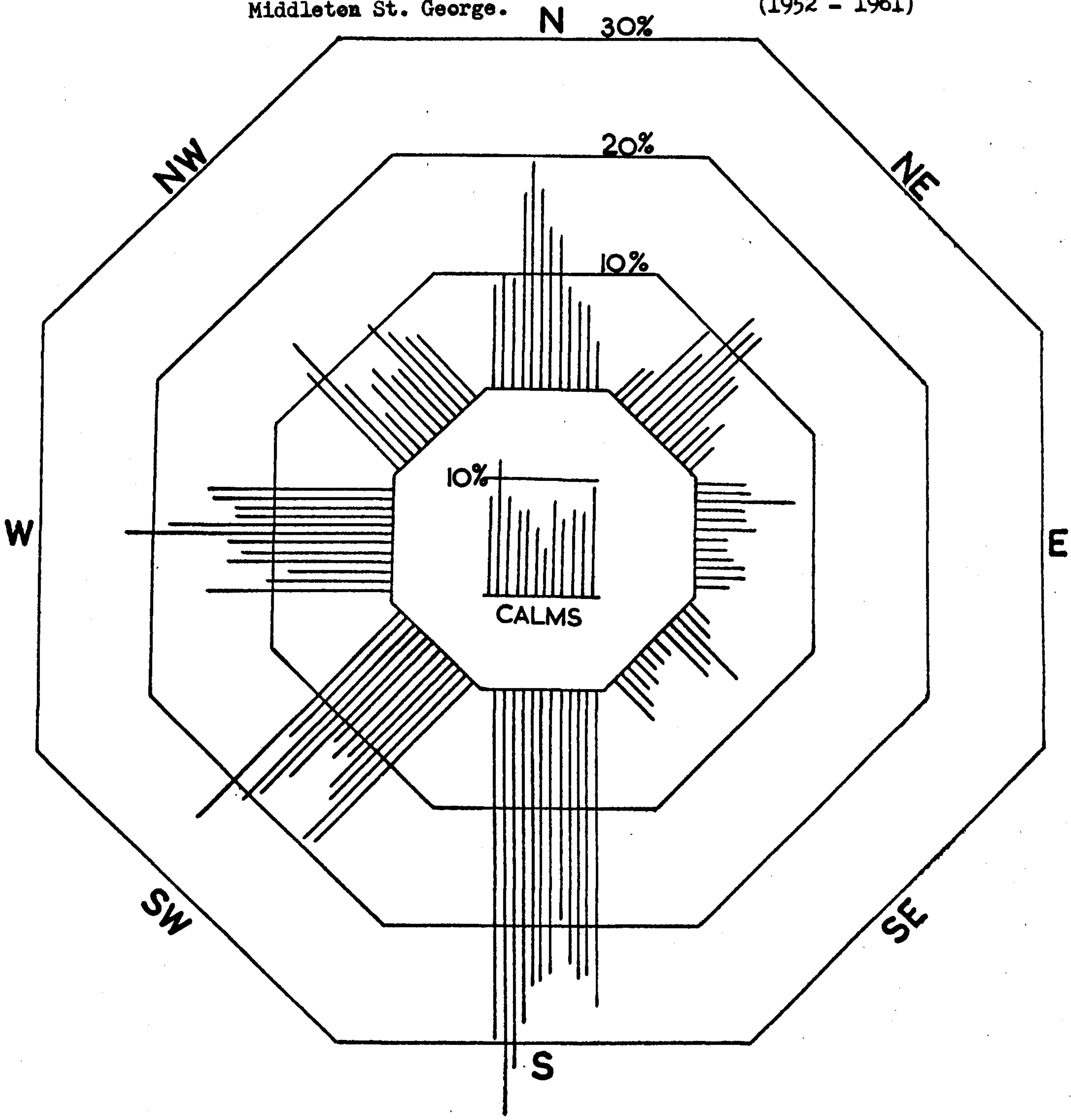
THUNDERSTORMS

The Hartlepools region is not subject to many thunderstorms because of the cooling influence of the sea in summer, the season of greatest convectional turbulence. The frequency of thunderstorms increases inland as this sea influence weakens, so that Middleton St. George has an average of 12 days with thunder between April and November compared with 8 at West Hartlepool. Thunderstorms generated in the Midlands of England often travel as far as Yorkshire before

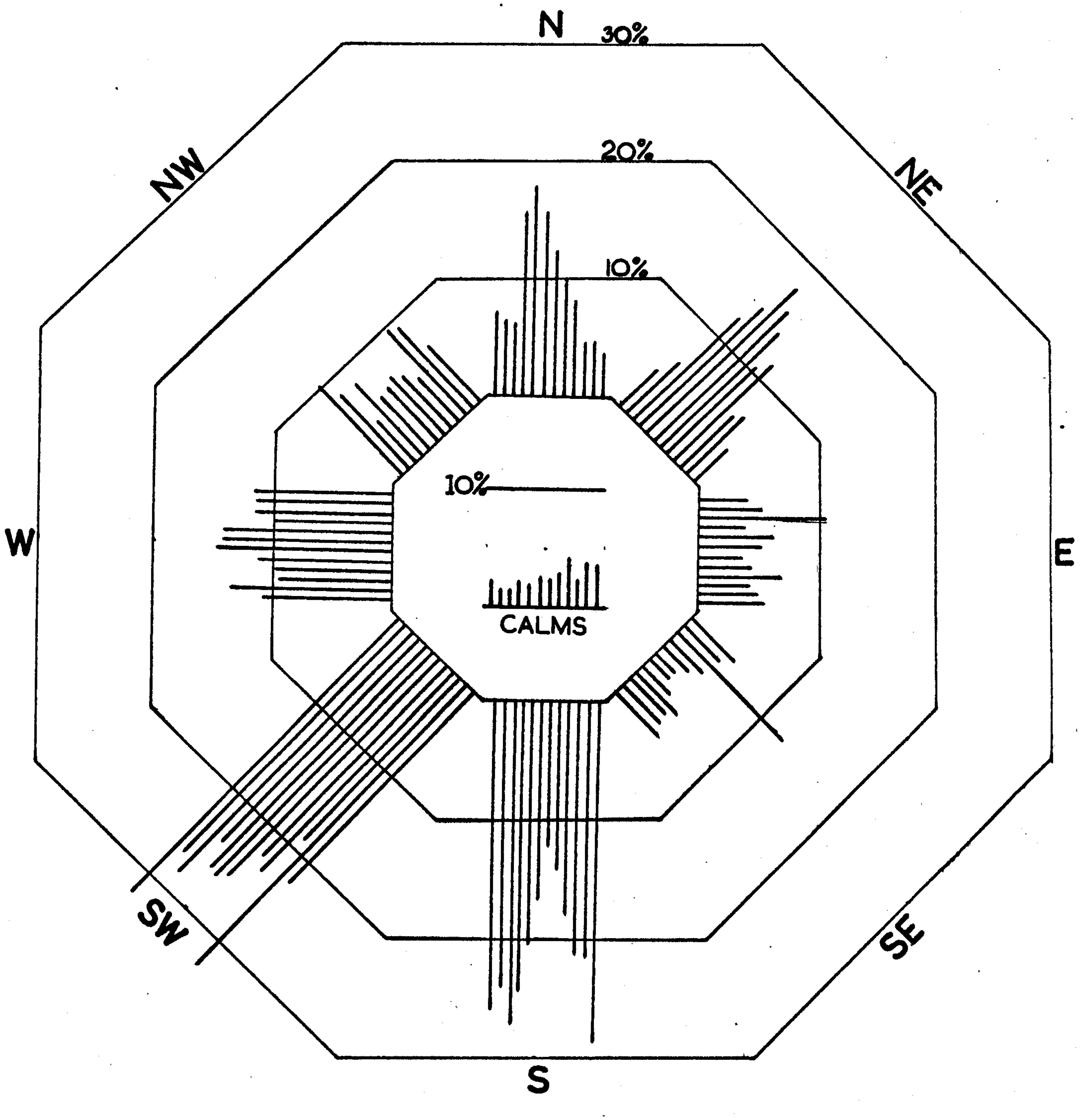
GRAPH 19. Monthly variation in percentage of winds from each of the principal compass directions recorded at 9.00 a.m. at West Hartlepool, 1952 - 1961.



GRAPH 20. Monthly variation in percentages of winds from each of the principal compass directions recorded at 9.00 a.m. at Middleton St. George. (1952 - 1961)



GRAPH 21. Monthly variation in percentages of winds from each of the eight principal compass directions recorded at Billingham works of Imperial Chemical Industries, 1956-60.



dying out in the evening (1). The Vale of York funnels these storms but can also develop isolated storms of its own due to the intensive heating of the air in the summer months in an area separated from the North Sea by the Yorkshire Moors. Such storms occur most frequently in July and August, between midday and 8.00 p.m. on calm days or on days with a weak southerly air stream. On occasions the Tees lowland interior leads the whole country in the number of thunderstorms (e.g. July 1960 and August 1958). The following table gives the mean monthly frequencies of days with thunder for selected stations:

Mean number of days with thunder, 1952-61

	J	F	M	A	M	J	Jy	A	S	O	N	D	Total
West Hartlepool	0.2	0	0	0.2	1.3	1.5	2.2	1.9	0.5	0.6	0.2	0	8.6
Redcar	0.2	0	0	0.2	1.3	1.3	2.2	1.4	0.3	0.3	0.2	0	7.4
Middleton St. George	0	0	0	0.4	1.8	1.5	3.8	3.1	0.7	0.5	0.1	0	11.9
Dishforth	0	0	0	0.7	2.1	2.2	3.6	3.4	0.9	0.3	0.1	0.1	13.4
Houghall	0	0	0	0.2	1.3	1.2	1.9	1.7	0.5	0.4	0	0.1	7.3

Thus the inland stations in the Vale of York experience almost twice as many thunderstorms as stations on the coast. It is surprising that Houghall in the Wear Valley does not have any more thunderstorms than coastal places but the relief in the middle Wear Valley is not as flat as that of the Vale of York, nor are the temperatures as high.

WINDS

The pattern of the air circulation is shown on Graph 19, Graph 20 and Graph 21. Dominating the pattern are south-westerly and westerly winds which result from the high frequency of depressions passing across the British Isles, particularly in autumn and winter when, from October to February, they form about half of all the winds. At West Hartlepool only July records any calms but inland calm days are more frequent and occur in every month at Middleton St. George.

(1) Watson E.M. Climate. Scientific Survey of North Eastern England. British Association, 1949.

Graph 19 shows the winds at 9.00 a.m. at West Hartlepool. Graph 20 the same at Middleton St. George, but Graph 21 is based on the anemograph records at Billingham (I.C.I.) for the shorter period 1956-61. The latter are more thorough as giving a round-the-clock record but as it is quite common for the direction of the wind to persist all day the three graphs are reasonably comparable.

An important modification of this pattern is the sea breeze which is noticeable from March to August in the afternoons (and on a lesser scale from September to October). In other months it amounts to an insignificant increase, only small intervals of sea breezes being recorded. This sea breeze reaches inland as far as Middleton St. George at least, and probably as far as the Pennines. By definition the sea breeze is a wind induced by the difference in temperature between the warmer land and the cooler sea, conditions which arise in the warmer summer months. A complicating factor in the measurement of the sea breeze, however, is that in this region at this season north-east winds are common as the result of major pressure distributions over the British Isles, especially anticyclones centred to the north. An examination has therefore been made of the wind statistics recorded at Middleton St. George for four occasions every day (3.00 a.m., 9.00 a.m., 3.00 p.m., and 9.00 p.m.) By comparing the figures for mid-morning and mid-afternoon any onset of the sea breeze can be traced. This examination of the statistics for the period 1952-61 reveals the following significant facts:

(a) The percentage of calms drops in the afternoons, the greatest difference between morning and afternoon being in April and May, the period when the land's warmth is being built up most rapidly; the least difference comes in the cooler months and in November there is a slight increase in calms in the afternoons.

	J	F	M	A	M	J	Jy	A	S	O	N	D
% calms 9.00 a.m.	8.4	11.8	8.4	7.3	7.4	5.7	3.9	8.1	6.7	7.4	7.3	9.4
% calms 3.00 p.m.	3.5	5.0	2.3	0.3	0.3	1.3	1.9	1.0	2.7	2.6	8.6	7.4

(b) The percentage of N.E. winds rises in the afternoons all the year, being remarkable from March to August. Between April and July, inclusive, these winds from the sea become dominant in the afternoons while remaining insignificant in the mornings. This then is the period of the sea breeze.

	J	F	M	A	M	J	Jy	A	S	O	N	D
% N.E. 9.00 a.m.	3.2	3.6	9.4	7.7	12.9	12.0	12.3	8.1	7.7	3.5	4.7	2.6
% N.E. 3.00 p.m.	5.5	8.2	17.5	23.3	30.6	23.3	22.9	19.3	11.6	8.1	5.4	4.5

(c) Winds from the dominant quarter, south, decrease in a striking fashion from May to August, less so during the rest of the year, and actually increase on December afternoons.

	J	F	M	A	M	J	Jy	A	S	O	N	D
% S. wind 9.00 a.m.	26.8	24.3	24.5	23.3	19.7	24.0	24.8	25.2	28.3	32.3	36.3	29.7
% S. wind 3.00 p.m.	24.2	18.2	20.2	17.9	11.3	12.7	15.2	14.5	25.4	25.5	30.3	31.1

(d) The percentage of S.W. winds rises in the afternoons from May to August but decreases for the rest of the year with the exception of November, when there is a small increase. The increase in the case of the S.W. winds is small against that of the sea breeze, but it is nevertheless distinctive as marking a departure from the southerly air coming up the Vale of York.

	J	F	M	A	M	J	Jy	A	S	O	N	D
% S.W. 9.00 a.m.	19.0	19.6	15.5	14.7	11.9	13.0	11.9	16.5	19.3	20.6	14.0	24.5
% S.W. 3.00 p.m.	15.8	15.7	12.6	12.7	15.2	19.3	19.0	22.3	16.0	19.1	15.7	19.7

An examination of the 9.00 p.m. wind figures shows other changes from afternoon conditions:

(a) There is a return to the calmer conditions prevailing before the inflow of the sea breeze.

	J	F	M	A	M	J	Jy	A	S	O	N	D
% calms 3.00 p.m.	3.5	5.0	2.3	0.3	0.3	1.3	1.9	1.0	2.7	2.6	8.6	7.4
% calms 9.00 p.m.	9.0	12.5	8.4	14.7	8.7	10.6	7.7	10.0	11.9	10.3	12.0	9.6

(b) The percentage of N.E. winds (the sea breeze) decreases as the inland temperatures fall. Again this change is most striking between March and August.

	J	F	M	A	M	J	Jy	A	S	O	N	D
% N.E. 3.00 p.m.	5.5	8.2	17.5	23.3	30.6	23.3	22.9	19.3	11.6	8.1	5.4	4.5
% N.E. 9.00 p.m.	4.5	5.0	9.4	7.7	13.2	10.0	5.5	6.1	6.4	4.5	3.4	3.2

(c) There is a very large increase in the proportion of winds from the north in the evenings from April to August. In May these north winds become predominant, averaging 23.9% of all winds at Middleton St. George. The north wind is due to cool air from the East Durham Plateau sliding down to the Tees lowland at dusk in the summer months - a katabatic wind. Obviously on most occasions the isobaric gradient prevents such katabatic winds but in summer the combination of calm air and lowland heat radiation offers suitable conditions:

	J	F	M	A	M	J	Jy	A	S	O	N	D
% N. 3.00 p.m.	12.6	13.2	9.4	12.0	12.6	14.0	7.7	10.0	9.0	10.0	8.6	5.5
% N. 9.00 p.m.	10.0	7.8	10.7	17.3	23.9	20.0	17.8	15.2	7.4	6.1	8.3	5.5

The local air movements of the summer months described above are sufficient to lower the temperatures at the coast in the afternoons by several degrees compared with Middleton St. George. The July 1961 figures for temperature differences in the afternoon between West Hartlepool and Middleton St. George include the following:

Date	°F difference in maxima	Wind behaviour (from Middleton St. George records)
2nd	3	N.E. early, backing N.W. at1100 hrs. and W. at 1500 hrs.
4th	7	N.W. freshening and veering N.E. after 1500 hrs.
9th	1	W. to N.W. throughout, light to moderate.
10th	3	S.W. light backing to S. after 1430 hrs.
11th	6	Light variable becoming N.E. to E.S.E. light to moderate.
12th	7	Light variable but generally N.E. to E. backing N.W. to W. after 1900 hrs.
15th	1	Calm at first, becoming light N.E. backing N.W. after 1000 hrs.
16th	5	N.E. throughout, light, but moderate after 1215 hrs.
18th	1	Light W.N.W. to N. veering N.E. light to moderate.
19th	4	Light N.W. veering N.E. occasionally moderating 1200-1500 hrs
21st	0	Light N.W. veering N.E. light.
22nd	4	Light N.W. veering E. to E.S.E. after 1000 hrs.
27th	1	W.S.W. to W. light to moderate backing N.E. after 1300 hrs.
28th	1	N.W. becoming W.N.W. after 1600 hrs.
29th	3	W.N.W. to N.W. moderating and veering N.E. to E.N.E.
30th	1	Light S.W. moderating at times in the late afternoon.
31st	3	S.W. veering N.W. to N.E. after 1400 hrs.

These details illustrate that effect of the sea breeze which is to cool the coast at the very time of year when most people visit it for holidays. Luckily for them, however, most of these winds are light and the sand-blowing common in winter months at Seaton Carew is at a minimum. It is not always cooler at the coast with a N.E. wind (see 21st July above) because other factors are at work such as heavy cloud and rain which lower the inland temperatures. For example out of 12 days in July 1960 when the maximum temperature at Middleton St. George was lower that at West Hartlepool 11 days were rainy.

Returning to the graphs of winds at Middleton St. George and West Hartlepool a comparison shows that throughout the year West Hartlepool has more winds from the east and north-east. Both have least N.E. winds in December (5.2% West Hartlepool, 2.6% Middleton St. George) and most in May (20.0% West Hartlepool, 12.9% Middleton St. George). This difference is partly due to the earlier stirring of the air at the coast while the air at Middleton St. George is still motionless, so that the latter is recording calms instead of N.E. winds on many occasions. It is also partly due to the deflection of N.E. winds by the Vale of York's steep sides so that they become N. Winds.

Similarly in the case of east winds there is a greater proportion at West Hartlepool than inland. At Middleton St. George there is a tendency for such winds to blow from the south-east rather than from the east yet even allowing for this by combining east with south-east winds West Hartlepool has a striking excess from March to September.

East Winds %	J	F	M	A	M	J	Jy	A	S	O	N	D
West Hartlepool	14.5	6.1	14.5	9.3	15.2	9.3	6.8	6.4	6.7	5.2	2.6	3.2
Middleton St. George	4.2	4.6	8.4	4.0	4.2	5.0	2.6	2.6	3.0	3.9	4.0	2.6
S.E. Winds %												
West Hartlepool	3.2	2.8	4.5	3.7	0.9	1.0	0.6	1.9	2.3	3.2	4.0	6.1
Middleton St. George	2.3	3.2	7.4	4.7	5.2	1.7	1.9	1.6	2.7	2.6	3.7	4.8

An explanation possibly lies in the shape of the coastline. The north-westerly trend may cause southerly winds coming along the Yorkshire coast to swing west after passing the Saltburn cliffs so that south winds at Middleton St. George appear as east winds at West Hartlepool.

Middleton St. George has twice as many winds from the south as West

Hartlepool throughout the year.

South winds %	J	F	M	A	M	J	Jy	A	S	O	N	D
West Hartlepool	11.9	11.8	11.3	8.7	7.1	5.7	7.7	7.7	11.3	10.6	15.3	12.6
Middleton St. George	26.8	24.3	24.5	23.3	19.7	24.0	24.8	25.2	28.3	32.3	36.3	29.7

The topography explains this contrast since the Vale of York tends to channel air movements towards the north, while at West Hartlepool southerly air streams may be diverted to the north-west by the North Yorkshire Moors or to the north-east by the less dominating East Durham Plateau, according to the isobaric pattern.

Graphs 19 and 20 bring out the contrast in the predominant winds, south at Middleton St. George and south-west at West Hartlepool. In the case of S.W. winds the latter has a far higher proportion than the former; a higher proportion indeed than even that of south winds at Middleton St. George, amounting to over 30% of all winds in October, November, December and January. Even at their minimum, in May, the S.W. winds form 14.2% of all winds at West Hartlepool. It is probable that the lesser frequency of S.W. winds at Middleton St. George is due to the channelling effect of the Vale of York since the frequency of south winds is so high.

No such channelling effect seems to be exerted by the upper Tees valley as Middleton St. George receives less west winds that West Hartlepool, particularly between September and March. The Pennine valleys are in any case much narrower than the Vale of York and cannot be expected to have the same channelling effects.

OVERALL CHARACTERISTCS

The lowland of the Hartlepools region is the warmest part of County Durham although it does suffer from the cold offshore waters and cool damp onshore winds common to the whole of the north-east coast. The East Durham Plateau rises to over 600 feet above sea level near Trimdon although the slopes have a southerly aspect which maked them warmer than the areas further north.

The region is one of the driest parts of the British Isles, and the coasts, though not the Plateau, escape most of the worst snowfalls of winter. There is a summer maximum of rainfall, associated with convectional storms, most marked at places inland but found right across to the coast, though most precipitation comes from warm fronts and occlusions with thundery characteristics rather than from thunderstorms proper.

A narrow coastal strip is strongly influenced by maritime conditions, Sea breezes on the warmer days lower temperatures significantly, and the warmth of the sea in winter prevents dense radiation fogs from forming on the scale usually found in south Yorkshire and the Midlands of England. Industrial smoke does cause a belt of atmospheric pollution along the River Tees but there is generally sufficient wind to keep this smoke moving out to sea.

The climate may be summed up as a modified continental type, the modification being greatest on the coast.

Chapter 3

THE AGRICULTURE OF THE HARTLEPOOLS REGION

The area covered by the present agricultural survey extends to the Tees on the south side, to Sedgefield, Thorpe Thewles and Trimdon on the west, and to Castle Eden on the north, although statistical data has also been analysed for a wider fringe area.

Physical background

Apart from the sea there are few easily recognised physical boundaries within the region studied. The 50 foot contour may be taken as a dividing line between the estuarine floodplain of the River Tees and the boulder-clay lowland which climbs towards the dip-slope of the East Durham Plateau. Below this line the land is strikingly flat so that road bridges over the winding streams and creeks entering the sand-choked Tees estuary must have embanked approaches, giving the bridge-humps the appearance of prominent features of the relief. East of the village of Cowpen Bewley the waterlogged soils of Fore Marsh and Cowpen Marsh are damp in summer and flooded in patches in winter. Greatham Creek is one of three former mouths of the River Tees and is now blocked off from that river by large-scale land reclamation on the Seal Sands. The old coastline is marked today by the road from West Hartlepool to Port Clarence.

Bailey, writing at the beginning of the nineteenth century, (1), mentions that the first embankment at Saltholme, now one mile north of the Tees, was built in 1740, 18 feet to 24 feet wide at the base, and 5 to 7 feet high. After this dyke was breached along 400 feet by a high tide in 1771 it was replaced by a larger construction 36 feet wide at the base and 8 feet high.

(1) J. Bailey, A General View of the Agriculture of County Durham, 1810.

This lasted until 1807 when another exceptionally high tide broke through it. Stop-gap repairs before the winter were later augmented by a new dyke on the landward side of the old. Begun in 1808, this dyke was 60 feet wide at the base and 9 feet high, running for four miles and securing 600 acres at Saltholme, 300 acres at Billingham, and 500 acres at Cowpen.

Today the plain is protected by sand dunes 20 feet high from Seaton Carew to the North Gare Breakwater, and from here a dyke runs south, past a recently installed dry-dock at Graythorp, to Greatham Creek, and thence to the great rectangular dykes on the Seal Sands where tipping is gradually filling in the enclosed strand. This five mile long structure is 16 feet high for most of its length, and 22 to 28 feet high at its northern end. In the freak high tides of February, 1953, the sea flooded over the top and inundated the lower parts of the Cowpen Marsh and Saltholme Farm.

All the land below 50 feet, however, is not marshy, as the water table sinks inland, and productive arable land is found as low as 10 feet A.O.D. North of the North Gare Breakwater, behind the coastal sand dunes, lies a mile and a half long strip of sand blown in from the beaches, but here the water table is within a foot of the surface for most of the year, and while much of the strip next to the dunes is used as a golf course, most of the area on the seaward side of the coast road is summer grazing land for sheep and cattle. It is perhaps in this part of the Hartlepools region where the physical background has had the most permanent effect on the agricultural land-use.

The short rise between the 25 and 50 foot contours at Greatham and Billingham is probably the true edge of the estuarine floodplain but a similar bluff at Wolviston, between the 75 and 100 foot contours may be the beginning of the dip-slope of the East Durham Plateau, which rises away to the north-west.

The whole area is mantled in a thick sheet of boulder clay, reddish in colour on the lower ground, reflecting the dominant Triassic deposits in the Tees valley, but yellow-brown and sometimes blue-brown on the higher ground. The conjectured Darlington-Hartlepool fault which separates the Triassic strata from the Permian is completely obscured by this clay cover, whose thickness varies from 100 feet at Norton to 50 feet under the I.C.I. works at Billingham, and becomes zero at Seaton Carew where the Bunter sandstone comes to the surface to form Long Scar rocks. Sand and gravel ridges and lenses left by the Ice Age and subsequent melt-water action are so small and scattered that they have an insignificant effect on farming except in so far as quarries have rendered certain fields temporarily unproductive. Typical of these is an arc of gravel mounds running from Thorpe Thewles through Wolviston to Brierton on the south-western edge of West Hartlepool.

The dip-slope of the East Durham Plateau rises to the north-west to over 600 feet near Trimdon and near Thornley. Where it reaches the coast a fine line of cliffs of creamy yellow Magnesian Limestone is formed, exceeding 100 feet at Blackhall Rocks in the south and gaining height further north. The Plateau ends in a north-west facing escarpment overlooking the Wear valley, the steepness of the scarp varying according to the amount of erosion suffered. The clay cover continues from the Tees valley over the Plateau and apart from numerous quarry exposures, especially in the Kelloe, Cornforth and Bishop Middleham districts, the limestone is concealed. Variety is given to the scenery by streams such as those flowing into Greatham Creek, Billingham Beck, and the River Skerne, which have incised winding valleys into this boulder clay cover. The steep wooded sides of ravines such as those in the south-west corner of Elwick Hall parish contrast sharply with the region below 50 feet at the coast. In most cases the streams occupying these valleys are misfits, and it would seem that the valleys were cut by considerably larger rivers at the time when melting ice supplied water from further north. The same theory of glacial overflow water may apply to the surprisingly deep gorges such as Crimdon Dene and Castle Eden Dene which cross the plateau north of the Hartlepools, forming formidable obstacles to communication. Apart from these ravines and denes there is almost no land in the Hartlepools region which is uncultivable by reason of relief.

Woodland occupies only a small proportion of the area surveyed. The largest extents lie on Lord Londonderry's estate at Wynyard, between Sedgefield and Wolviston, where approximately 1½ square miles of countryside are forested. Castle Eden Dene and Crimdon Dene are also wooded but these areas are in any case unfit for farming because of their steep sides. The Forestry Commission maintain smaller strips of coniferous trees on Butterwick Moor, Pike Whin Moor, and Stotfold Moor between 300 and 400 feet. Many farmers also retain a narrow belt of trees as a wind-break, usually on the north side of the farm buildings, but these occupy a negligible area and in some cases serve as poultry runs.

On the northern side of the survey area subsidence of the surface due to the extraction of coal is a problem to the farmers. Although the problem is worse in West Durham the Wingate district has numerous hollows filled with water which is unable to drain away. Field drains are upset and change their levels; outlets become inlets, or the whole network gets a broken back. Buildings lean and crack, while fences sag and posts are left hanging. It may be partly for this reason that there is an irregular, almost unnoticed, but continued southward movement of tenant farmers who began in a small way on coalfield farms and have later found themselves able to afford better land on the more truly rural south side of the county.

<u>Climatic background</u>

As the chapter on climate makes clear, there are significant differences between the Plateau and the Tees lowland. The 1952-61 figures for this area show that while the lowlands had a mean rainfall of just over 22 inches a year, the Plateau valleys received over 24 inches annually, and there is good reason to suppose that the largest part of the uplands which is more exposed than the valleys has between 26-30 inches. The higher rainfalls of autumn and winter hinder ploughing on the heavier soils, but are of value in maintaining moisture content during the marked dry spells of spring and the not infrequent dry weeks of summer. August, usually the cereal harvest month, is unfortunately the month, as the lower quartile of Graph 16 shows, when the expectation of rain is greatest.

The altitudes on the Plateau and the variations in aspect make considerable differences to the agriculture, especially with respect to the ripening of cereals. This was particularly noticeable in the cool wet summer of 1962, when the harvesting of cereals, even on the Tees lowlands, was not possible till the very last days in August. At an altitude of 400 feet in the parishes of Hutton Henry, Wingate and Sheraton, the harvest could not begin until after the first week in September as the corn was unripe. At 500-600 feet round Trimdon and Kelloe the oats and wheat were still green at this time, though barley was ready for the reaper.

A comparison of the dates on which corn harvesting began is possible for four farms which have fortunately kept records, and made them available to the present writer. Middle Field Farm, near Greatham, lies at 30 feet A.O.D. on level land; Home Farm, Wynyard, rises from below 150 feet to over 250 feet; Cole Hill Farm, west of Elwick, rises from 250 feet to over 400 feet; and Kelloe Laws Farm stands at the crest of the Plateau escarpment at 500 feet:

	1956	1957	1958	1959	1960	1961	1962	1963
Middle Field	15 Sep.	13 Aug.	30 Aug.	4 Aug.	11 Aug.	11 Aug.	30 Aug.	11 Sep.
Home Farm	10 Sep	22 Aug.	2 Sep.	14 Aug.	29 Aug.	30 Aug.	10 Sep.	
Cole Hill				13 Aug.	15 Aug.	24 Aug.	18 Sep.	
Kelloe Laws						6 Sep.	8 Sep.	21 Sep.

Apart from the unusually wet and cool summer of 1956 Home Farm has begun harvesting corn crops on the average 12 days later than Middle Farm, and at Kelloe harvest usually begins from a fortnight to three weeks later than at Greatham.

The variation in intensity of insolation due to aspect of slope was well shown in a field (Grid Reference 454277) on Stob House Farm near Wolviston in August 1962, when a field of wheat was well ripened except for a distinct section on a north-facing dip, and a startling triangle in which the crop was green in the shadow of a small coppice.

In addition the heavier autumn rains on the Plateau hold back the sowing of wheat compared with the lowlands, and in spring the drilling of oats and barley is likewise delayed by the length of time snow may lie, giving rise to water-logged furrows that defy machinery.

The length of the growing season also depends to a large extent on altitude. If, as short term records suggest, the temperature on the Plateau (averaging 400 feet high) is as much as 2.5^{o}F. lower than on the Tees lowland, then the beginning of the growing season will be delayed by about a fortnight and the end will arrive about twelve days earlier on the higher ground. Such factors as these affect not only the germination of seeds sown in the spring but also the dates at which cattle can be taken from winter indoor quarters to pasture, and brought in once more in the autumn. Consequently the expense of winter fodder is greater on the higher farms.

One aspect of the regional climate which favours stock rearing is the overcast skies (the area received an average of only 5 hours sunshine in July from 1956 to 1961) and the relatively small occurrence of the drying out conditions produced by wind and sun as compared with other parts of the country. This may account for the more level and continuous growth of an important crop like grass through the summer months (1)

The effects on the soil of climatic differences between the Plateau and the Lowlands add yet another dimension to the assessment of the agricultural geography of the Hartlepools region. Due to the heavier rainfall on the Plateau losses of nitrogen must be significantly greater on the higher ground, although nitrogen losses are almost negligible from late November onwards when soil temperatures drop below 40°F. Lime is also lost more heavily than on the lowland and acidity tends to develop (2)

Historical background

The changes in farming in the last 200 years do not disguise the fact that the Hartlepools have always been surrounded by a district of mixed farming. An examination of documents left by the Baker family of Elemore Hall has been made by the present writer to establish the outlines of farming practice in this region in the eighteenth century. The documents, mainly farm leases, date from 1740 to 1793, and are now preserved in the Department of Palaeography at Durham. They provide an illuminating picture of farming in the 1700's at Layton, south of Sedgefield.

The farmers were tenants who were given leases for three, or more usually, six years, of what were surprisingly large farms. Cowley House, for example, had 352 acres, West Layton 262 acres, East Layton 210 acres, and Neasles 178

(1) Hanley, Boyd, and Williamson. An Agricultural Survey of the Northern Province, 1936.

(2) J. Webber, AGRICULTURE, 1960.

acres. The terms of the leases laid down schemes of husbandry which imposed a rigid three-year rotation of wheat, oats and fallow, which in some cases lasted at least twenty years, for example in Stanley Field on Cowley House Farm. The fallow had to be limed at the rate of "a chalder of burnt unfallen lyme for every acre". Three quarters of the dung available had to be laid and spread on pasture fields while the remaining quarter went on to the fallow tillage land.

Some of the fields were taken out of the tillage rotation earlier. The last crop, wheat in most cases, was undersown with "common hay-seed at 10 bushels to the acre", so that the field became meadow, remaining so for about ten years. Some fields at Cowley House Farm went from 1779 to 1792, inclusive, as meadow, after such a conversion (e.g. 24 acres of Barn Ling, 4 acres of Little Fallow, and 10 acres of Whinney Pasture), while 10 acres of the south-west part of South Ling, having been laid down to grass in 1774, were ploughed out again as early as 1778. The ploughing out of grassland was a year's work and was preceded by "paring and burning" the old turf.

Special penalties were imposed on any tenant who infringed the schedule of rotation. A lease by John Conyers to Wm. Hildra of land at or near Layton in 1743 specified that the rent would be increased by £5 per annum for every acre converted to tillage without the landlord's consent. Most of the leases examined by the present writer carried similar conditions. In this way the fertility of the soil was maintained and a balance preserved between permanent grassland and arable.

Apart from the crops already mentioned barley was grown, but usually only in the season after grassland had been ploughed out. Peas were rarely grown at Layton, and appear to have been an alternative in the rotation to oats.

Clover is first mentioned in the Layton leases in 1772, and this may be significant as marking approximately the date when clover was adopted in the district to extend the old three-year wheat-oats-fallow rotation to a four year scheme, namely wheat-oats-clover-fallow. Lord Ernle, states that in 1768 turnips and clover were still unknown in many parts of the country, and their full use appreciated only in the eastern counties (1). Obviously the Layton farmers were not backward in this respect.

A 1777 lease to George Mann, of Cowley House Farm, forbade him to sow potatoes (except for his own use), turnips (except for 6 acres), mustard, rape, clover, rye grass, or any sort of grass seed, without the consent of the landlord. Restrictions of this nature were cramping for a tenant who wished to improve or experiment.

By far the largest proportion of these farms, however, was under grass, the tillage comprising about one third of the acreage of farmland. Between 1771-1792, for example, Cowley House Farm, with a total area of 352 acres, had tillage varying from 114 acres (32%) at the lowest (in the years 1775-77), to 162 acres (46%) at the highest (in 1773). It is remarkable how these proportions of crop-land and grassland coincide with those of the present day on the same lands. In 1960 the parish of Sedgefield had 42% of its total farmland under cereal and root crops, and 58% under grass (temporary and permanent) although the three-year grass leys are so short that they are regarded as arable. On individual farms the same comparison can be made: West Layton Farm in 1962 had 37% of its acreage under crops other than grass, and Layton House Farm 41%.

Rents in this district rose steadily during the period 1740-92. Cowley House Farm, with 352 acres, had its rent increased from £135 per annum in 1754 to £170

(1) Lord Ernle. English Farming Past and Present.

in 1773, and to £185 in 1777. By 1774 most of the Layton farms were being let at rentals averaging ten shillings per acre.

Baker's wife Judith owned farms in her own right at Wingate Grange, and the carefully kept accounts she left show that the same type of mixed farming was practised here as in the rest of south-east Durham. A list of the stock kept on one of the farms at Wingate Grange in May 1783 includes the following:
9 horses (including 2 foals, a 2 year-old colt, an old horse, and 5 carthorses and mares);
6 milk cattle; 12 bullocks; 1 Galloway (bull?); 2 calves; 67 ewes, 2 rams, and 59 lambs; and 7 pigs.
By November of the same year the number of lambs had dropped to 9 and only 9 bullocks remained, evidence of a considerable meat trade. This particular farm, one of four at Wingate Grange, occupied 335 acres (compare the present Wingate Grange Farm of 370 acres) and was temporarily without a tenant, so that Judith Baker was having to farm it. In 1784 therefore she had the cereal crops valued as follows:

15½ acres	wheat	- 210	bushels at	3/6d.	bushel	£36. 15. 0
6¾ "	barley	- 140	" "	2/6d	"	£17. 10. 0
32¾ "	oats	- 780	" "	1/6d	"	£58. 10. 0

These were later sold at the following prices:

16 acres	wheat and 4 acres barley	£60
33 "	oats	£80
2 "	barley	£10

The yields were therefore as follows: wheat 13 bushels per acre; barley 20; oats 24.

The farms at Wingate Grange were not considered attractive, as the lack of tenants betrays, and the low yields of cereal crops may have been the explanation.

The rents in 1774 were:

Ralph Clark's Farm ...	525 acres	£145	or 5/6d. an acre.
Jonathan Moody's Farm ..	161 "	£63	or 7/9d. " "
Bryan Thompson's Farm ..	272 "	£70	or 5/2d. " "

This seems to indicate that the Wingate Grange farms were poorer than those at Layton, and this was before the working of coal made prospects for farming round Wingate even less attractive.

A brochure advertising for sale "the freehold Manor of Harte" in 1770 provides interesting evidence about the farming at the coast near Hartlepool. Out of 22 holdings, all worked by tenant farmers, the size distribution was as follows:

Less than 5 acres	5- 20 acres	20 - 50 acres	50- 100 acres	100 - 150 acres	150 - 300 acres	Over 300 acres
1	3	-	-	11	4	3

The three farms of over 300 acres were those lying along the coast immediately to the north-west of Hartlepool and two of them shared that great tidal flat known then as the Slyke and now (much reduced) as the Slake, while the other contained large stretches of sand dunes along the shore. The low rents of these larger farms confirms their inferior soils - John Dunn's farm, 551 acres, at £265. 10. 0 (or 9/7d an acre); Widow Wood's farm, 327 acres, at £141 (or 8/7d an acre); and John Mowbray's farm, 311 acres, at £190 (or 12/2d an acre).

On the other hand Thomas Chipchase's farm at Throston Grange, although only 171 acres in size, had no less than 154 acres of highly prized pasture (High Town Pasture) with 17 acres of meadow for hay, the rent being £170 (or 19/10d and acre). Anne Ovington's farm adjoining Hart on the south-east, with 177 acres, rented at £117 a year (or 20/- an acre). The lowest rents were paid for farms on the higher ground, Hart Moor yielding 5/7d an acre, and Naisberry Farm 6/4d an acre.

Some of these farms have survived intact in size and shape to the present time though roads, railways, housing development and industry have modified the pattern immediately adjacent to the Hartlepools towns.

Comparing the proportions of arable, meadow and pasture at Hart and at Layton for the year 1770 it is found that there is little difference.

	Hart	Layton
Arable	40%	40%
Meadow	11%	14%
Pasture	49%	46%

Individual farms varied in their proportions. For example at Layton the four farms were laid out as follows:

	Cowley House	Tones' Farm	Stabart's Farm	Dewell's Farm
Arable	36%	43%	43%	40%
Meadow	11%	27%	7%	14%
Pasture	53%	30%	50%	46%

At Hart there was more variation, ranging from a farm of 171 acres with no arable whatsoever to Whelly Hill Farm with 58% arable, and Throston Moor Farm with 59% arable.

While the farms examined above may be regarded as typical of the eighteenth century in south-east Durham, Arthur Young's account of the Earl of Darlington's farming practices at Staindrop shows what could be done on the larger farm equipped with more capital than the struggling tenants. On a holding of 1,080 acres, 40% of which was arable, 27% meadow, and 33% pasture, turnips proved so successful as a fodder crop that in 1769 20 horses, 20 draught oxen, 18 fatting oxen, 52 Scotch cattle of 35 stone each, and 2 milk cows were fed over the winter. This allowed extra quantities of manure to be accumulated for the benefit of the new season's crops. Cabbages were another fodder crop tried by the Earl of Darlington, beginning in 1766. Hollow-draining was introduced to remove superfluous water and many small inefficient closes were eliminated. Tp replace the common hayseeds with which meadow was sown every acre received 17 lb. of white Dutch clover, 14 bushels of clean hayseeds, 1½ lb. of rib-grass and 1½ lb, of trefoil (1).

When Young examines the farming typical of south-west Durham it becomes apparent just how poor and backward was that in the Hartlepools region. Yields of grain, for example, were 25 bushels of wheat per acre, barley 35 bushels, and oats about 40 bushels, almost double those of Wingate Grange quoted above. Clover, however, was not known (though since it was certainly known at Layton in 1772 it might be supposed that Young's own visit was not unconnected with its introduction) and the tenants were not allowed to plant potatoes. Much of the meadow-land hay was sold off the farms as the number of cattle over-wintered was small, and moreover those cows which were not being milked were fed only on straw. Sheep were kept in flocks of from thirty to 200 and their winter feeding consisted of grass, and in very bad weather poor hay. Oxen were kept to plough the arable lands but as the depth of ploughing was a mere six inches the extra strength of horses was not always required. On clay soils eight horses and eight oxen were needed for every 100 acres of plough land; on gravel four of each were sufficient. The amount that could be ploughed in a day was as little as three quarters of an acre, and when the preparation for the sowing of wheat included four ploughings several weeks' endeavour was necessary on all but the smallest acreages. An acre and a half were needed to feed a cow during the summer, and an acre would support five wethers, or four ewes with lambs.

(1) Arthur Young. Northern Tour, 1770.

Hutchinson's "History of Durham", written between 1784 - 1794, states that Hartlepool lay "in a great corn country". Much corn was exported as well as butter and cheese, from Stockton, at that time a flourishing port, while Hartlepool itself had decayed into a mere haven for storm-bound shipping. Elwick Hall parish was remarkable in having neither town nor village, cottage house for the poor, surgeon or apothecary, midwife, blacksmith, joiner, mason, bricklayer, cart or wheelwright, weaver, butcher, shoemaker, tailor, or barber, schoolmaster, alehouse, bakehouse, grocer, chandler, or corn-mill. It had only 18 farms and in the 170 years since there has been no change from this condition, the parish still being entirely rural and still having the same number of farms.

The next source of information about the farming in the Hartlepools region is Bailey's report to the Board of Agriculture in 1810 on the state of farming in County Durham. The rotation of crops changed in pattern towards the end of the eighteenth century when the improvements initiated by Jethro Tull, Lord Townshend, and Robert Bakewell - drilling cereals instead of broadcasting the seed by hand, growing turnips and clover to end the necessity of resting the soil by fallowing, and breeding livestock for special qualities - had spread and proved their worth even to the most cautious farmers. Bailey quotes the old rotations in Durham as follows:

1. Fallow		1. Fallow		1. Fallow
2. Wheat		2. Wheat		2. Wheat
3. Oats	OR	3. Peas	OR	3. Beans
4. Fallow		4. Oats		4. Fallow
		5. Fallow		

The new system introduced clover and turnips on lighter soils and clover alone on the heavier land.

Dry soils	Strong loams	Ochrey clay	Moory soils
1. Turnips	1. Fallow	1. Fallow	1. Fallow
2. Barley or Wheat	2. Wheat	2. Wheat	2. Oats
3. Clover (one or two years)	3. Clover (one or two years)	3. Clover and seeds for two years	3. Clover and seeds for two years
4. Oats (or wheat if barley after turnips)	4. Beans or Oats	4. Oats	4. Oats

Presumably the Hartlepools region followed the schedule for strong loams given above since Bailey's soil map of the county describes those in the south-east as fertile strong clayey loam, producing good crops of wheat, beans, clover and rich old grazing pastures, all the way from the River Tees to Hart village. Map 1 reproduces Bailey's map of the soil characteristics for the area under consideration. Of the "poor unfertile clay" which covered the area from Seaham to Trimdon and Grindon, Bailey says they produced "miserable crops of corn" and a "herbage that scarcely any kind of stock will eat unless compelled by hunger".

By now liming arable land was confined to the first year after the ploughing up of the old grass. Liming old arable had been found to be of doubtful value, and it was better to fold sheep in clover fields so that their droppings enriched the soil. The Hartlepools district was well known for its limestone quarries and limekilns, the poor state of communications necessitating local supplies.

Several farmers in the south-east of Durham were enterprising enough to pioneer new crops. Bamlett of Haverton Hill Farm, who came to his farm to find it overrun by wild oats, runch, and other weeds, planted corn in drills for eleven successive years and ended by producing as abundant crops as any in the county. These included oats, beans (sown in February or March and yielding

30-40 bushels to the acre) and clover. Ashworth led the way at Hutton Henry with a new continental swede known as ruta baga. Ralph Ord of Sands, near Sedgefield, had a top soil especially suited to carrots but about 1780 he changed to ruta baga when he found that the new crop fed his young rams just as well. John Ovington of Hart grew a type of sweet-smelling yellow-flowered clover called melilot for his cattle.

Wet soils, always lagging behind in the stages of cultivation, were usually dry enough by June for a crop of rape which was eaten by sheep in September, after which these soils could be ploughed for the following season's wheat. Crops like these were slowly being recognised as better for the land than bare summer fallowing.

Bailey, like Young, condemns the outmoded practice in the Vale of Tees of stacking hay in the middle of a field and foddering cattle all over the field during the winter. To give various fields the benefit of dunging the haystack was moved from year to year. Nevertheless there were some first-class grazing pastures around Billingham and on Skerneside, where stock could be fed from early May to late September or early October, at the density of one cow to an acre, or three sheep to two acres. On newly sown grass at Wynyard, Sir Henry Vane Tempest was grazing eight sheep per acre during the first year, and three per acre in the second year. It was generally reckoned that on these fine pastures a two year old bullock would gain fifteen stones in twenty weeks from May Day, i.e. 10½ lb. per week.

The arable land in the far south-east corner of the county was also reckoned to be in a high class, and Bailey cites Saltholme as ranking with the most fertile lands in the county. On the 60 acres of alluvium next to the River Tees enclosed by Bamlett of Haverton Hill in 1800 the "most luxuriant" crops were taken for seven years, including rape, oats and barley.

South-east Durham, however, became most renowned for its Teeswater cattle, a breed popular throughout the country. Michael Dobinson, a Sedgefield farmer, gradually improved this shorthorned animal with Dutch bulls till cattle of great size and weight were produced. The Colling brothers who were also associated with this improvement at the end of the eighteenth century farmed near Darlington. The celebrated Durham Ox, which travelled through England in a specially constructed carriage from 1801 to 1810, convincing thousands of farmers of the virtues of selective breeding, was one of these improved cattle. Descended from the Ketton herd of Charles Colling, this prodigious beast weighed 34 cwt. Its qualities made its offspring, in the words of Lord Ernle, "the best rent-payers, both as milkers and meat producers". The time taken to fatten up cattle for slaughter was shortened by these experiments from five or more years to under three years. The Galloway bulls from Scotland disappeared from Durham farms in favour of the Shorthorn. Prizes offered by the Durham Agricultural Society, formed in 1793, encouraged the efforts of the livestock breeders, and sheep were similarly improved, the crossing with the Leicester breed being most popular, Ewes were giving more and stronger lambs. Cleveland Bays, the powerful plough-horses for which south-east Durham was famed, were employed especially on the more intractable soils, but other evidence (e.g. the 1870 census) suggests that Bailey appears to err on the side of optimism when he states that two horses were generally kept for every 40-45 acres of ploughing (in 1870 most parishes kept one horse for every 15-20 acres of ploughland).

Having a rather sparse population the Tees lowlands could export much of their agricultural produce, and large numbers of livestock were regularly driven south to Wakefield and Skipton, for example, to supply meat to the manufacturing districts of Yorkshire and Lancashire. Local markets were held on Mondays at Darlington and on Wednesdays at Stockton, and apart from livestock, corn, pork, hams, butter and cheeses were offered for sale.

THE 1801 CROP RETURNS

Fragmentary evidence of crop distributions is available from the census carried out in 1801 on a parish basis:

Parish	Acreage	Wheat	Barley	Oats	Rye	Potatoes	Peas	Beans	Turnips & Rape
Castle Eden	1,630	89	4	94	-	2	2	2	10
(Yield in bushels)		15	25	20					
Easington	12,400	1,270	48	1,325	1	43	66	16	157 (no rape)
		13/14	20	20			13	13	
Elwick Hall	4,150	533	3	455	-	2	-	-	20
		15		15		100			
Greatham	2,640	342	36	215	-	-	101	43	Some turnips
Hart	8,280	883	67	919	patch	14	51	20	97 (no rape)
		20	40	30+					
Monk Hesleden	6,060	551	32	512	-	17	15	58	60
Wolviston	2,390	518	23	265	-	20	132		33
Hartlepool	840	-	-	-	-	2	-	-	-

These show Wolviston, on lighter well-drained soils, with the greatest proportion under wheat (22%), while Greatham and Elwick Hall have 13% of their total acreage under wheat, Hart 11%, Easington 10% and Monk Hesleden 9%. The same parishes had about 10% of their land under oats, but less than 1% under barley. While peas and beans occupied 4-5% of the land in the lowland parishes of Wolviston and Greatham, neither took as much as 1% in the higher areas to the north. Turnips were grown on only 1 acre per 100, potatoes were even less important, and while rape is grown in some parishes clover is not mentioned at all. The fields round the ancient port of Hartleppol were all under grass, and it may reasonably be assumed that the other parishes had vast extents of grassland and even waste in the less accessible districts.

In the middle of the nineteenth century Caird's journeys round England shed more light on the lack of progress on the heavier soils of south-east Durham, where fallowing was still the practice although it had disappeared over most of the country. Farmers were encountered who were prejudiced against innovations, and their poverty was partly the result, partly the cause, of declining yields. Much land needed draining, and investment many of the poorer tenants could not afford. No manures were purchased and few root crops were grown, so that livestock raising was handicapped. On the brighter side Caird quotes the better soils along the coast "with crops of excellent potatoes, turnips and other vegetables". Here the usual rotation was clover, potatoes, wheat, turnips, potatoes, wheat, (undersown with seeds). Crops were generally heavy and the system was recognised as much more profitable than the old two-crop and fallow schedule. Improvements were still being made in livestock breeding and draining heavy land by Lord Durham and Lord Londonderry, whose capital was being rapidly increased at this time by the prosperity of their coal mining interests.

The numerous colliery villages which were springing up in mid - and south Durham provided a significant new market for meat, milk, butter, cheese, bread, and vegetables. The pits, largely dependent on ponies for underground haulage, bought large quantities of hay for animals which never saw green fields. A parallel development of the larger urban centres created a heavy demand for fresh milk and market-garden produce.

Much of what Caird and Bailey said about farming in Durham is confirmed by Bell in his prize essay for the Journal of the Royal Agricultural Society written in 1854. Concerning the quality of the soils, Bell, as a land agent, looks to the rentals as his guide. In the Hartlepools region "the easternmost portion of which is a mellow loam", there were about 13,000 acres of farmland "extending from Greatham and Claxton round by Newton Bewley and Wolviston to Port Clarence, worth on a general average of the whole 20s. per acre". Immediately west of this "we have the Elwick district, where a large proportion of the land lets on an average of 19s.; then Morton, averaging about 21s.; next (keeping direct west) we have Hollin Carr and other grounds, a great deal of which is not worth more than 10s. South-west of them we have the Sedgefield district, let on an average of 25s., most of it strong but friable - good potato and turnip land, and very capable of being raised to a higher average by judicious draining".

Draining the land, a most necessary practice on the clay-based soils of the Hartlepools region, had obviously gone a long way by the middle of the nineteenth century. Although not mentioned in the Baker family leases to tenants at Layton, drainage expenses were a common item in leases in 1854. Bell states that most tenants were bound "to pay, in addition to the rent agreed upon, 5% on the landlord's outlay in draining any part of the farm".

Leases at this period still contained clauses which laid down schedules of husbandry. Permanent grassland, especially, was preserved intact by this means as the tenant was forbidden to plough it out. The frequency with which small tenant farms changed hands led, in Bell's opinion, to backwardness in improving since there was little incentive for a short-lease tenant to put up buildings, to drain wet fields, or to nurse the fertility of the soil when he could so soon be dispossessed.

Since Bailey's account of agriculture in the late eighteenth century a new factor had come into being which was greatly to affect farming in the Hartlepools region. A new town had in fact come into existence on the opposite side of the harbour and mud-flats to the ancient port of Hartlepool. In 1831 Hartlepool was a decayed harbour village of only 1400 inhabitants, while across the **Slake** to the south lay Stranton, a farm village with under 400 people. The railways made all the difference, bringing a new trade in coal for London, and rival companies ensured that the shelter of Hartlepool Bay was to be put to better use. First a line was laid from the newly developed coal mines in the Spennymoor-Ferryhill-Wingate district to Hartlepool; experts of coal began in 1835, and imports of Baltic timber began in 1840. A rival line from the same Spennymoor-Ferryhill pits but reaching Hartlepool Bay from the south via Billingham led to the creation of an entirely new port with artificial docks dug out of the Slake, and named at first West Harbour, then later West Hartlepool. By 1854 the new settlement had 7,500 inhabitants and was growing fast, with three iron works, a shipyard, a slaughter house and three corn mills. A re-orientation of marketing of farm produce took place in the surrounding rural areas to cater for the new booming ports on the Bay. Potato growing became common near the growing settlements; hundreds of Irish labourers were employed to dig the new docks and many of them stayed on to work in the foundries and iron works, creating a substantial demand for potatoes, flour and meat.

Bell quotes yields per acre as follows:

Wheat	On the best lands of the county,	200 to 30	bushels	per	acre.
Barley	ditto	36 to 42	"	"	"
Oats	ditto	40 to 60	"	"	"
Hay	ditto	1½ tons per acre.			

Bell wrote at a time which Lord Ernle has called "the golden age of English agriculture", referring to the ten years 1853-62, when the seasons were "uniformly favourable", and the harvests good, fair, or abundant. There can be little doubt that in the Hartlepools region the combination of good weather, an expanding and conveniently nearby market, and the continued improvement of the physical conditions of the soil by draining saw arable farming at its peak.

The picture presented by the first official statistics whose collection began by the Board of Agriculture in 1866 is therefore one which was destined soon to change under the impact of the falling prices of agricultural products resulting from the rapid growth of imports. The initial collection of these agricultural returns was so haphazard that for many parishes in the Hartlepools region they do not exist. Moreover, some of these parishes have changed in size as large ones like Hart and Billingham were divided into smaller parishes, so that the agricultural character of a parish is liable to alter from one census to another. Another weakness of the parish statistics is that certain items like rough grazing acreages were not included in the census at first, while although the number of persons occupying land is given, the number of farm workers is not included until after the 1914-18 war. Likewise the numbers of livestock are collected in an increasingly refined manner as time goes on so that the earliest statistics are vague by comparison with the present day intricate classification. As the census was not made compulsory until 1926 (with the exception of the period 1918 to 1921) where certain farmers did not make returns estimates had to be made and this may lead to some inaccuracy in the parish totals.

The proportions of farmland under any given form of use, however, are probably reasonable accurate, assuming that any areas not covered by the census are perhaps omitted in a similar proportion. Absolute figures for any parish are almost impossible to establish because as farms change hands and a new occupier may have farms in more than one parish, he may include all his land in the same return. In any case some farms lie on both sides of a parish boundary but are counted as part of that parish in which most of their area lies. Again, to disguise individual holdings, the Ministry of Agriculture must amalgamate the statistics of parishes with less than five holdings with those of an adjoining parish.

The 1870 figures show farming at its nineteenth century peak, with the arable acreage far greater than in 1770:

Parish	Agricultural acreage	Arable acreage	% Arable
Hart	6,783	4,608	68
Stranton	4.707	3,748	80
Elwich Hall	3,015	1,918	64
Greatham	2,640	1,713	65
Billingham	7,057	4,431	63
Monk Hesleden	5,358	3,183	59
Castle Eden	1,456	653	45
Grindon	3,091	1,733	56

The acreage was made up in detail as follows: (percentages of total farmland)

Parish	Wheat	Barley	Oats	Potatoes	Legumes	Roots	Fallow	Temp. Grass	Permanent Grass
Hart	19	4	11	1	4	7	11	10	32
Stranton	22	6	10	5	8	6	10	11	20
Elwick Hall	16	4	10	1	4	5	12	10	36
Greatham	18	6	8	4	5	5	11	7	35
Billingham	17	3	9	2	5	4	10	12	37
Monk Hesleden	14	3	14	1	2	7	8	9	41
Castle Eden	7	2	9	3	1	9	2	11	55
Grindon	11	4	10	2	3	3	8	14	44

Among minor crops making up the arable acreage were flax (21 acres at Hart) and cabbages (7½ acres at Stranton; 1¾ acres at Greatham). The legumes grown in this district were beans (120 acres at Hart; 64 at Elwick Hall; 256¼ at Billingham; 94¾ at Stranton; 59½ at Greatham; 52½ at Monk Hesleden; 80 at Grindon), peas (86½ acres at Hart; 25½ at Elwick Hall; 41¾ at Monk Hesleden; 9 at Castle Eden; 12 at Grindon; 92¾ acres near Billingham; 80¼ acres at Stranton; 4½ acres at Greatham) and vetches (50 acres in Hart parish; 44 acres in Elwick Hall parish; 16¼ acres in Billingham parish; 198 acres in Stranton parish; and 62¼ acres in Greatham parish).

The combined effects of draining, new implements, better communications, the growing urban market and the accompanying higher prices for agricultural produce had halved the acreage of permanent grass as compared with 1770. The new arable was now growing barley, potatoes, legumes, flax, turnips and grass-clover mixtures, but the practice of leaving part of the tillage land as bare fallow was still as prevalent as a century earlier, the proportion remaining at just over a tenth of the total farmland. The absence of chemical fertilizers and the drain of fertility by cereal crops and potatoes made fallowing a necessity.

The situation in 1870 with regard to horses had not changed since Bailey first reported in 1794. In the parish of Hart 234 horses were employed, an average of one for every 20 acres of ploughland, and this was typical of the Hartlepools region. While the parish of Elwick Hall had one horse for every 22 acres, Greatham one to 18 acres, Grindon one to 18 acres, and Monk Hesleden one to 16 acres, Castle Eden parish was exceptional in requiring one horse to every 10 acres of ploughland, perhaps a reflection of heavier soils.

The writer felt it desirable to compare the parishes whose statistics are available for 1870 on the basis of the intensity of stocking on the farms. Since the various classes of livestock eat different quantities of grass in a given period it is necessary first to equate their grazing requirements for the time of year when the agricultural census is taken. Wilfred Smith's grazing index (1), calculated in the 1930's, has been used for this purpose. The unit of the index

(1) W. Smith. The Agricultural Geography of the Fylde. GEOGRAPHY, 1937.

this intensity of grazing. Looking more closely at the stock figures it is clear that the lower stocking intensity in these two parishes corresponds to fewer milk cattle being kept per unit area, while their sheep densities, surprisingly enough, are also on the low side.

Animals per 100 acres of total farmland, 1870

	Hart	El.Hall	Billm.	Strn.	Grhm.	M.H.	C.Eden	Grindon
Dairy Cattle	4.6	3.6	4.4	4.3	4.5	3.1	6.0	2.5
Other cattle over 2 years	4.2	3.8	10.0	3.2	5.1	5.3	6.0	4.4
Sheep	25.4	22.9	40.6	21.5	27.0	36.4	37.6	23.6

The relative remoteness of the parishes of Grindon, Elwick Hall and Monk Hesleden from the chief markets for fresh milk may be blamed for the weak position of dairying in these districts. In 1870 the coal underlying Monk Hesleden had not been exploited and there were farms where now there are bustling mining villages. The coast road had not yet been built and most of the parish's 57 farm holdings lay too far from the coast railway to deliver milk daily. Elwick Hall farms lay just beyond the limit of fresh milk deliveries to the Hartlepools towns, and many of them made butter. Those farms immediately on the border of fresh milk access to the Hartlepools, that is those just west of Elwick and Dalton Piercy, vied for the contract for supplying milk every day to the Workhouse at West Hartlepool. A journey by horse and cart to deliver this involved a six mile haul and milking at 2.00 a.m. Grindon parish occupied a similar position with regard to the Stockton market for milk, and, moreover, was dominated by the 900 acre farm-estate of the Marquis of Londonderry, always a beef farm.

Before leaving the 1870 crop statistics comment is necessary as regards the potato acreages. While the parish of Stranton devoted 5% of its farmland to this bulky, labour-consuming crop, and Greatham 4%, the parishes away from the immediate urban perimeter devoted only 1-2%. Castle Eden, with its colliery villages close by, had 3% of its farmland under potatoes, a significant pointer to the importance of access to markets.

The size of farms also varied with distance from the urban centres; the towns were surrounded by groups of smaller holdings, whereas Elwick Hall contained predominantly larger farms, as the following figures show:

Parish	Number of farms					Total farmland
	Less than 5 acres	5 - 20 acres	20 - 50 acres	50 - 100 acres	Over 100 acres	acreage
Hart	15	18	5	6	30	6,783
Elwick Hall	2	-	-	3	15	3,015
Billingham	6	12	9	17	25	7,057
Stranton	8	15	10	4	18	4,707
Greatham	17	11	4	4	12	2,640

There had been a decrease in the number of small farms due to absorption in the period between 1854 and the 1870's, and this was regarded as a cause of progress because many of the small estates had become neglected (1). In the mining districts, however, the smallness of farms was a comparative advantage because the farmer's family with a couple of hired lads and the occasional services of women was adequate for the work of a 100-150 acre farm producing mainly milk, butter and poultry.

Written in 1879, John Coleman's account gives an insight into the details of farming in the S.E. Durham area. On Mr. Anthony Dobson's farm at High Grange, Wolviston, rented from both the Dean and Chapter of Durham and the Ecclesiastical Commissioners, (580 acres), the acreage of corn had been cut in face of the

(1) Royal Commission on Agriculture: Report of Assistant Commissioner John Coleman on Durham. Comnd. 2778. 1881. Page 215-234.

prevailing low prices. On 40 acres of heavy soil, after fallowing and liming for wheat, 4 cwt of dissolved bones were applied in the spring, and the wheat was sown with grass seeds. After two years the grass was dressed with 5 cwt. of ground bones and 1 cwt. of nitrate of soda. Lime was very expensive at this period and as most farms were tenant-occupied grassland steadily deteriorated from the need for drainage, lime and manure. Mr. Dobson's farm had been drained, it is interesting to note, partly at government expense.

Saltholme Farm at Teesmouth again attracts the attention of the itinerant expert. Coleman reported that it was owned by the Dean and Chapter and farmed by Mr. Earles. Its 1,100 acres included 800 acres of grass, and some of the arable was being laid down to grass in the 1870's. Although the land was not suitable for breeding either cattle or sheep, 1,000 old sheep were wintered on the marsh, fed partly on cake and beans, and an experiment in 1878 when 200 ewes were kept had been a success, yielding 350 lambs whose limbs had been unaffected by the wet land. 150-200 cattle were bought in autumn, wintered on hay and cake, and finished on grass. By the liberal use of oilcake each acre of grazing would support a sheep, two acres a beast. Foot-and-mouth disease and pneumonia caused heavy losses in some years.

Mordon Carrs are referred to as an area much improved by the drainage schemes initiated by the owners, Lord Boyne, Lord Eldon, Mr. Surtees and others, at the expense, however, of flooding an area downstream at Great Burdon because of the increase in flow of the River Skerne.

The importance of the collieries as a market for farm produce is shown in Coleman's report on the farms on the Magnesian Limestone. Seaham Colliery, for example, needed hay and oats for 700 horses and ponies, each animal consuming 98 lb. of corn and 84 lb. of hay per week.

The Report of the Royal Commission on Agriculture (1879) contains a letter from Mr. Menter, agent for the Ecclesiastical Commissioners at Darlington, which reveals the distress in the region following the dismal weather of the 1870's: "Speaking generally of this North-eastern district, there has been no good harvest since 1874, and hardly an average one during that time, six bad years in succession have ruined many farmers, and swallowed up the capital of all of them, the lands are unclear, as season after season it has been impossible to fallow them properly, and they have not been farmed as in previous years".

"Though the bad seasons have primarily brought about the agricultural distress, some of it is due no doubt to the large supplies of corn and meat now imported into the Kingdom, and which year by year is constantly on the increase".

From the late 1870's when the gloom of agricultural depression thickened as a result of the fierce competition of cheap foreign grain, meat, and dairy produce, the arable acreage shrank as the poorer soils passed out of cultivation and became permanent grass. The worst season for wheat prices was 1894-95, when an imperial quarter fetched only 23/-, the lowest price for 150 years, and after this a painfully slow recovery took place. Pringle (1) quotes a land agent responsible for farms in South Durham for the opinion that "our strong arable land in this northern district is not adapted for corn, unless in very fine seasons, and that such as is not capable of growing turnips should be laid away to grass, which it will undoubtedly grow if attended to and followed up. The production of dairy produce and meat is more profitable than corn".

At the time of Pringle's visit (1895) the arable land left looked to be in good heart and there seemed no difficulty in finding tenants for medium-sized farms, now that prices and rents were so low. "The greater proportion of grass the more to be desired is the farm. More than ever is it the case that bad land

(1) R.H. Pringle. Royal Commission on Agriculture. Report on South Durham, 1895.

is at a discount. Within the last few years some of the strongest land has been taken by substantial tenants at very low rents, and is being gradually laid down to grass. Fields laid down in bad order or allowed to tumble down have been broken up and thoroughly well fallowed, preparatory to a fresh and suitable re-seeding. In some cases drainage has been done, and the use of basic slag has become almost general".

The 1901 parish statistics for the Hartlepools region have been extracted and the arable percentages calculated to show the extent of the changes since the arable peaks of 1870:

Parish	Agricultural acreage	Arable acreage	% arable of all farmland	% in 1870	% decline from 1870 arable
Hart	7,061	4,088	58	68	10
Elwick Hall	3,517	1,415	40	64	24
Stranton	1,210	837	69	80	11
Greatham	2,793	1,620	58	65	7
Cowpen Bewley	2,123	487	23)	N.A.)	
Newton Bewley	1,511	793	53) 40	N.A.) 63	23
Wolviston	1,926	710	37)	N.A.)	
Billingham	2,539	1,226	48)	N.A.)	
Seaton Carew	2,199	1,499	68	N.A.	
Brierton	702	483	69	N.A.	
Sheraton	2,178	674	31	N.A.	
Monk Hesleden	5,877	2,399	41	59	18
Castle Eden	1,433	435	30	45	15
Grindon	2,974	1,150	39	56	17
Seaton	2,191	1,492	68	N.A.	

Stranton was being rapidly built over at the end of the nineteenth century by the expanding town of West Hartlepool, which accounts for the large fall in the area of agricultural land from 4,707 acres in 1870 to 1,210 acres in 1901. Elwick Hall, Monk Hesleden and Greatham parishes were now recording more agricultural land, but this was probably due to an increase in the number of farmers who sent in returns rather than to any real extension of the land under cultivation. The building of the Cerebos salt works at Greatham in fact took away farm land.

Grindon, Castle Eden, Monk Hesleden and Elwick Hall, on the higher ground inland, and with heavier wetter soils, were stricken worst by the fall in grain prices and their arable acreages decreased more than those in the lowland parishes with the notable exception of Billingham. Here the old parish had been split into four new parishes, including the low-arable Cowpen Bewley area with its marshes, and Wolviston with a large proportion of heavy soils west of the Stockton-Sunderland road. It is tempting to assume that the greatest decrease in the arable in Billingham parish took place on these poorer soils. Meanwhile the loams of the Hart to Wolviston belt stood the depression remarkably well, retaining their arable.

This comparison of changes in the arable acreage is misleading, however, in so far as the amount of temporary grass, which increased remarkably after 1870, is classed as arable land. Although sown as a temporary measure it remained in grass as prices continued to fall, and gradually came to be recognised as permanent grass. The extent of change is thus masked so that a comparison of the 1870 and 1901 tillage acreages is more revealing. Even here, however, there are complicating factors because the acreage of fallow land had decreased strikingly, so that the remaining tillage area had become more productive.

The 1901 acreage was made up as follows: (percentages of all farmland)

Parish	Wheat	Barley	Oats	Potatoes	Legumes	Roots	Fallow	Temporary Grass	Permanent Grass
Hart	4	9	12	4	2	7	4	15	42
Elwick Hall	5	5	9	1	2	6	4	9	60
Billingham	7	4	9	3	1	4	4	17	52
Stranton	5	10	13	10	1	7	3	19	31
Greatham	8	6	12	3	2	5	7	12	42
Seaton Carew	7	6	19	5	2	7	4	19	32
Seaton (1)	9	4	14	6	2	8	3	20	32
Brierton	8	7	15	2	-	8	3	24	31
Cowpen Bewley (2)	3	-	6	0.5	0.5	2	1	9	77
Newton Bewley (2)	9	6	10	3.5	3	7	4	10	47
Wolviston (2)	5	4	8	1	1	3.5	4.5	10	63
Sheraton (2)	3	2	6	1	1	6	-	12	69
Monk Hesleden	2	5	10	2	1	6	2	13	59
Castle Eden	-	6	7	2.5	1	6	1	7	70
Grindon	3	3	8	1	1	3	4	16	61

N.B. The Billingham figures are not comparable with the 1870 figures owing to changes in parish boundaries. A comparable set of figures is obtained by amalgamating totals for Billingham, Cowpen Bewley, Newton Bewley, and Wolviston thus:

6	3	8	2	1	4	3	12	60

Whereas wheat, the leading tillage crop in 1870, had shrunk in importance from occupying about a fifth of the agricultural land to a mere twentieth in most

(1) Seaton figures are for the year 1903, the nearest year available.

(2) Figures for 1902, the nearest year available.

parishes (3), barley had held its own, and even expanded relatively in Stranton (West Hartlepool) and Hart, while oats had done even better, expanding in the parishes of Stranton, Greatham, and possibly in Brierton, Seaton Carew and Seaton. This was a result of the fall in wheat prices and perhaps also of the encroachment of the built-up area, since it is safer to grow cereals next to housing estates than to keep animals.

A parallel development was the increase in the share of the acreage of potatoes, doubled in the case of Stranton, and quadrupled in that of Hart. Urban demand and the better soils of these town-fringe parishes were responsible for the increase. Greatham, whose potato acreage decreased slightly, had been even more affected by the growth of the Hartlepool's needs for fresh vegetables, and had a significant acreage under market gardens by 1901. Land which might otherwise have been sown with potatoes was growing soft fruits and greens, and hothouses had appeared.

Beans were declining as a fodder crop at the end of the nineteenth century since the increase in the grass crop acreage allowed larger quantities of hay to be made.

All classes of livestock increased in numbers between 1870-1901, especially dairy cattle and sheep.

(3) Wheat reached its lowest acreage in Co. Durham as a whole in 1904 - 7,000 acres.

Parish	Animals per 100 acres of total farmland						
	Dairy cattle		Beef cattle		Sheep		
	1870	1901	1870	1901	1870	1901	
Hart	4.6	6.9	4.2	3.2	25.4	34.7	
Elwick Hall	3.6	3.5	3.8	4.2	22.9	38.3	
Billingham	4.4	5.6	10.0	6.4	40.6	47.1	(including C.Bewley, N. Bewley and Wolviston)
Billingham (alone)	N.A.	5.9	N.A.	6.4	N.A.	38.6	
Cowpen Bewley	N.A.	4.9	N.A.	17.6	N.A.	38.6	
Newton Bewley	N.A.	7.0	N.A.	4.8	N.A.	27.6	
Wolviston	N.A.	4.9	N.A.	3.7	N.A.	48.1	
Stranton	4.3	7.6	3.2	2,3	21.5	25.4	
Greatham	4.5	5.4	5.1	5.2	27.0	34.2	
Monk Hesleden	3.1	4.1	5.3	6.4	36.4	65.5	
Castle Eden	6.0	8.7	6.0	11.2	37.6	48.2	
Grindon	2.5	6.8	4.4	6.8	23.6	99.9	
Seaton Carew	N.A.	5.8	N.A.	4.5	N.A.	37.8	
Seaton	N.A.	6.0	N.A.	6.2	N.A.	44.4	
Brierton	N.A.	4.0	N.A.	8.8	N.A.	80.6	(Note: Beef cattle include only cattle other than dairy over 2 years).
Sheraton	N.A.	2.7	N.A.	9.4	N.A.	101.7	

Some specialization is by now evident in that parishes such as Hart and Stranton, with easy access to the milk market provided by the Hartlepools, increased their dairy herds while cutting their numbers of beef cattle, while parishes such as Sheraton and Cowpen Bewley, with little hope of competing in milk production, kept up to three times as many beef cattle as dairy cattle. While all parishes showed increases in their flocks of sheep, the expansion was only marginal around the towns (cf. Stranton and Greatham) but on a large scale in Grindon parish where numbers more than quadrupled, and in Monk Hesleden and

Elwick Hall both of which almost doubled their sheep numbers.

Despite the heavier stocking of the farms the increase in the acreage of grazing had been proportionately greater with the result that in most parishes the animals had more space. In Castle Eden and Grindon, however, the stock expansion had exceeded the increase in grass with a consequent increase in the intensity of grazing. Using the same grazing indices as for 1870 the number of acres of grazing land per grazing unit has been calculated as follows:

Parish	Acres of grazing land per grazing unit			Parish
Hart	2.13		1.71	Castle Eden
Elwick Hall	3.43		1.74	Grindon
Billingham	1.95	(Billingham alone 1.91)	1.39	Seaton Carew
Stranton	2.09		1.11	Seaton
Greatham	1.57		1.53	Brierton
Monk Hesleden	2.36		2.80	Sheraton
Cowpen Bewley	2.02		1.92	Wolviston
Newton Bewley	1.88			

Note: Billingham figures include C. Bewley, N. Bewley, and Wolviston.

Although the sizes of farms are not given in the 1901 agricultural census returns it is worthy of note that in Stranton, the parish in which the new town of West Hartlepool had grown up, urban development had gobbled up a vast proportion of agricultural land. In 1870 there were 55 holdings on 4,707 acres, an average farm size of nearly 86 acres; by 1901 this had been reduced to 23 holdings on 1,210 acres, an average farm size of only 53 acres.

Parish	Number of holdings		Average size of holdings in acres	
	1870	1901	1870	1901
Hart	74	77	92	92
Elwick Hall	20	21	151	168
Greatham	48	40	55	70
Billingham	69	89	102	91
Stranton	55	23	86	53
Monk Hesleden	57	60	94	98
Castle Eden	31	20	47	72
Grindon	22	15	141	198

At Greatham, though the number of holdings had decreased, this seems to have been the result of the amalgamation of farms into larger sizes, and the same is found in the parishes of Grindon and Castle Eden. In Billingham parish the reverse process had been at work and the number of holdings had increased so much that although the agricultural acreage was up by about 1,000 acres the average farm size went down by 11 acres.

A description of farming improvements at the turn of the century (1) stresses the debt owed to artificial manures and new machinery. Roots benefitted most from synthetic fertilizer, while basic slag was found invaluable for pasture and meadow hay on heavier soils. Lime was being used less extensively than formerly, and Magnesian Limestone was regarded as being too rich in magnesia and had fallen into disrepute. Oil-cakes of all kinds, mostly manufactured at Hull, were largely used for fattening animals and dairy cows, and added greatly to the value of the manure.

Corn drills were in common use, although till the 1880's grain crops had been generally sown broadcast. Reaping machines had become general early in

(1) Victoria County History of Durham, 1907, Vol. 2, P. 362.

the 1870's, but binders were later, coming in a great rush about 1898. Potato diggers and manure distributors were also in common use by 1900, but a milking machine in use at a large dairy farm near Sunderland in 1907 had not yet received general approval.

Yields had been raised on the milk farms from about 400 gallons per cow per year in 1867 to 550 gallons in 1904, according to a paper read to the Royal Statistical Society by R.H. Rew in 1904. Milk consumption had also increased from about 11 gallons per head of the population annually in 1868 to nearly 16 gallons in 1904.

Self-contained milk farms were few, however, and it was the common practice in Durham to buy non-pedigree Shorthorn cows at 6 to 8 years old, milk them till dry, then fatten them off, a system which gave 750-800 gallons per cow with liberal feeding. Other milk producers bought cows a year or two younger and bred from them. Milk retailed in 1907 at 4d. per quart, and its profitability was increasing the number of milk farms in the more populous districts.

When prices began to recover the lost ground in the early part of the twentieth century the conversion of arable into grassland ceased. The 1912 statistics for parishes in the Hartlepools region reveal slight decreases in the acreage of permanent grass in the upland parishes of Sheraton and Elwick Hall in favour of corresponding increases in the acreage of temporary grass; on the lowland parishes of Seaton Carew, West Hartlepool (Stranton) and Hart a small amount of temporary grass had become permanent grass. The area of fallow continued to dwindle in all parishes, while potatoes and barley made marginal gains in acreage. Seaton Carew farms had followed the example of their urban neighbours in West Hartlepool and had more than doubled the proportion under potatoes from 5% to 11.4%. The other parishes nearest the West Hartlepool market had also increased their potato acreages: Hart to 5% (though as the new division of the old 7,000 acre parish of Hart into the smaller parishes of Hart, Elwick, Dalton Piercy, Nesbitt, Thorpe Bulmer and Throston shows, some parts of this former parish had a higher percentage of land under potatoes - Hart 7%, Throston 7%, Seaton 9%; so that the contrast in this respect between the urban and rural parishes is maintained.

1912 crop acreages for parishes in the Hartlepools region

Parish	Agricultural acreage	Arable acreage	% arable	% change since 1901	% change since 1870
Hart	2,223	1,369	62		
Elwick	1,436	664	46		
Dalton Piercy	930	439	47		
Throston	1,118	726	65		
Nesbitt	220	97	44		
Thorpe Bulmer	698	340	49		
(above combined)	6,625	3,635	55	-3	-13
Elwick Hall	3,324	1,374	41	+1	-23
Billingham	2,514	1,168	46		
Cowpen Bewley	2,072	463	22		
Newton Bewley	1,535	784	50		
Wolviston	1,703	629	37		
(above four combined)	7,824	3,044	39	-1	-24
West Hartlepool (Stranton)	1,114	722	65	-4	-15
Greatham	1,940	1,123	58	0	-7
Seaton Carew	1,989	1,258	63	-5	N.A.
Brierton	695	472	68	-1	N.A.
Sheraton	2,044	723	35	+4	N.A.

Parish	Agricultural acreage	Arable acreage	% arable	% change since 1901	% change since 1870
Bishopton	3,846	1,566	41		
Seaton	1,280	882	69	+1	
Claxton	865	485	56		
Sedgefield	5,003	1,835	35		
Trimdon	2,089	754	36		
Embleton	2,858	690	24		
Shotton	2,780	1,139	41		
Wingate	3,488	1,138	33		
Bradbury	1,853	391	21		
Mordon	1,509	367	24		
Monk Hesleden	1,971	854	43	+2	-16
Foxton/Shotton	1,494	667	45		
Castle Eden	1,436	420	29	-1	-16
Fishburn	1,983	854	43		
Butterwick	1,437	428	30		
Hutton Henry	1,808	917	51		
Grindon	2,504	802	32	-7	-24
Bishop Middleham	1,723	830	48		

N.B: Greatham and Claxton were formerly one parish. Monk Hesleden was divided into two to create Shotton parish.

The loss of agricultural land to the builders was most noticeable in the first decade of the century in the parishes of Seaton, down from 2,191 acres to 1,280, and Monk Hesleden (with Shotton) down from 5,877 acres to 4,751.

These acreages were made up as follows: (as percentages).

Parish	Wheat	Barley	Oats	Potatoes	Legumes	Roots	Fallow	Temp. Grass	Perm. Grass
Hart	9	11	12	7	1.2	8.5	0.5	11	38
Elwick	4	10	9	3.5	0.5	6.5	1.5	11	54
Dalton Piercy	3	8	11	3.3	1	8	1.5	12	53
Throston	7	12	12	7	-	9	2.5	12	35
Nesbitt	3	9	8	4	3	7	-	12	56
Thorpe Bulmer	5	8	9	4	2	6	3	12	51
(above combined)	6	7	11	5	0.7	8	1.5	11	45
Elwick Hall	6	4	8	0.6	1.8	6	3	12	59
Billingham	6	6	11	4.5	0.6	4.5	2.5	11	54
Cowpen Bewley	3	0.3	7	1.2	0.3	2.7	1	6	78
Newton Bewley	6	10	11	3.7	0.8	7	3	10	50
Wolviston	7	3	8	1.3	0.6	3.4	4	9	63
(above four)	5	4.5	9	3	1.5	4	2.5	9	61
West Hartlepool	10	10	10	10	1	8	0.2	11	35
Greatham	10	5	13	4.3	1.2	6	4	12	42
Seaton Carew	8	9	13	11.4	1.9	9	2.5	10	37
Brierton	14	3	12	4.5	1	11	1	21	32
Sheraton	2	5	7	1.5	0.3	5	-	14	65
Bishopton	7	3	8	0.8	1.5	2.5	5	14	59
Seaton	5	10	11	9	-	12	-	18	31
Claxton	4	11	13	2.8	1.2	9	1	13	44
Sedgefield	3	6	8	3.5	0.3	5.5	0.9	9	65
Trimdon	3	5	8	1.6	1	5	0.5	13	64
Embleton	2	3	5	0.8	1.1	3.5	2	7	76

Parish	Wheat	Barley	Oats	Potatoes	Legumes	Roots	Fallow	Temp. Grass	Perm. Grass
Shotton	2	6	9	4	0.1	7	0.6	12	59
Wingate	3	4	8	2	-	4.5	0.7	11	67
Bradbury	3	3	6	1	-	3	0.7	6	79
Mordon	3	4	6	0.7	-	3	3	5	76
Monk Hesleden	3	7	8	3.5	0.2	6	3	10	57
Foxton/Shotton	4	5	6	1.3	0.1	4	2	9	55
Castle Eden	2	4.5	6	3.5	0.3	4.5	-	8	71
Fishburn	4	7	9	3.1	-	5.3	2	12	57
Butterwick	3	6.5	7	2.6	0.2	4	1.6	5	71
Hutton Henry	5	7	11	4.6	0.2	8	1.8	12	50
Grindon	6	3	8	0.8	1.4	5	1.6	7	68
Bishop Middleham	5	10	11	4	-	7	0.4	11	52

From these figures those parishes where corn was important can easily be distinguished from those where grass, and presumably grazing, were of greater importance. A ring of the former lay around the Hartlepools towns from Hart to Throston, Seaton, Greatham and Newton Bewley, where between a quarter and a third of the agricultural land was under cereals. On the higher parishes immediately to the west of this urban ring cereals occupied a fifth to a quarter of the farmland; and around Billingham the proportion was similar. The parishes in which corn took up less than a fifth of the farmland were those on the plateau slopes where heavier soils predominate, and on the Teesmouth marshes of Cowpen Bewley. Even here, however, the demands of winter feeding of stock seem to have made necessary the retention of a minimum of about 10% of the farmland under corn, mainly oats, as at Embleton and Cowpen Bewley.

The significance of natural conditions such as climate and soils may be recognized in this contrast between the corn acreage percentages of the various parishes. At a time when the economic background for corn was not encouraging those districts where corn production was handicapped by heavy land and late harvests inevitably cut their sowings of cereals to a minimum.

The parishes with the greatest percentages of permanent grass were Bradbury (79%), Cowpen Bewley (78%), Embleton (76%), and Mordon (76%), all of which, when temporary leys are added, had well over 80% of their farmland under grass. Wingate, Sheraton, Trimdon, Sedgefield, Nesbitt, Elwick Hall, Wolviston, Bishopton, Shotton, Monk Hesleden, Castle Eden, Fishburn, Butterwick and Grindon, all areas on the dip-slope clays, came not far behind with grass occupying about three-quarters of the farmland. In those parishes where corn was important, however, grass, both permanent and temporary, together occupied only about half of the farmland.

The livestock figures for 1912 show that in the parishes for which statistics are comparable there was a decline in absolute numbers - in dairy cattle by 2.6%, in beef cattle by 5.5%, and in sheep by 13.4%. However, allowing for the shrinkage of the overall acreage of farmland from 40,234 to 36,391 acres between 1901-1912, there was a relative increase in dairy cattle from 5.5 per 100 acres to 6.0, and in beef cattle from 6.1 to 6.4. Sheep alone decreased in both relative and absolute terms; from 52.1 per 100 acres they fell to 49.9. These relative changes followed national trends in the first twelve years of the century. Parishes which notably reversed the tre nd were Castle Eden, Grindon, and Newton Bewley, where sheep numbers increased - in Castle Eden from 690 to 1,117; in Grindon from 2,972 to 3,074; in Newton Bewley from 417 to 847.

In parishes where dairy cattle decreased between 1901 and 1912 the anomaly can often be traced to a single farm which had changed from milk production to stock-fattening; as for example in the parish of Newton Bewley, where the two farms run by the Atkinson family went out of milk production in 1906. Despite increased numbers of milk cattle on the three other farms at Newton Bewley which ran dairy herds, the total for the parish dropped. There was a corresponding increase in the number of sheep in Newton Bewley over this period, also due to a single change of policy.

Parish	Animals per 100 acres of farmland			Parish	Animals per 100 acres of farmland		
1912	Dairy	Beef	Sheep		Dairy	Beef	Sheep
Hart	5.4	3.1	43.9	Sheraton	30.	7.9	82.9
Elwick	4.6	5.7	43.8	Bishopton	5.5	2.9	32.9
Dalton Piercy	2.9	6.0	58.8	Seaton	8.2	3.1	36.5
Throston	13.4	2.8	45.5	Sedgefield	7.0	4.3	39.2
Nesbitt	1.8	9.1	62.7	Trimdon	6.6	2.6	23.7
Thorpe Bulmer	1.9	6.4	41.7	Embleton	3.4	4.6	55.1
(above combined)	5.7	4.6	46.8	Shotton	4.2	2.3	41.7
Billingham	8.4	5.7	34.6	Monk Hesleden	6.4	1.8	34.1
Cowpen Bewley	4.9	24.7	53.6	(above 2 combined)	5.1	2.1	38.5
Newton Bewley	5.3	6.3	55.2	Wingate	3.3	5.4	32.7
Wolviston	6.6	3.3	44.7	Bradbury	5.5	5.6	68.8
(above 4 combined)	6.5	10.3	45.1	Mordon	5.8	4.0	49.8
Elwick Hall	5.2	5.7	34.6	Foxton	4.3	4.5	69.6
West Hartlepool	10.8	3.8	29.0	Castle Eden	5.2	10.2	77.8
Greatham	6.3	4.7	28.9	Fishburn	4.2	2.5	36.6
Claxton	11.6	4.0	46.6	Butterwick	3.1	3.3	30.3
(above 2 combined)	7.9	4.5	34.3	Hutton Henry	5.3	6.6	27.6
Seaton Carew	6.4	5.3	32.0	Grindon	5.5	9.4	122.8
Brierton	2.6	13.9	60.9	Bishop Middleham	3.7	4.6	20.8

The trend towards specialisation noted in the 1901 figures is continued more markedly here. That part of the old parish of Hart nearest the Hartlepools, namely Throston, along with West Hartlepool itself, Billingham, Claxton and Seaton, all show concentrations of milk cattle compared with the surrounding rural parishes. A.D. Hall (1) was impressed at this time by the importance of the factor of distance in localising milk production. "Round the edge of all the industrial districts of the north small dairy farming on grass land prevails; there is an immediate and steady market for milk".

Beef production was most predominant in the parishes of Cowpen Bewley, Brierton, Nesbitt (a one-farm parish), Castle Eden, Grindon and Sheraton, all parishes where a single very large farm unit decided the pattern of the parish's production. Sheep were outstandingly numerous in Nesbitt, Brierton, Sheraton, Bradbury, Foxton, Castle Eden and Grindon, thus closely following the beef pattern.

By applying the same grazing indices as for 1870 and 1901 the intensity of stocking was calculated as follows:

Parish	Grazing acres per grazing unit	Parish	Grazing acres/grazing unit
Embleton	3.76	Cowpen Bewley	1.82
Wingate	3.41	Wolviston	1.82
Thorpe Bulmer	2.51	Nesbitt	1.79
Sheraton	2.51	Sedgefield	1.74
Shotton	2.39	Monk Hesleden	1.68
Bradbury	2.16	Billingham	1.67
Elwick Hall	2.15	Fishburn	1.62
Mordon	2.05	Newton Bewley	1.62
Butterwick	2.04	Grindon	1.54
Bishopton	2.03	Hart	1.53
Trimdon	1.98	Claxton	1.43
Dalton Piercy	1.97	Brierton	1.39

(1) A.D. Hall. A Pilgrimage of British Farming, 1913, Chapter 17.

Parish	Grazing acres per grazing unit	Parish	Grazing acres/grazing unit
Foxton	1.96	Greatham	1.24
Bishop Middleham	1.96	Seaton	1.14
Elwick	1.93	West Hartlepool	0.97
Castle Eden	1.91	Seaton Carew	0.95
Hutton Henry	1.90	Throston	0.89

By 1912 the stocking intensity had been restored to that of the years before the expansion of the grass acreage and in certain parishes it had been exceeded, as the following comparisons shows:

Parish	Number of grazing acres per grazing unit		
	1870	1901	1912
Hart	1.64	2.13	1.64
Elwick Hall	2.77	3.43	2.15
Billingham	1.72	1.95	1.74

(Note: Hart and Billingham figures cover the areas of the old parishes as they were in 1870 for the sake of comparison).

While the higher productivity of the urban fringe parishes is once more emphasized, the parishes of Embleton and Wingate are outstanding for their low stocking ratios because of their large areas of rough badly drained grassland. Of all the parishes with over 80% of their acreages under grass only Cowpen Bewley, by virtue of its specialisation in beef cattle, has a grazing index of less than 2.00. Lack of arable land meant that there were fewer horses in these parishes and thus the stock density was lowered.

Milk supply in the Hartlepools towns was becoming an important business by this time, and in 1911 the Co-operative Society opened a dairy, occupying modest premises in Whitby Street, West Hartlepool, to serve the two Hartlepools towns. Supplies were drawn from an area extending to Northallerton, and were transported from that distance by rail. Certain farms with access to the Stockton-

Sunderland railway supplied Sunderland, twenty miles to the north, rather than use the roads to the Hartlepools, six miles to the east, but such farms were few, and most of the farms through which that railway ran were fattening farms.

The analysis of farm sizes provided by the 1912 agricultural statistics shows that around West Hartlepool the division of farms continued. From 23 holdings on 1,210 acres in 1901, an average farm-size of 53 acres, the number had increased to 30 on only 1,114 acres, an average size of only 37 acres. At the northern end of the Hartlepools 18 farms in Throston parish averaged 61 acres, twelve of them being less than 50 acres. At the southern end in Seaton Carew parish 31 holdings averaged 64 acres, nine being less than 5 acres, and another ten less than 50 acres. Sub-division here had increased the number of holdings from 22 in 1901.

Where land values were lower, away from the urban fringes, farms were fewer and larger. Farms over 300 acres in size existed in Sheraton parish (3), Grindon (3), Embleton (3), Butterwick (2), Cowpen Bewley (2), Wingate (2), and in Thorpe Bulmer, Foxton, Elwick and Bradbury (1 each). The average farm-size was over 200 acres in the parishes of Nesbitt (one farm only), Thorpe Bulmer, Cowpen Bewley, Sheraton, Foxton, and Embleton.

For one of these larger farms, Middlethorpe, in the parish of Thorpe Bulmer, a detailed field-by-field schedule of husbandry has been kept by the Brown family since 1912. Always a cash-cropping-with-fattening farm, Middlethorpe in 1912 had more than the local average acreage under corn, roots and fallow, but less than the average proportion of grass. A field of beans was always grown to feed stock in winter, but hay and turnips provided the bulk of animal fodder, a small proportion being ground oats.

This farm, standing on the south side of the great cleft known as

Crimdon Dene, was affected little by the development of the last unexploited corner of the Durham coalfield which took place in the early part of the twentieth century. New collieries were sunk at Blackhall (1894), at Horden (1900) and at Easington (1900) and the settlements which rapidly grew up around the pit-heads provided fresh markets for the farms on the north side of Crimdon Dene, though at the same time they eliminated several farms by their encroachment. The following figures show the quick growth of the colliery villages:

Population census figures

Parish	1901	1911	1921	1931	1939
Easington	1,731	2,711	9,186	11,986	11.846
Shotton	1,917	12,561	15,647	19,529	21,264
Monk Hesleden	1,302	2,093	5,781	7,298	8,518

The rural parishes around the collieries maintained their nineteenth century populations in contrast but even so the figures for Easington Rural District, including both colliery and farming villages, rose thus:

1901	1911	1921	1931	1939
40,562	60,040	75,642	88,027	81,598

It was not until the construction in the mid-1920's of the coast road from Easington to West Hartlepool, crossing Crimdon Dene and removing the barrier between Middlethorpe Farm and the colliery villages, that this farm could avail itself of the market for potatoes that they provided. After 1926 the percentage of the farm acreage under potatoes rose from a steady 3-5% to 7-9% in the late 1920's and 10-12% in the 1930's. The result of cutting the new road was to shorten the distance from Middlethorpe to Blackhall from seven or eight miles (i.e. via Hart, Sheraton and Castle Eden) to only one mile.

The Great War

After a stable period from 1901 farming was once more subjected to violent disturbances of an international origin when the Great War began in 1914. A great many men left the farms for military service and women were called upon to fill the gaps, though a farmer could appeal to the tribunals when he considered a man indespensable. The Army bought horses where they could be spared and it is significant that it was during the war that the first tractors appeared in the district. After the 1915 Milner Committee had reported on the possibilities of increasing British food production the government set up District Agricultural Committees to advise farmers, and in 1917 a Food Production Department began to encourage the extension of the acreage under food crops by such means as the Corn Production Act (1917) which gave powers to compel the ploughing out of grassland, which fixed minimum prices for cereals, and provided machinery for fixing minimum wages. It was a farm in the Hartlepools region which provided the first prosecution in the county for failure to cultivate land, though generally the area responded well to the call for greater food production (1).

The modification of the farming pattern on Middlethorpe Farm at Hart is shown by the following figures :

Year	Percentages of farm area occupied by crops and grass								
	Wheat	Barley	Oats	Potatoes	Legumes	Roots	Fallow	Temporary Grass	Permanent Grass
1912	14	8	16	3	2	11	8	5	31
1913	16	8	12	5	3	7	8	8	31
1914	12	10	9	6	3	6	3	15	31
1915	12	13	13	5	3	6	3	12	31
1916	10	15	15	4	4	8	-	13	31

(1) Northern Daily Mail, West Hartlepool, 24th September 1918.

Year	Percentages of farm area occupied by crops and grass								
	Wheat	Barley	Oats	Potatoes	Legumes	Roots	Fallow	Temporary Grass	Permanent Grass
1917	15	9	11	5	4	6	2	15	31
1918	16	17	12	4	2	9	2	6	31
1919	14	16	13	3	5	6	6	5	27

The most significant alterations were the doubling of the barley acreage from 19 acres in 1912-13 to 35 acres in 1916, and the elimination of one fallow field, while clover increased from 11 acres in 1913 to 35 acres in 1914. This farm had always grown more corn that the average for the region, however, and little change is apparent in the wheat acreage here while the area as a whole did sow more wheat.

It was during the Great War of 1914-18 that the West Hartlepool Co-operative Dairy actively encouraged farmers in the parishes round the Hartlepools to turn to dairying, by making arrangements to collect milk from the farms. Several farms which still remain in the milk trade trace their first entry into the production of milk to dates between 1916 and 1928, the exact date often depending on individual changes of management such as deaths and retirements bring. When motor lorries had established themselves as a reliable means of transport the Co-operative Dairy was among the first to use them on a run from West Hartlepool to Wolviston and back via Elwick in the early 1920's. The catchment area for this dairy was limited to the north by the lack of a road along the coast, and although such a road was constructed by the mid-1920's (under a scheme to provide work for the large numbers of unemployed) the milk from the farms north of Crimdon Dene went to a dairy at Wellfield (Wingate).

In the early 1920's veal prices were high and many cattle were slaughtered young, leading to a decrease in the number of cattle under two years old, but this soon passed when prices fell once more. Wheat prices also slumped when government price supports were withdrawn in 1921, but this made little difference in the Hartlepools region where wheat was an integral part of the arable rotation, and where wheat straw was required for winter stock as both fodder and bedding. Other extraneous factors which affected the profitability of farming in the 1920's were the minimum wages regulations, introduced in 1917, at a time of greater prosperity, which now bore heavily on farmers who had not been thrifty during the war. Although rates relief was granted to farmers in 1923, and even more in 1928, many farmers were making no profit, and some a loss, during the 1920's. This resulted in a gradual movement from the land of both tenants and farm labourers, and in a renewal of the decline in the arable acreage.

The 1930 statistics for the parishes in the Hartlepools region reveal the steady drop in the arable acreage:

Parish	Agricultural acreage	Arable acreage	% Arable	% Decrease or increase Since 1912	Since 1901	Since 1870
Hart	2,517	1,527	61	-1		
Elwick	1,443	653	45	-1		
Dalton Piercy	982	483	49	+2		
Throston	866	514	59	-6		
Nesbitt	220	111	50	+6		
Thorpe Bulmer	694	359	52	+3		
(above combined)	6,722	3,647	54	-1	-4	-14
Billingham	1,049	518	49	+3		
Cowpen Bewley	2,516	447	18	-4		
Newton Bewley	1,533	656	43	-7		
Wolviston	1,670	566	34	-3		
(above 4 comb.)	6,768	2,187	32	-7	-8	-31
Elwick Hall	3,348	1,293	38	-3	-2	-26
West Hartlepool	11,030	712	69	+4	0	-11
Greatham	2,194	991	45	-13	-13	-20
Seaton Carew	349	243	70	+7	+2	
Brierton	757	474	63	-5	-6	
Sheraton	2,041	658	32	-3	+1	
Bishopton	3,975	1,200	30	-11		
Seaton	1,574	1,056	67	-2	-1	
Claxton	867	426	49	-7		
Sedgefield	5,178	1,760	34	-1		
Trimdon	1,919	664	34	-2		
Embleton	2,858	674	24	0		
Shotton	3,363	1,594	47	+6		
Wingate	3,199	871	27	-6		
Bradbury	1,851	485	25	+5		
Mordon	1,492	391	26	+2		
Monk Hesleden	1,755	1,024	58	+15	+17	-1
Foxton/Shotton	1,528	546	36	-9		
Castle Eden	1,413	481	34	+5	+4	-11
Fishburn	1,995	864	43	0		
Butterwick	1,483	351	24	-6		

Parish	Agricultural acreage	Arable acreage	Arable	% Decrease or increase Since 1912	Since 1901	Since 1870
Hutton Henry	1,782	929	52	+1		
Grindon	3,346	716	21	-11	-18	-35
Bishop Middleham	1,600	764	48	0		

By this time the upland farms had slowed down their rate of conversion to permanent grass simply because so much arable had already been converted in the late nineteenth century, and a certain amount of fodder oats and roots as well as hay had to be grown, so that a minimum of arable was always retained. Now it was the turn of the better soils at Greatham, Newton Bewley, Throston, Brierton, Claxton and Bishopton to feel the change. Some of the urban-fringe parishes show an increase in the arable proportion of the farmland, but the most spectacular change came in Monk Hesleden parish where the amount of arable increased from 43% in 1912 to 58% in 1930. This was on account of the new colliery villages Easington, Horden and Blackhall, which had grown rapidly sihce the sinking of the shafts in the first two decades of the century. Despite a shrinking of the agricultural area as a whole the area of arable increased within this parish, to provide more potatoes for the mining communities, and more oats and hay for the pit ponies.

The changes in cropping from 1912 may be seen from the following figures, which are percentages of the total farmland.

Parish	Wheat	Barley	Oats	Potatoes	Legumes	Roots	Fallow	Temp. Grass	Perm. Grass (including rough grazing)
Hart	9	6	14.5	7.6	1.5	5.6	1.5	13.5	39
Elwick	4.3	4	9.3	3.5	0.3	5.1	1.9	16	55
Dalton Piercy	9.5	5.2	7.5	3.7	0.4	5.7	3.0	13.6	51
Throston	5.3	5	12.5	9	3.1	5.8	-	18	41
Nesbitt	4.8	6	10.5	4	3.7	8	-	13.7	49.5

Parish	Wheat	Barley	Oats	Potatoes	Legumes	Roots	Fallow	Temp. Grass	Term. Grass (including rough grazing)
Thorpe Bulmer	8	3.3	10.4	4.4	1	6.8	1.8	15.5	48
(above combined)	7.5	5	12	6	1	6	1.5	14.5	46
Elwick Hall	7	3	10	1	2	4.5	2	9	61
Billingham	3	1.3	16	3	0.3	4	3	18	51
Cowpen Bewley	2.5	0.5	5.7	0.9	-	1.8	2.2	4	82
Newton Bewley	5	2.6	17	3	1.5	5.4	1.4	7	57
Wolviston	6	0.7	10	1.9	0.1	3	2.4	9	66
(above 4 comb.)	4	1.1	11	2	0.4	3.2	2.2	8	68
West Hartlepool	7	6	11	6	1	5.5	2	26	31
Greatham	7	3	13	4	1	4	3	8	55
Seaton Carew	6	2	14	23	1	9	1	12	30
Brierton	11	2	11	3	2	8	2	23	37
Sheraton	4	3	5	3	0.3	5	0.5	10	68
Bishopton	4	1	10	1.2	0.3	2.5	2.5	8	70
Seaton	9	3	21	8	1	7	2	14	33
Claxton	8	4	12	4	3	7	2.5	9	51
Sedgefield	4	3	9	2.6	0.04	4	1.2	10	66
Trimdon	3	3	7.5	2.5	0.3	4	0.5	13.5	65.5
Embleton	3	1.5	6	0.7	-	2.3	1.8	8	76
Shotton	4	6	14	3.8	0.6	5	0.5	13	53
Wingate	2.4	1.3	9	1.3	-	4	0.5	9	73
Bradbury	3	2	6	1.4	-	3	0.8	10	74
Mordon	4	2.7	6	1.5	-	2.7	2	7	74
Monk Hesleden	8	2	16.5	7	-	7	1.6	17	42
Foxton/Shotton	5	2	10	1.2	-	3.3	0.3	13	64

Parish	Wheat	Barley	Oats	Potatoes	Legumes	Roots	Fallow	Temp. Grass	Perm. Grass (including rough grazing)
Castle Eden	5	1.5	8	3	0.2	4	0.5	11	66
Fishburn	4	5	12	3.5	0.1	4	1.6	13	57
Butterwick	2.5	4	4	1.6	0.4	2.5	2.5	6	76
Hutton Henry	5	4	12	4.7	-	6.4	1.3	18	48
Grindon	2.7	2	7	1.2	0.3	2.1	0.6	5	79
Bishop Middleham	4	8	12	3.6	-	6.3	0.2	14	52

Cereal crops, while tending to decrease in acreage very slightly, still occupied in 1930 about a quarter of the agricultural land on the better soils of the Tees plain, and about a fifth on the worse drained and cooler farms on the higher ground of the East Durham Plateau. On the Tees marshes and on the difficult land on the Plateau, however, this proportion was down to a tenth, as in Cowpen Bewley, Bradbury, Embleton and Butterwick.

Oats still remained the leading corn crop, with almost twice the acreage of wheat, which in turn occupied twice the acreage of barley. In the poorer areas barley and wheat were equally unimportant. Barley had been the chief victim of the cut in the arable acreage, oats maintaining its position, and wheat actually increasing its acreage after the trough of the low prices had been passed about 1900.

Bare fallow and peas, along with beans, continued to disappear as they became increasingly uneconomic as fodder crops, and potatoes and grass replaced them. Potatoes made an extraordinary advance in relative importance in Seaton Carew parish, where only 349 acres remained as farmland after the expansion of the South Durham Steel and Iron Company's works, and of this 80½ acres grew potatoes. Smaller advances were made in the more rural parishes where labour for potato-picking was, on account of the many industrial unemployed, far easier to obtain than ever before.

Roots diminished in importance between 1912 and 1930 because more grass was available for hay-making and because cattle cake was being increasingly used by the dairy farms. Grassland, both temporary and permanent, increased in acreage as former temporary leys became established permanent pasture, and fresh tillage was sown with seeds. The trend towards grass reached its climax at about this time, immediately before the government took fresh steps to encourage corn.

Changes in the percentage of agricultural land under grass (Temp. and Perm.)

Parish	1901	1912	1930	Parish	1901	1912	1930
Hart	57	56	61	Wingate		78	82
Elwick Hall	69	70	70	Bradbury		85	84
Billingham	69	70	76	Mordon		81	81
West Hartlepool	50	46	57	Monk Hesleden	72	68	59
Greatham	54	54	63	Shotton		71	66
Seaton Carew	51	47	42	Embleton		83	84
Brierton	55	53	60	Foxton-Shotton		64	77
Sheraton	81	79	78	Castle Eden	77	79	77
Bishopton		73	78	Fishburn		69	70
Seaton	52	49	47	Butterwick		76	82
Claxton		57	60	Hutton Henry		62	66
Sedgefield		74	76	Grindon	77	75	84
Trimdon		73	79	Bishop Middleham		63	66

N.B. Hart figures include those for Elwick, Throston, Dalton Piercy, Thorpe Bulmer, and Nesbitt. Billingham figures include those for Cowpen Bewley Newton Bewley and Wolviston.

The crop rotation in the 1920's at Middlethorpe Farm still included two corn crops (wheat, barley or oats) every four years, and often every three years, as follows: roots-corn-corn; or roots-corn-roots-corn; or corn-seeds-corn-roots. Nine out of nineteen fields on this farm had grass leys of three to six years during the 1920's, and five others had clover for at least one year. In many of these parishes near towns the unusually high proportion of grass for mowing may be attributed to the demand for hay by town stables, and most of the hay came from fields of temporary grass. West Hartlepool, for example, had 26% of its agricultural land under temporary grass in 1930, and over half of this was for mowing.

A further intensification of livestock farming (after the lull induced by the Great War) took advantage of the extra grassland. The 1930 figures for the Hartlepools region farms in 34 parishes show an increase of 10.5% in dairy cattle, of 17.7% in beef cattle (animals over two years other than dairy), and of 1.7% in sheep numbers compared with 1912. Here again these average figures conceal exceptions to the general trend where in certain parishes one or two farms had fresh occupiers, and consequently new production policies. In Claxton parish, for example, the swing was from dairy cattle to beef, as was also the case in Monk Hesleden and Sedgefield, but the swing went in the opposite direction in Bishopton, Elwick, and Dalton Piercy parishes. There were few parishes which increased all their classes of livestock; only Sheraton, Elwick Hall, Hutton Henry, and Wolviston, which had been relatively under-stocked in 1912. Embleton, Shotton, Hart and Newton Bewley increased both classes of cattle, but lost in sheep numbers. The parishes which gained in sheep numbers were those remote from urban centres and therefore free from dangers such as dogs and children, who damage fences. It is significant that the parishes in which sheep numbers fell most heavily were those where urban encroachment had been most severe - West Hartlepool (down from 323 in 1912 to 88 in 1930), Seaton Carew (637 to nil), and Billingham (813 to 148).

Applying the same grazing indices as previously the number of acres of grazing land per grazing unit has been calculated as follows:

Grazing acres per grazing unit

Parish	1912	1930	Parish	1912	1930
Hart	1.53	1.64	Sheraton	2.51	1.87
Thorpe Bulmer	2.51	2.61	Bishopton	2.03	2.08
Nesbitt	1.79	2.47	Sedgefield	1.74	2.04
Elwick	1.93	2.03	Trimdon	1.98	1.84
Dalton Piercy	1.97	1.79	Embleton	3.76	1.98
Throston	0.89	1.41	Shotton	2.39	2.37
(above combined)	1.65	1.83	Wingate	3.41	3.05
Billingham	1.67	2.17	Bradbury	2.16	2.62
Newton Bewley	1.62	1.83	Mordon	2.05	2.18
Cowpen Bewley	1.82	2.79	Monk Hesleden	1.68	2.27
Wolviston	1.82	2.10	Claxton	1.43	1.50
(above 4 comb.)	1.74	2.34	Foxton	1.96	2.09
Elwick Hall	2.15	2.47	Castle Eden	1.91	1.71
West Hartlepool	0.97	2.07	Fishburn	1.62	2.34
Greatham	1.24	2.75	Butterwick	2.04	3.41
Seaton Carew	0.95	0.93	Hutton Henry	1.90	1.77
Seaton	1.14	1.02	Grindon	1.54	2.47
Brierton	1.39	1.51	Bishop Middleham	1.96	1.94

Despite the increase in stock numbers there had been a greater relative increase in grazing land in the parishes of the Hartlepools region, as the above figures show. The exceptions, where the density of stocking had increased, were the upland parishes whose large proportions of permanent grass remained the same as in pre-war days, and those low and parishes which had been badly affected by urban encroachment. The new depression in farming was being accompanied by the same diminution of stock density as had followed the depression in the late nineteenth century.

There were some striking changes in farm size in the parishes listed above, in the period 1912-1930. The smallest holdings, those of less than 5 acres, decreased in number from 116 to 76, a fall of 34%; those from 5-50 acres decreased by 21%, from 217 to 170; farms of 50-300 acres decreased from 341 to 314, a fall of 8%; while farms over 300 acres increased by 24%, from 21 to 26. A large part of this change must be attributed to the growth of the towns of West Hartlepool and Billingham, the former spreading south over farms in Seaton Carew, and north over farms in Throston, while Billingham was being reduced, especially after the Great War, to two-fifths of its former farm acreage. At the same time there was some consolidation of holdings as a result of the economic depression which squeezed certain farmers out of business. This is apparent from the figures for Sedgefield, one of the larger, more rural parishes:

Farm size in acres

	0 - 5	5 - 50	50 - 300	Over 300	Total farmland acreage
1912	7	19	35	0	5,024
1930	3	12	29	2	5,178

Here the amount of farmland increased slightly (perhaps as a result of the inclusion of rough grazing in the census of 1930) whereas the number of farms dropped from 61 to 46. In Brierton parish the Robinson family bought three of the four farms in the parish and ran these as one unit, fattening beef cattle and sheep. In Bishopton parish although the number of farms went down from 36 to 30 the average size of farm increased from 107 acres in 1912 to 133 acres in 1930. In 1919 the Durham County Council purchased Throston Grange Farm west of Hartlepool for the purpose of creating smallholdings and thereby increased the number of small farms, but isolated cases such as this did little to reverse the trend towards fewer and larger holdings.

Economic factors weighed very heavily at this particular period when the industrial districts of Teesside were impoverished by the slump in the iron, steel, and shipbuilding trades. The fall in living standards of the town populations was responsible for a switch in diet among the unemployed from the more expensive items like meat and milk to potatoes and bread, and while this discouraged cattle farmers the prices of wheat and potatoes were so low there was no compensating encouragement for arable farming. The acute unemployment in the Hartlepools, which increased rapidly between 1929 and 1932, did provide, it is true, extra supplies of cheap labour at harvest times, but the negative effects of the depression were more telling.

A practice which illustrates the depressed state of farming in the Hartlepools region was the farming out of cattle and sheep by the wealthier farmers. Small farms with little capital behind them used to take in animals for grazing; sheep cost threepence a week and cows one shilling. During the winter the owners of the animals bought a whole haystack standing on the smaller farm and their beasts were fed on it. In this way many small farmers were kept in business, and their soils benefitted from farmyard manure when otherwise most of their hay would have been sold to town stables and the ensuing shortage of manure would have proved detrimental to what was still predominantly arable land.

Although the Great War of 1914-18 had seen the introduction of one or two tractors into the Hartlepools region, they were very much a curiosity and were not employed beyond a few weeks in the year. Horses still did the ploughing in 1930. A good horse could be sold in the towns for £40 and there were plenty of trades in the towns which needed horses. Farmers tended, therefore, to keep their horses despite the falling acreage of ploughland, as the following figures show:

Parish	Acres of ploughland per horse			
	1870	1901	1912	1930
Elwick Hall	22	18	11	16
Hart	20	15	12	17
Greatham	18	15	9	14
Sheraton		11	13	15

This helps to explain why the acreage of oats stayed well above those of wheat and barley, since oats was the most important fodder cereal.

The 1930 statistics supply figures of the labour employed on the farms. Even farms of less than 50 acres employed a regular worker over 21 years old because labour was very cheap owing to the depression, and the larger farms with more ploughing usually had two regular men. Rearing and fattening farms required fewer men than the dairy farms, however, and in Claxton parish, where most of the seven farms were fattening farms, only nine men were employed on them, despite the fact that they were all over 100 acres. Women were employed as milkers on dairy farms but in West Hartlepool and Greatham the small market gardens used relatively large numbers of female labour.

LAND UTILISATION SURVEY, 1931-32

This survey, carried out in County Durham by schoolchildren and students in 1931-32, produced for the first time a comprehensive cartographic record of the use to which the land was being put at the depth of the economic depression.

The pattern of farming revealed by the maps is one of arable almost at its smallest extent and permanent grassland at its greatest. It must be remembered that much permanent grass had been allowed to deteriorate to such an extent that today it would be called rough grazing, and that which was marked on the Land Utilisation maps as rough pasture was usually gorse-covered waste land. The ley grass system whereby temporary grass replaced tillage crops was introduced into the Hartlepools region increasingly after the Great War so that it was difficult for the children who made this survey to distinguish between arable grass and permanent grass. Detailed checks by the present writer, however, using individual farms, confirm that the Land Utilisation maps are generally correct in their proportions of permanent grass and arable land. At Middlethorpe Farm, near Hart, the Brown family's records show that 27% of the farm was under permanent grass, all of which is accurately indicated on the Land Utilisation map, field by field. Although documentary evidence for other farms is not available the writer has satisfied himself from conversations with farmers in all parts of the area under consideration that the 1932 Land Utilisation maps are an accurate record of the distribution of permanent grass and arable grass.

Using the Land Utilisation Survey maps of 1932 the following agricultural zones in the Hartlepools region and adjoining districts may be discerned:

1. A narrow belt of arable surrounding the urban area of the Hartlepool towns to a depth of a quarter of a mile, except at the south end where a wet patch of grassland known as the Carrs separated the steelworks slag tips from the village of Seaton Carew.
2. South of Seaton Carew a belt of rough marsh pasture followed the coast to the Port Clarence ironworks tips next to the Seal Sands. This belt broadened on both sides of Greatham Creek, merging into Cowpen Marsh

which occupied the area below 12 feet A.O.D. east of Cowpen Bewley. Such large acreages of very poor grazing land account for the parish of Cowpen Bewley having only 18% of its farmland under arable in 1930.

3. Between area 2 and the 50 foot contour lay a triangular area consisting mainly of permanent grass, but containing significant blocks of arable land, away from the streams. The main arable patches were:
   (a) about 300 acres east of Greatham between the coast road and the railway on the farms Greenabella, Tofts, Thorn Tree, and Marsh House.
   (b) south-west of Greatham on Hall Farm, West Meadows and Field House.
   (c) south and south-east of Cowpen Bewley on Earl's Nook Farm, Little Marsh Farm, and the north-west corner of the vast Saltholme Farm.
   (d) at the southern end of Saltholme Farm a belt a quarter of a mile wide separated the permanent grass and rough pasture from the built-up area of Haverton Hill and Port Clarence.
4. From south-west of Wolviston running north-east through Newton Bewley to Greatham, Claxton and Brierton, was a belt of predominantly arable land following a low ridge of well-drained gravelly soils.
5. North and west of this arable belt there ran a zone in which arable occupied one third and permanent grass two thirds of the farmland, covering the parishes of Dalton Piercy and Elwick. Certain farms had a preponderance of arable such as Naisberry Farm (Elwick), North Farm (Elwick), and Dovecote Farm (Elwick) while others were mainly in permanent grass like Home Farm (Elwick), Manor Farm (Dalton Piercy), Brierton Moor Farm (Brierton), North Farm (Brierton), Potter's Farm (Elwick), and Low Stotfield Farm (Elwick Hall).

6. West of this again, occupying the parishes of Elwick Hall, Grindon, Embleton and the south end of Wingate parish, was a belt of farmland in which permanent grass was predominant. Almost every farm here had large areas of rough pasture, especially on the higher land to the north. Farms with an exceptionally high proportion of permanent grass included Murton Hall, Murton Blue House, Embleton Old Hall (all Embleton), Ten O'Clock Farm, Butterwick Moor (Butterwick and Oldacres), Catlaw Hall (Hutton Henry), Pike Whin (Sheraton with Hulam), Galley Law (Fishburn), Redcar House and Cowley House (Sedgefield), Gunnersvale and Red Gap (Elwick Hall, Grindon Grange (Grindon), and Manor Farm and Green Farm (Wolviston). Farms with large stretches of rough pasture included Red Gap, East Holling Carr, Red Hurworth, Butterwick Moor, White Hurworth and Park House (Trimdon). Large blocks of arable did exist, for example 100 acres between Embleton and the railway to the west, 200 acres immediately north of Thorpe Thewles on both sides of the Durham road, and 200 acres between Beacon Hill Farm and Butterwick Belt Plantation east of Sedgefield, but these were shared by several farms whose grassland constituted even larger blocks of countryside surrounding the arable. These were the poorest farms in the Hartlepools district though there were several notable farms which like that at Cole Hill (Embleton) continued to thrive during the depression. The second-class nature of this area is stressed by the absence of villages.

7. South-west of this poor belt lay a much larger section of farmland roughly triangular in shape, in which the arable occupied one third and permanent grass two thirds of the farmland, between Sedgefield, Stockton and Darlington. In contrast with the last zone this belt is remarkable for the evenness with which village settlement is distributed; one every mile

is the pattern except between Little Stainton and Long Newton, where a mile of rough pasture on badly drained flat country existed south of Gilly Flat Farm.

8. The notorious peat bog country of Mordon and Bradbury was still in 1930 an area of almost 100% grassland. No marsh pasture was marked on the map but the size of the purely grass area (about 6-7 square miles) is most striking. Preston Carrs, Mordon Carrs, and Bradbury Carrs occupied river flats about the middle Skerne, at about 230 feet A.O.D., and formed an even larger patch of permanent grass than the Cowpen Marsh district near Teesmouth.

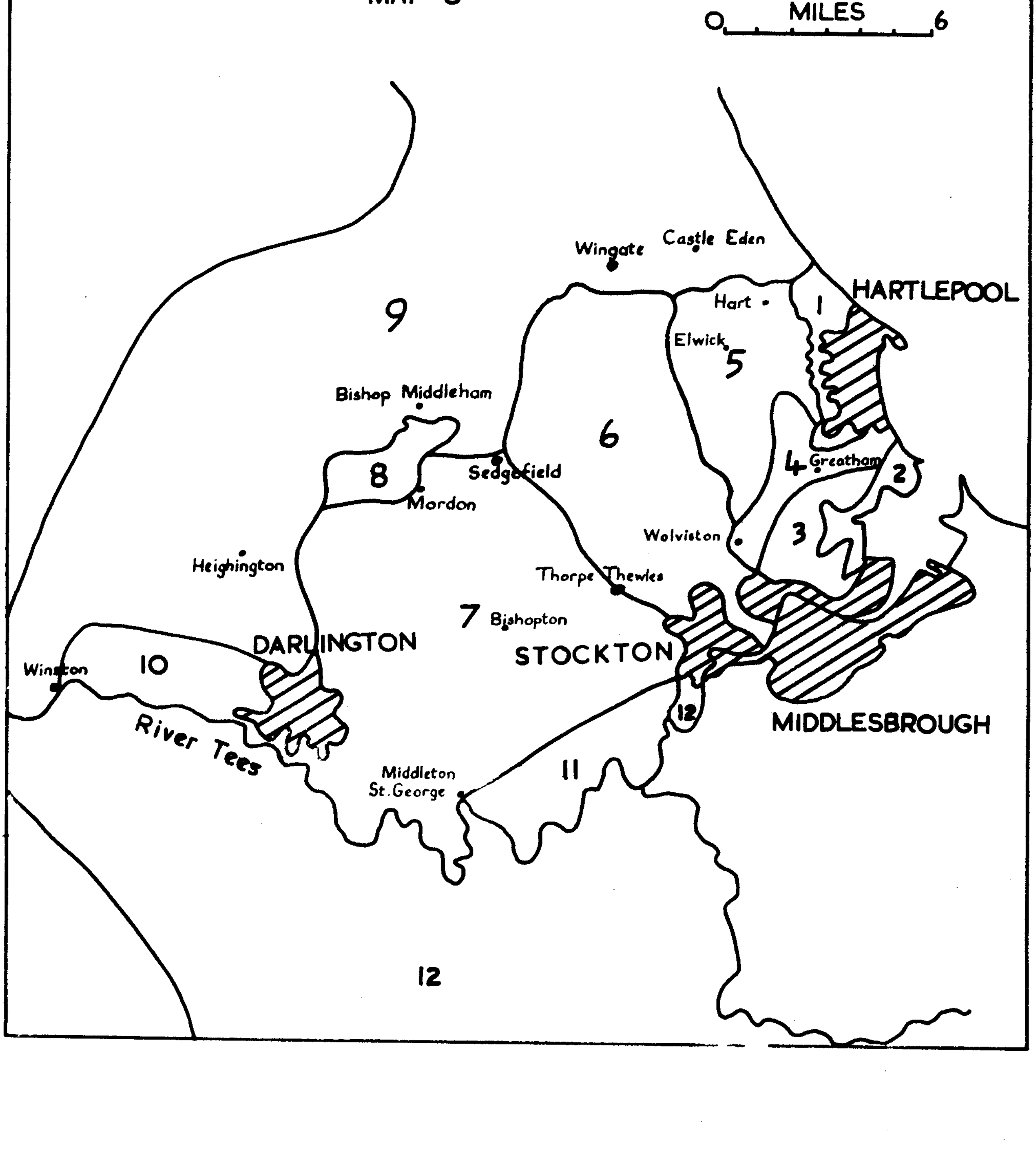
9. To the north and west of all the foregoing farm belts lay arable country, swinging round from the coast at Blackhall, through the coalfield villages Wingate, Fishburn, Bishop Middleham, Shildon and Ferryhill, to thin out as far as arable farming is concerned on reaching Heighington and Houghton-le-Side, north-west of Darlington. This arable zone continues northwards across the coalfield but it is well spattered with rough pasture, an indication of bad drainage, poverty and low stocking densities.

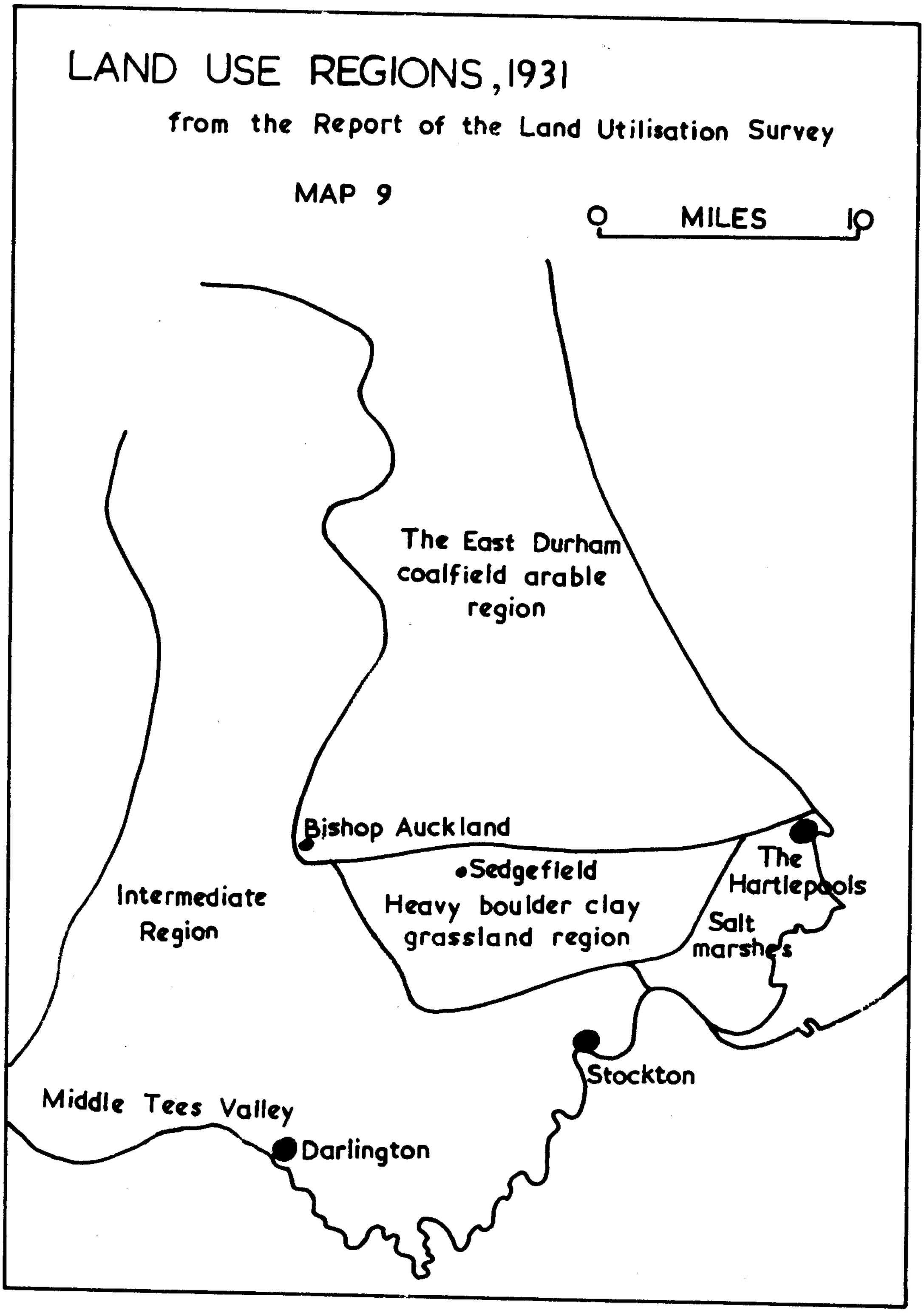
10. An unusually uniform arable block is found west of Darlington, especially between and north of Gainford and High Coniscliffe on the River Tees. This belt of rich loamy soils was referred to by Bell in 1856 as the finest arable land in the County. It was outstanding in 1930 as the most extensive solid block of arable without grassland interruptions in the rural areas off the coalfield, and on the coalfield only the Sunderland-Ryhope-Washington area compares with it.

11. South of a line from Middleton St. George to Stockton a belt of mainly permanent grassland reached the River Tees, in flat country with poor communications.

ARABLE AND GRASS REGIONS, 1931

MAP 8




LAND USE REGIONS, 1931
from the Report of the Land Utilisation Survey
MAP 9
0 MILES 10
The East Durham coalfield arable region
Bishop Auckland
Sedgefield
Heavy boulder clay grassland region
The Hartlepools
Salt marshes
Intermediate Region
Stockton
Middle Tees Valley
Darlington

12. Completing the ring around the Hartlepools region was a balanced arable-grass region south of the Tees and extending between the Cleveland Hills and the Pennines down the Vale of York. Towards the large urban centres of Middlesbrough and Stockton the arable proportion increased gradually across the undulating Cleveland Plain.

Map 8 shows these regions and Map 9 is given in the Land Utilisation Survey Memoirs as a more generalised picture of the farming which the present writer feels is deceiving in its simplicity. It shows the Hartlepools as lying at the north-eastern end of a belt of salt-marshes stretching ten miles from Stockton, whereas the actual area covered by marshland is limited to a much narrower and shorter belt extending almost everywhere one mile inland from the north-west shore of Tees Bay, and two miles inland east of Cowpen Bewley. Part of the land thus marked as marshland was in fact the highly productive corn-potatoes-hay belt immediately surrounding the Hartlepools (region 1 on Map 8), part was the arable belt between Wolviston and Brierton (region 4 on Map 8), and part was the mixed arable-and-grass district south of Greatham (region 3 on Map 8).

While Map 9 is not inaccurate in describing the area between Bishop Auckland and Stockton as a grassland region, nevertheless it does not indicate the significant difference between the predominantly grass areas (e.g. Bradbury 74% grass in 1930, Mordon 74%, with their notorious Carrs, and the Wingate to Grindon strip, 73% to 79% grass) and the areas where arable took up about one third of the total farmland (e.g. Dalton Piercy parish with only 51% permanent grass in 1930). In terms of land utilisation the poorer grazing of Wingate parish, which had in 1930 a grazing index of 3.05 acres of grazing land per grazing unit, should not be grouped with that better pasture of Dalton Piercy with its index of 1.79, or of Hart with an index of 1.64.

The depression of the 1930's

The Wheat Act of 1932, which provided for a subsidy to growers had a marked effect on the acreage of wheat sown in subsequent years, but for some farms in the Hartlepools region this help came too late, because they had already sunk into dereliction. These included Benknowl (Elwick), Hart Moor, Thorpe Bulmer (Hart), and Stotfold Moor (Elwick Hall). They lay in this condition until the 1939-45 War during which energetic government measures and new occupiers took them in hand. Tenants who had flourished during the Great War and the immediate post-war years went bankrupt on farms at Nesbitt Hall, Benridge, Crimdon House (Monk Hesleden), Nelson and Thorpe Bulmer (Hart parish). On Hesleden Hall Farm and North Hart Farm the occupants retired prematurely rather than continue to make losses year after year.

In the last 1920's and early 1930's German potatoes, imported as part of overdue reparations payments, were selling in West Hartlepool at such low prices that local farms, desperate in many cases for ready cash, were obliged to hold back their potato crops till well after the New Year.

It was not easy for any farm to change to more lucrative lines of production when prices for all agricultural products were at rock-bottom; with wheat down to 4/- per cwt., potatoes to 22/- per ton, and beef cattle having to be taken several times to the marts to find buyers at all, while milk was fetching such poor prices that dairy cattle lost £20 per head in value, nothing was to be gained by switching to any alternative type of farming. Nevertheless, the basic strength of mixed farming kept the farms alive in the Hartlepools region when more specialist arable farms in the Eastern Counties were dying. Farm labourers were the worst sufferers since many farmers cut their overhead costs by economising first in labour, and as a consequence even the best farmed land became under-cultivated, and wicken grass crept into the tillage fields.

Although this was hardly a time for great agricultural improvements one most significant change was affecting all farming. This was the adoption and spread of motor transport. Farms which had been previously too remote from West Hartlepool and Stockton now found that they could deliver milk to these urban centres. Beef cattle no longer had to be driven on foot to these markets but instead went by lorry. Local corn-millers, however, were ruined by this development because corn could be collected by vehicles from distant mills on the Tyne. The Newton Bewley mill was closed in the 1930's though that at Greatham struggled on till the 1940's.

Another new development which was to have large repercussions on the farms in the Hartlepools region was the rise in the later 1920's of the Imperial Chemical Industries' vast plant at Billingham. The infant chemical fertilizer industry was to make undreamed-of yields possible for many crops, but local effects were as follows:

(a) Bulky fertilizers such as nitro-chalk could be delivered by road from works to farm without delay, unnecessary exposure to the air, or break of bulk.

(b) The physical expansion of the works in the mid-1930's both reduced the agricultural acreage in the parish of Billingham and because of atmospheric pollution rendered the adjoining grazing pastures less palatable.

(c) A more attractive alternative source of employment was provided for Teesside labourers, and yet another industry was added to those which tended to raise local wage-rates.

In the midst of the severe depression these three factors did not appear too formidable because farmers were not able to afford fertilizer, and I.C.I. worked well under capacity at this period, offering less employment than had been expected.

Figure 1 shows that on Middlethorpe Farm the 1930's were a time when the cropping pattern changes included the end of fallowing, the expansion of the potato acreage, and a steady decline in the importance of beans. Grass and corn remained rather steady compared with the striking changes of the 1920's; the period was one of stagnation.

The basis of the livestock business in the inter war years was the purchase of calves from the higher districts of western Durham (Barnard Castle was the first area in the county to be fully attested), store cattle aged 2-2½ years from Ireland (arranged by the Hall family of Cowpen Bewley, through the Darlington and Stockton marts for several generations), and Scotch lambs. The calves were kept for 2½ to 3 years before they were fat enough for the butcher, the stores for a shorter period, and the Scotch lambs, which replaced the farmer's own lambs about September, were fattened for between 4 weeks and 4 months, according to the grass available and the fluctuation of mutton prices.

Farms on the northern fringes of the Hartlepools region bought their stores at Haswell and Castle Eden marts rather than at Darlington or Stockton, and used the railway to bring them home. At certain times of year farmers went as far afield as Gateshead and even York for store cattle, especially if there was a good spring flush of grass and the larger local demand for stores made them difficult to obtain. The biggest buyer of fatstock in the Hartlepools region was the Hartlepools Co-operative Society, but many animals were sold privately to butchers. The slaughter house was in West Hartlepool where a large trade in meat flourished, many butchers catering both for town customers and for shipping entering the port.

Shorthorns predominated among cattle though Ayrshires, Friesians, Jerseys and Guernseys were popular with dairy farms nearer the towns. Dairy cattle were often bought as required, spring calving being the common practice, so that the milk cows could obtain the best grazing when they were at peak production. Many farmers near the towns were producer-retailers, using horse and float to deliver to the urban market on their doorstep. Herds of 30-50 cattle (with 10-12 in milk) were the rule on all except farms of less than 50 acres, 2 acres of grass per cow being required on the average. Cows for suckler calves were mainly Shorthorns, sometimes crossed with an Aberdeen-Angus bull (1).

Half-breds were the rule among sheep though further west around Darlington the Masham was the main breed (according to Hanley), and the fattening farms usually kept them in the ratio of one breeding ewe per 1½ acres of grass. Fat lambs were ready for the butcher by late May and June, having been born in late winter, and when the home crop of lambs had been sold the Scotch-born lambs were bought in as replacements. The rams were generally Suffolks.

Pigs were reared almost entirely for pork as no bacon-curing factory was available, but around Darlington bacon-pigs could be kept as the works at Leeming in Yorkshire was within easy reach by rail. The most important breed was the Large White, several farms having up to 30 sows.

West Hartlepool dairies, especially the Co-operative Dairy, had expanded since the Great War and were using motor transport to collect milk in 17-gallon churns from local farms. Milk also came by rail from Northallerton because the local catchment area extended only to a radius of four miles. In the Trimdon district and in many other colliery villages many of the smaller dairy farmers took to retailing their milk from door to door. Potatoes were hawked through the villages as another means of earning a livelihood, supplementing the meagre farm income. Farms which went bankrupt in this area included Hall Farm, at

(1) Hanley, Boyd and Williamson. An Agricultural Survey of the Northern Province, 1936.

Trimdon, Catley Hill Farm and West Carr Side.

It was the farms nearest the towns which survived the depression best because they could always rely on being able to sell hay and oats to town stables, and milk and potatoes to the town distributors. The colliery farms also possessed a tied market in their pit ponies, each colliery having some hundreds of these tiny animals dependent entirely on hand-feeding of hay and crushed grain.

Government action was by no means lacking at this period, however, and in October 1933 the Milk Marketing Boards were set up to help the dairying side of farming. Liquid milk had been selling at wholesale prices of 12 pence per gallon in summer, and 16½ pence in winter, while after 1929 the price of milk for manufacture, because of the flow of imports, fell precipitately as low as 5 pence per gallon. This fall upset the previously existing balance between dairy farms in remote areas which had supplied the milk products market and the producers who had access to the liquid milk market. Farmers who had hitherto supplied the manufacturing market only now tried to enter the liquid market in order to recover their costs of production. Transport costs had been falling slowly, road transport had been improving, and the use of bulk tankers and the greater use of pasteurisation combined to make it easier for distant producers to reach the liquid market in large urban consuming areas.

The Milk Marketing Boards were price-fixing bodies which continued the old policy of selling milk at differential prices, i.e. a higher price for a fairly level supply of liquid milk for fresh consumption, and a lower price for manufacturing milk. Milk in England and Wales continued to be sold by producers direct to distributors but the Milk Marketing Board was a third party to each contract, prescribing the price to be charged and collecting the proceeds. Producers received an average price, termed the "Pool" price, which was the weighted average selling price of all milk after deductions in respect of the Board's administrative expenses, transport charges, and levies for special premiums. The policy of all the Boards was to obtain the highest possible price for milk sold on the liquid market and each year, in prescribing the contract for the sale of milk, the Boards sought to raise the price slightly. The general effect of the price-fixing policies was to give a somewhat better and more assured return to producers than they had received previously (1).

In 1934, when it had become clear that imported butter and cheese, whose prices determined those at which home supplies could be sold, were not going to rise in price, the government decided that emergency action must be taken to safeguard home production. Provision was accordingly made in the Milk Act of 1934 whereby minimum "standard" prices of 5d. per gallon for milk manufactured into butter and cheese (and 6d. in winter) were guaranteed to the Milk Marketing Boards. This subsidy was a great help to the struggling dairy farmers in the remote areas and relieved the liquid market of their competition.

The Milk-in-Schools Scheme, publicity campaigns to advertise the nutritive value of milk, and grants towards the provision of cheap milk to nursing and expectant mothers and children under school age in certain economically depressed areas were other government steps taken to stimulate an increased consumption of milk. The Boards endeavoured to improve the quality of milk by offering the bonus of a penny per gallon over and above the "Pool" price to all producers qualifying for Grade "A" licences. Herds free from tuberculosis increased when in 1935 the Tuberculosis (Attested Herds) Schemes came into operation; milk from such herds received a bonus of a penny per gallon.

(1) Report of the Committee on the Working of the Agricultural Marketing Acts, 1947. (Economic Series, No. 48).

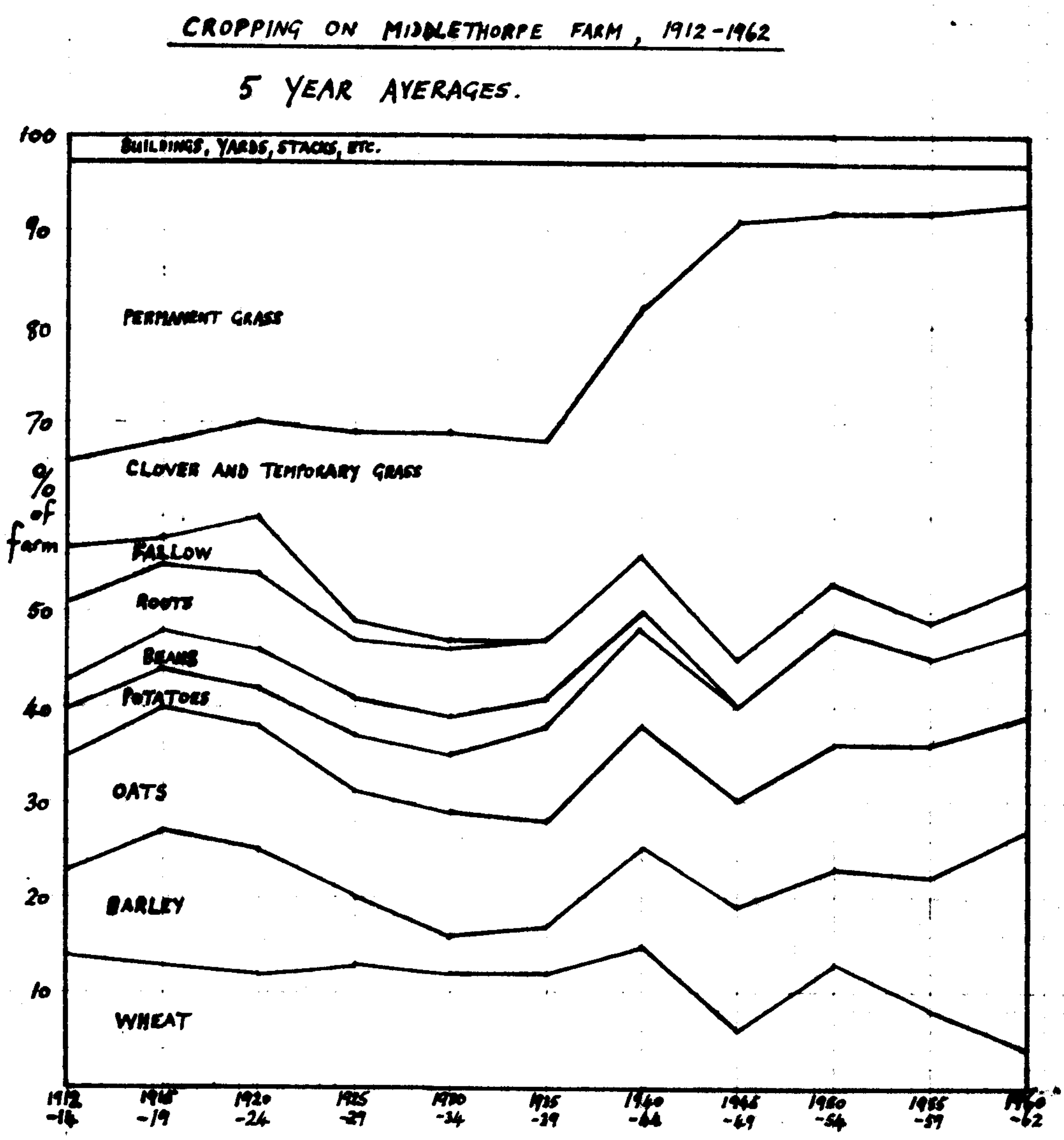
In March, 1934 the Potato Marketing Scheme came into operation to solve the problem of a very variable output that could not be kept from one season to another. Output varied, partly as a result of changes in the acreage planted, but more by fluctuation in yield which varied over the country as a whole from 5.5 tons per acre in 1931 to 7.4 tons per acre in 1939. In general, demand for potatoes increased little with a lower price, and in a year of heavy yield the price would fall so much that growers' receipts were greatly reduced. Thus a national crop of 3 million tons in 1931 had an estimated value of nearly £16 million, whilst a crop half as large again in the following year is estimated to have been purchased from growers for just over £9 million (1).

The Scheme took the form of limitation of supplies by fixing the size of the potatoes that could be sold for human consumption. This was done by determining the size of the holes in the riddle over which potatoes are normally passed before marketing in order to remove earth and very small potatoes. In years of heavy yield the Potato Marketing Board increased the minimum size of saleable potatoes. Some control over production was also exercised by allotting to each producer a "basic" acreage which related to the acreage planted in the years 1931-33. A producer could increase his basic acreage by an initial payment of a levy of £5 per acre as a contribution towards the cost of surplus disposal. The channels of sale were also regulated by determining that growers could sell only to authorised merchants.

The excessively low prices of the early 1930's were thereby raised in years of heavy yields while in poor years the smaller potatoes could be sold and the growers received prices no higher than before. The result in the

(1) Report of the Committee on the Working of the Agricultural Marketing Acts, 1947.

FIG. 1


CROPPING ON MIDDLETHORPE FARM, 1912-1962
5 YEAR AVERAGES.
BUILDINGS, YARDS, STACKS, ETC.
PERMANENT GRASS
CLOVER AND TEMPORARY GRASS
FALLOW
ROOTS
BEANS
POTATOES
OATS
BARLEY
WHEAT
% of farm
100
90
80
70
50
40
30
20
10
1912 -14
1915 -19
1920 -24
1925 -29
1930 -34
1935 -39
1940 -44
1945 -49
1950 -54
1955 -59
1960 -62

Hartlepools region was to encourage farmers to extend their potato acreages. The graph for Middlethorpe Farm (Fig. 1) shows this well in the increase between the 1930-34 average and 1935-39.

WAR-TIME ARRANGEMENTS

On the outbreak of war in late 1939 farming lost a great deal of freedom of initiative but made a huge leap forward economically, many of the gains being of a permanent nature. The control exerted by the government exceeded anything of a comparable type seen before, even in the War of 1914-18. A system of assured markets and guaranteed prices was a complete reversal of all that had depressed farming in the interwar period, and the necessity of saving shipping space forced a return to grain cultivation on many farms which had reduced their corn acreage as a matter of policy. Farmers acted according to government advice, tendered by local War Agricultural Executive Committees formed of the farmers themselves, or were evicted. Many farms were rescued from near dereliction by stern warnings which made their occupants work harder than they had done for years, others by new occupants who replaced those unable or unwilling to make the effort.

The cropping on Middlethorpe Farm, Hart, as shown on Fig. 1, swung over to larger acreages of wheat, barley, oats, and rotation grasses, at the expense of ploughing out much permanent grass, and cutting out fallow entirely. Beans and roots were cut down, and in 1942 beans disappeared altogether. As the war went on the corn acreage became larger till in 1942 it occupied fully half of the farm, (wheat 18%, barley 10%, oats 22%), with potatoes taking up 10% and roots 8%. Permanent grass fell to a mere 10%, though 19% remained under temporary grass, mainly for hay-making. The grazing area was so diminished that inevitably a large proportion of the stock on the fattening farms had to be sold. Certain farmers, selling unusually large quantities of corn in the same year in which they had disposed of stock, were so impoverished by income tax demands that they were temporarily de-capitalised, their breeding animals having represented investment capital.

This was the period in which the tractor replaced the horse on the majority of farms in the Hartlepools region. Isolated cases where farmers ran tractors before the war had taught the value of mechanised methods, especially for ploughing on the heavier soils, but the necessity of large scale ploughing finally converted most farmers into buying them. The shortage of labour brought about by the conscription of men of military age was only partly relieved by the tractor, by young women of the "Land Army", and by the use of prisoners-of-war from a camp at Hart. When industrial targets were bombed by the enemy on Teesside there was some disruption and loss, chiefly on account of stack fires.

The old grass pastures were ploughed out and sown first with oats and roots to clean the soil, then with wheat and barley, and the yields were usually highly pleasing, though by the end of the war many fields showing the strain of growing corn for several years in succession, having missed the normal resting period under grass.

From 1940 milk prices were prescribed by the Milk Marketing Board at levels determined by the Ministry of Food, which fixed maximum retail prices by Statutory Order. As a result of movements of population and changes in the requirements of various classes of consumers, many retailers who had previously got most of their milk direct from producers had to get large balancing supplies from wholesalers, on which they had to pay premiums. The wholesalers in turn had insufficient supplies from their producers and so had to pay premiums to depot proprietors and manufacturers in order to obtain milk from other areas.

From 1st October 1942 the Milk Marketing Board became the sole buyer of all milk sold off farms (other than by producer-retailers). At the same time a new price structure was introduced, based on the principle that all dairymen should be able to buy milk at the same basic price whether it was supplied ex-farm or through a wholesaler or depot (1).

Fertilizer, often too expensive during the years of depression before 1939, only became used on a large scale during the war; in this respect again a permanent new feature had entered farming. At first the fertilizer was not always the best balanced due to shortages of certain chemicals, notably rock phosphate and potash, and despite the location of two fertiliser plants on Teesside (I.C.I. and Eaglescliffe) the farms in the Hartlepools region were no better off than the average British farm in this respect. The increased demand for fertiliser has been maintained and the manufacturers have improved the quality and increased the quantity available.

POST-WAR FARMING

The agricultural policy of all governments since the war ended in 1945 has, more than any other factor, determined the course of farming. It has been to maintain guaranteed prices for grain, milk, and other livestock products. Under the Agriculture Act of 1947 state control of agriculture was made a permanent thing, and in view of world-wide food shortages at that time the fear of a flood of imports of cheap grain or meat seemed remote. Tenant farmers were granted increased security of tenure, and many of them took advantage of this to install piped water, electricity, and water-closets; expensive equipment for the dairy parlour and new field machines were other investments made at this time by tenant farmers as well as owner-occupiers. Grants have been made

(1) The Remuneration of Milk Distributors in the U.K. (Thorold Report) 1962.

available to owners and occupiers of agricultural land for such things as ditching and under-drainage, towards the cost of farm water supplies, of approved permanent buildings, sewage disposal, work on roads, fords and bridges, sheep and cattle pens, fencing, providing cattle grids and shelter belts, reclaiming waste land, removing hedges, ditches, boulders etc., and towards the cost of amalgamating uneconomic holdings. Ploughing grants of so much per acre are available to encourage maintenance of the tillage area and the regular ploughing up of leys; the ploughing out of old permanent grass is even more remunerative than that of three year old leys. Exchequer contributions are also obtainable towards the cost of nitrogenous and phosphate fertilizers, and of lime and spreading lime (1).

The 1960 statistics for the parishes in the Hartlepools region, covering one third of County Durham's agricultural land, reveal the swing back to arable farming since the 1930's.

(1) At The Farmer's Service - Ministry of Agriculture, 1960.

Parish	Agricultural acreage	Arable acreage	% Arable	% Decrease or increase from 1930	1912	1901	1870
Hart	2,434	1,955	80	+19	+18		
Elwick	1,698	1,163	58	+13	+12		
Dalton Piercy	869	594	68	+19	+21		
Hartlepool	473	402	85	+26	+20		
(above combined)	5,474	4,114	75	+21	+20	+17	+7
Billingham	4,381	2,050	47				
Newton Bewley	704	470	67	+24	+17		
(above two comb.)	5,085	2,520	50	+18	+11	+10	-13
Elwick Hall	3,568	2,081	58	+20	+17	+18	-6
West Hartlepool	1,424	1,046	73	+ 4	+ 8	+ 4	- 7
Greatham)	2,540	1,616	64				
Seaton)				+10	+ 2		
Brierton	514	376	73	+10	+ 5	+ 4	
Claxton	869	547	63	+14	+ 7		
Sheraton	2,055	1,050	51	+19	+16	+20	
Bishopton	1,999	1,434	72)				
Little Stainton	978	622	64)				
E. and W. Newbiggin	960	575	60)				
(above three comb.)	3,937	2,631	67)	+37	+26		
Sedgefield	4,395	2,846	65	+31	+30		
Trimdon	2,012	993	49	+15	+13		
Embleton	2,448	1,385	56	+32	+32		
Bradbury	1,853	823	44	+18	+23		
Mordon	1,044	712	68	+42	+44		
Foxton & Shotton	1,632	1,266	77	+41	+32		
Bishop Middleham	1,625	1,118	69	+21	+21		
Fishburn	1,650	1,179	72	+29	+29		
Butterwick	1,923	1,364	71	+47	+41		
Great Stainton	1,102	685	62				
Elstob	770	650	84				
Stillington	928	627	68				
Whitton	676	436	65				
Carlton	1,209	762	63				

Parish	Agricultural acreage	Arable acreage	% Arable	% Decrease or increase from 1930	1912	1901	1870
Redmarshall	988	510	52				
Sadberge	1,891	1,410	74				
Long Newton	3,952	2,683	68				
Elton	1,535	982	64				
Norton	1,834	1,168	64				
Monk Hesleden	1,623	1,323	82	+24	+39	+41	+23
Castle Eden & Horden	1,004	837	83				
Wingate	3,414	2,216	65	+38	+32		
Hutton Henry	1,829	1,244	68	+16	+17		
Shotton	2,022	1,528	75				
Grindon	4,149	2,310	57	+36	+25	+18	+ 1
Overall (42 parishes)	72,974	47,037	64				

Note: In 1937 the parishes of Thorpe Bulmer and Nesbitt were incorporated within Hart; Throston became part of Hartlepool; Bishopton was split up into Bishopton, Little Stainton and Newbiggin; West Hartlepool gained Seaton Carew and part of Throston; Newton Bewley lost half of its area to Billingham; Greatham and Dalton Piercy lost land to West Hartlepool; Horden was separated from Shotton but its 1960 figures had to be amalgamated with those of Castle Eden where only a small number of farms exists; the Seaton and Greatham figures also had to be amalgamated in accordance with the 1947 Agriculture Act; Grindon gained part of the former parish of Wolviston, the rest of which, along with Cowpen Bewley, went into an enlarged Billingham.

Although milk production and stock fattening had become too important to allow a complete return to the high arable percentage of farmland of the period 1860-1870, the increase in the arable proportion was nevertheless remarkable. The three major factors behind this increase were undoubtedly the degree of financial support given to cereals by the government guarantees of prices, the intensive feeding of livestock, and the great technical advances made on the tillage side since 1930. The capital made available by relatively good prices during and after the 1939-45 war, and the security afforded by prices guaranteed under the 1947 and 1957 Agriculture Acts led to the purchase of machinery on a hitherto unknown scale. The replacement of horses by tractors began on a small scale in the Hartlepools region before the war but it was the great wartime ploughing up campaign which saw the transformation to mechanised agriculture. Some of the smaller farms visited by the present writer were not able to afford tractors until the early 1950's, but the larger farms took them up in the period 1940-43, when much old grass was being broken up.

Tractor-drawn implements have made a significant difference to the farms with heavier soils, both in the speed with which the work can be done, and in the fineness of the tilth produced. One machine, the 'rotavator', can chew up the soil so well that barley is being grown on land previously thought too heavy for it. The combine harvester makes sure of crops at critical times when weather might otherwise reduce the value of the harvest, while grain driers, though not yet as widespread, are also reducing the grip of the physical controls on arable farming.

Nevertheless, the fact that physical controls do exert significant pressure on land use is borne out by the lower proportions of arable in the parishes where soils are heavy and badly drained, as for example Trimdon, Billingham, Sheraton and Redmarshall, all with only about half of their farmland under arable, part of which, of course, is under temporary grass.

Near the towns another factor has operated to increase the already large arable proportion of the farmland, and this is the rapid rate of building since the war. As housing advances into open fields many farmers take a final crop, usually of a cereal, most of which can be harvested despite newly trodden footpaths through the corn, before the builders move in.

Hidden by the jump from 1930 to 1960 figures are the peak arable years of the war, and the inevitable decline immediately afterwards, which was halted in 1956 by the government's policy of encouraging ley farming, with rotation grasses taking up land that might have gone back to permanent grass if it had not been for the ploughing-out subsidy.

The following figures for 1960 have been calculated from raw data by the writer to show the percentage of the total agricultural land occupied by the various crops in each parish:

Parish	Wheat	Barley	Oats	Potat.	Legumes	Roots	Fallow	Temp Grass	Perm. Grass	Market Veg
Hart	9	10	14	12	-	5	0.2	29	20	1.3
Elwick	10	7	13	8	0.3	4	0.5	24	32	
Dalton Piercy	8	10	10	8	-	5	-	29	32	
Hartlepool	11	13	23	11	-	4	-	21	15	
(above combined)	9	9	14	10	-	5	0.2	27	23	0.5
Billingham	7	5	13	4	-	2	1	13	53	
Newton Bewley	10	9	18	4	-	3	-	17	33	
(above two comb.)	8	5	14	4	-	3	0.8	14	50	
Elwick Hall	10	10	13	2	0.6	4	1.1	16	41	
West Hartlepool	10	17	14	7	-	3	0.4	18	26	3.5
Greatham & Seaton	10	10	10	6	-	5	-	15	36	5
Brierton	12	3	19	10	-	2	3	23	27	
Claxton	9	10	18	4	2	5	-	16	36	
Sheraton	8	6	12	4	-	5	-	13	49	
Bishopton	8	19	11	2	-	4	-	26	28	
Little Stainton	2	13	15	-	-	1.2	1.2	30	36	
Newbiggin	5	6	15	1	-	2	3	28	40	
(above 3 comb.)	6	14	14	1	-	3	1	27	33	
Sedgefield	6	10	15	4	-	4	0.7	23	35	
Trimdon	7	6	12	3	-	3	0.5	17	51	
Embleton	6	10	12	1	0.3	2	0.5	22	43	
Bradbury	3	10	9	2	-	2	0.7	15	56	

Parish	Wheat	Barley	Oats	Potat.	Legumes	Roots	Fallow	Temp. Grass	Perm. Grass	Market Veg
Mordon	6	14	15	3	-	4	-	26	32	
Foxton & Shotton	9	22	12	3	-	4	0.6	25	22	
Bishop Middleham	10	15	9	8	-	2	-	21	31	2
Fishburn	7	14	11	4	-	2	2	30	28	
Butterwick	11	14	22	3	0.2	3	0.6	16	29	
Great Stainton	6	11	12	1	0.8	1	0.8	30	38	
Elstob	7	17	14	2	-	3	4	37	16	
Stillington	7	18	12	2	-	4	-	24	32	
Whitton	5	18	8	7	-	3	0.4	22	35	
Carlton	10	14	9	2	-	2	1	24	37	
Redmarshall	12	4	8	-	-	1	-	26	48	
Sadberge	5	19	15	3	-	3	3.3	24	25	0.6
Long Newton	6	14	12	2	-	3	0.3	28	32	
Elton	13	6	16	2	0.3	2	0.9	21	36	1.1
Norton	9	13	13	3	-	2	0.8	20	36	2.7
Monk Hesleden	14	12	12	8	-	5	-	28	18	1.6
Castle Eden & Horden	6	3.5	10	20	-	8	-	30	17	7
Wingate	6	11	10	3	-	2	0.2	29	35	
Hutton Henry	7	7	16	5	-	5	-	27	32	
Shotton	12	6	16	4	1.1	3.5	0.4	32	25	
Grindon	6	11	11	1	0.3	2	2.5	20	44	

The stimulus given by active government support has resulted in an enormous increase in the land under cereals and potatoes. Temporary grass has also increased and the proportion under permanent grass has accordingly shrunk. Leading the advance of the arable crops is barley, which has increased its acreage by over 50% since 1952 in the country as a whole and by 1961 reached its largest ever acreage. In the parishes of the Hartlepools region barley, after occupying about 3% of the total farmland in 1930, took up about 11% in 1960. In Foxton and Shotton parish barley occupied more than a fifth of the agricultural land, and in Bishopton and Sadberge parishes 19%.

Wheat and oats also increased their share of the cultivated area, though not in as spectacular a fashion as barley. Wheat occupied 8% and oats remained the leading cereal crop with 13% of the farmland. Thus about one third of the total acreage of farmland was under cereals in 1960 in the Hartlepools region, with the better drained soils having more (e.g. Butterwick 47%, Foxton and Shotton 44%), and the poorly drained soils less (e.g. Trimdon 25%, Billingham 26%)

While technical advances have made it easier to grow cereals since the 1930's there can be little doubt that it is the favourable economic circumstances and especially the government price guarantees which have been responsible for the popularity of cereal crops in the 1950's and 1960's. Barley's guaranteed price jumped from 23/- per cwt. in 1954 to 29/- in 1957, and that of oats was increased from 21/3d per cwt. in 1954 to 27/5d in 1957, because the government wished to cut the high level of imported animal feeding stuffs (in 1954 some 2 million tons worth about £55 million c.i.f.) by producing more at home. The production of barley in Britain rose from 2¼ million tons in 1954/55 to 4¼ million tons in 1960/61, when the rate of subsidy was nearly half the market price, which was out of all proportion to the support for any other commodity (1). The guaranteed price for wheat, a crop of less value for animal feeding than barley or oats, fell during the same period from 29/9d in 1954 to 26/11 per cwt. in 1960, which was connected with the growing surpluses of wheat in the Commonwealth and U.S.A.

With the widespread introduction of three-year leys of grass seeds and the heavy use of subsidised fertilizer there is less need for the traditional rotation crops of legumes, and most farms have ceased to grow peas and beans, though clover is still popular. In the parishes of Claxton and Shotton are the only farms where they remain on more than 1% of the farmland. In the former, one farm has

(1) Annual Review and Determination of Guarantees, 1961. Cmnd. 1311.

a contract to supply a West Hartlepool pet shop with beans for pigeon fanciers' requirements, and in the latter, one farm grew 18 acres of vetches in 1960.

Potatoes became more important during the war and have maintained their enlarged acreage. The new marketing arrangements which came into operation in 1955, with the establishment of a new Potato Marketing Board, offered deficiency payments whenever potatoes were sold below a standard price. In 1959 still fresh arrangements came into force, replacing seasonal and regional price scales with a national scheme for an average minimum price per ton for potatoes sold for human consumption only. In 1960 the parishes where potatoes were occupying the largest proportion of the farmland were Horden (with Castle Eden) with 20%, Hart with 12%, Hartlepool with 11%, Brierton with 10%, Monk Hesleden, Elwick, Dalton Piercy, and Bishop Middleham, all with 8%. All these parishes, besides having urban sources of labour for the tedious harvesting processes, also possess in common extensive areas of lighter soils based on glacial deposits of sand and gravel. Parishes where the traditional lack of potatoes still persisted in 1960 were those remote from the towns such as Little Stainton, Great Stainton, Embleton and Newbiggin, although Norton and Grindon, on Stockton's doorstep, also grew surprisingly few. In the case of these last-named parishes, soils derived from the heavy boulder clay are perhaps to blame.

Although the proportion of farmland under roots decreased after 1930 it was largely a matter of the substitution of kale for swedes. No kale was grown in 1930, while most farms in 1960 grew a strip of kale among bordering strips of swedes, mangolds, and potatoes. Heavier yields of hay, developed with the help of generous applications of fertilizer, have also rendered unnecessary some of the fodder root acreage. Thus only 4% of the Hartlepool region farmland was growing roots in 1960.

Temporary grass in 1960 occupied almost a quarter of the farmland and in several parishes had become more important than permanent grassland. The encouragement given to ley farming by the government ploughing-out subsidies is largely responsible for this, many fields being left down to grass for three years to earn the grant.

The only parishes with more than 50% of their farmland under permanent grass were Bradbury, Billingham and Trimdon, all having substantial areas of rough grazing, corresponding to what have been throughout centuries badly drained soils. Apart from the massive reduction in the proportion of permanent grass on the farms much of the permanent grass described as rough grazing has been improved by draining, ploughing, re-seeding and fertilizing. In the parish of Hart, for example, there were in 1960 only 60 acres of rough grazing compared with 212 in 1930; in Grindon the same period has seen a reduction from 496 acres to 86; in Embleton, more spectacularly, from 940 acres to 167.

The use to which the grassland, temporary and permanent, was put in 1960 varied from parish to parish. Farms which buy in store cattle for summer fattening and autumn selling obviously require much less hay as winter fodder, so they are able to cram fatstock on to a larger proportion of their grassland. The parishes where fattening farms are important therefore have only a low proportion of their grassland for mowing; Billingham, Greatham, Sheraton, Bradbury, Bishop Middleham, Wingate and Grindon all have less than 30% of their grass for hay (or silage). While most of the parishes of the Hartlepools region have about two-fifths of their grass for mowing a few have over half under hay, (e.g. Stillington, Sadberge, and Newbiggin), and in these parishes dairy cattle predominate. The high proportion of rough grazing in the grass acreage of the coalfield parishes (e.g. Shotton 12%, Wingate 14%, Hutton Henry 11%, Monk Hesleden 11%) is largely accounted for by subsidence due to mining, but the even higher proportions in Billingham (23%), Greatham and Seaton (27%), and Bradbury (27%) are due to edaphic factors, where drainage is impeded.

The change in the proportions of grass for mowing and grass for grazing since 1930 shows a downward trend in the former. Bearing in mind the decreased acreage of total grassland there has obviously been a major slash in the amount of hay grown in the Hartlepools region. The exceptions were the parishes where dairy cattle are predominant such as Monk Hesleden, Newton Bewley and Sedgefield, the proportion of hay meadow increasing compared with 1930, as the following figures show:

	1930			1960		
Parish	Mowing	Grazing	Rough	Mowing	Grazing	Rough (as percentage of all grassland)
Hart	41	48	11	34	61	5
Elwick	44	54	2	41	57	2
Newton Bewley	38	62	-	49	50	1
Elwick Hall	35	51	14	30	61	9
Claxton	38	61	1	31	68	1
Sheraton	30	70	-	26	59	15
Sedgefield	41	53	6	40	55	5
Trimdon	52	46	2	42	52	6
Bradbury	33	67	-	30	43	27
Bishop Middleham	44	53	3	26	71	3
Fishburn	52	41	7	45	54	1
Butterwick	47	43	10	43	52	5
Monk Hesleden	35	54	11	41	48	11
Wingate	37	47	16	29	57	14

Note: It would appear that the basis for assessing rough grazing land in 1930 was somewhat different from that adopted in 1960, since there has been no sudden deterioration in the grassland of either Sheraton or Bradbury.

The 1960 livestock figures show large increases over those for 1930, despite the reduced acreage of grassland. Guaranteed prices for milk and meat were undoubtedly responsible for the increased numbers, and scientific progress in disease control and higher yielding stock have both reduced the risks and increased the profitability of keeping animals. In the Hartlepools region a comparison of the 1930 and 1960 figures for 34 parishes shows an increase over these thirty years of 61% in dairy cattle, of 10% in beef cattle (cattle other than dairy over two years old), of 88% in young cattle (under two years), and of 9% in sheep. Some of this rise in sheep numbers is due to a higher yield of lambs per ewe, as for example in the case of Sedgefield parish, where in 1930 879 breeding ewes gave 1,192 lambs, while in 1960 859 ewes gave 1,536 lambs. The increase in Bradbury (1,331 to 2,614), in Bishop Middleham (540 to 1,612), and in Fishburn (646 to 1,115) is too large to be attributed solely to heavier yields, however, and a change in policy towards sheep is indicated. It should be mentioned that some of the cattle under two years would go to slaughter at only 14 to 18 months old, having been fattened on barley in a way which has become popular only since farms began producing much of their own feed grains.

From the increased numbers of young cattle in the region it can be seen that fresh policies have evolved since 1930. In 1930 young cattle outnumbered dairy cattle in the ratio of 4:3, while in 1960 the ratio had increased to 3:2. This indicates that much more rearing was being practised than in the depressed days of the 1930's when young stores could be purchased so cheaply from the hill farms in western Durham. The calf subsidy, paid for steer and heifer calves of beef type, was also a spur towards home rearing, even on milk-producing farms, as long as beef-type sires were used. This subsidy stood at £8. 10s. a head for calves born before 1st April, 1959, and £9. 5s. a head (steers), £7. 10s. a head (heifers), for calves born after that date, costing the Exchequer £17. 6 million in 1960/61. Only in one parish out of the 34, Sheraton, was the number of young cattle diminished, and this can be explained from the fact that half of the farmland in Sheraton is controlled by a family with strong interests in the auctioning of Irish store cattle, many of which find their way on to the two large farms run by this family.

The increase in the size of dairy herds, however, was the major difference between 1930 and 1960. The improvement in prices brought about by the Milk Marketing Board schemes, the guaranteed sale of milk at all times of the year, and the adaptability of the motor collection from farms, all led many farmers to embark upon milk production. The parishes which increased their numbers of dairy cattle most were those near the central dairies at West Hartlepool, Wellfield (Wingate) and Stockton. It was not a case of mass change, however, for many farms were unsuited to milk production either by lack of buildings, by remoteness, or by lack of labour. Certainly those farms already producing milk expanded production by building up the strength of their herds in the 1930's, and again after the war. A case in point is Home Farm, Elwick, where in the 1930's only 20 milk cattle were kept; in 1960 the corresponding figure was 55, the farm having been split in two (Home Farm and Lamb's House) in 1948. After the 1947 Agriculture Act had made many of the wartime financial guarantees permanent, and after the tightening of the regulations governing milking and buildings in the 1950's many farmers expanded their herds as they sank more capital into the business. Middle Field Farm at Greatham had 11 milk cows in 1949 but 23 in 1960, an instance that could be repeated for most of the smaller dairy farms. The increase produced in this way far outweighed the loss of milk cattle on farms going out of milk on account of the tighter regulations; these farms were mainly those which had dabbled in the milk trade and had persisted with inadequate buildings until the new rules made it illegal.

Applying the same grazing indices as previously, the number of acres of grazing land per grazing unit has been calculated as follows:

Acres of grazing land per grazing unit by parishes, 1960

Billingham	2.02	Hutton Henry	1.54	Little Stainton	1.33	Fishburn	1.17
Trimdon	2.02	Shotton	1.51	Monk Hesleden	1.32	Great	
Embleton	1.82	Newbiggin	1.51	Horton	1.30	Stainton	1.15
Seaton &		Redmarshall	1.50	Elton	1.28	Sadberge	1.14
Greatham	1.73	Claxton	1.49	Carlton	1.24	Castle Eden	
Wingate	1.70	Dalton Piercy	1.48	Sedgefield	1.24	& Horden	1.04
Bishop		Long Newton	1.48	Bishopton	1.24	Newton	
Middleham	1.64	Whitton	1.39	Elstob	1.24	Bewley	1.03
Elwick Hall	1.59	Grindon	1.39	Hart	1.20	Stillington	0.95
Sheraton	1.59	Butterwick	1.36	Foxton & Shotton	1.18	Elwick	0.91
Bradbury	1.58	Brierton	1.33	West Hartlepool	1.17	Hartlepool	0.74

The combination of larger numbers of cattle and the smaller acreage of grazing had cut the indices in all parishes except Trimdon where stock numbers had fallen and the grazing acreage had risen. The greatest changes in grazing index occurred where the numbers of dairy cattle (which weigh most in Smith's index code) had risen most, as in Elwick, Wingate, and Grindon. Changes in the methods of feeding stock had altered as feeding stuffs became cheaper as a result of the government subsidies for cereals, and concentrates and cattle cake were fed on a larger scale. According to the individual farmer's preference stock were fed to varying degrees indoors but as the above grazing indices refer to June, when all except a small minority of calves would normally be at grass, the table can be taken as a rough guide to the intensity of stocking in the parishes of the Hartlepools region. The parishes where there were large extents of rough grazing, for example, Billingham, Seaton, Wingate and Bradbury, were again the least intensively stocked.

The area of agricultural land continued to shrink between 1930 and 1960. Vast house building programmes were inaugurated especially after 1945 in the towns of West Hartlepool, Hartlepool and Billingham, so that whole farms disappeared in rapid succession, while most of the rural villages also expanded substantially. The colliery villages grew to a lesser degree but a completely new town, Peterlee, was created in the mid-fifties on the hills between Horden and Shotton Colliery, blotting out several farms.

Farm sizes decreased on the average because of this urban spread but some farms were nibbled away in various other ways, such as by the construction of electricity transmission lines and pylons, by the creation of water reservoirs and pumping stations, and by the opening of the short-lived West Hartlepool Civic Airport which soon gave way to the gaint new integrated works of the South Durham Steel and Iron Company near Greatham. A comparison of 31 parishes (1) shows the following changes in farm sizes from 1930:

	Under 5 acres	5-20	20-50	50-100	100-150	150-300	Over 300 acres
1930	76	102	68	100	93	121	26
1960	87	86	66	93	78	115	26

The decrease in the number of farms in the 5-20 acre class is greater than these figures indicate because in the 1930's the Durham County Council set up smallholdings at Hart and at Hutton Henry, many of which have been amalgamated

(1) Namely Hart, Elwick, Dalton Piercy, Hartlepool, Billingham, Newton Bewley, Elwick Hall, West Hartlepool, Greatham, Seaton, Brierton, Claxton, Sheraton, Bishopton, Little Stainton, Newbiggin, Sedgefield, Trimdon, Embleton, Bradbury, Mordon, Foxton and Shotton, Bishop Middleham, Fishburn, Butterwick and Oldacres, Monk Hesleden, Castle Eden and Horden, Wingate, Hutton Henry, Shotton, Grindon. (Horden was included with Shotton in 1930 but in Castle Eden returns for 1960).

since, thus accounting for the apparently small decrease in the numbers of the 20-50 acre class. The process of amalgamation on a larger scale is shown by the following figures for Billingham (including Wolviston and Cowpen Bewley):

Number of holdings

	Under 5 acres	5-20	20-50	50-100	100-150	150-300	Over 300 acres
1930	4	6	4	14	12	-	3
1960	5	5	5	9	5	5	2

The encroachment of the builder is shown by the corresponding figures for Sedgefield:

1930	3	8	4	14	2	13	2
1960	9	6	6	12	7	9	1

It is not easy to generalise about the trends in farm labour because while in the 42 parishes of the Hartlepools region the total labour force has decreased from 1,664 in 1930 to 1,357 in 1960 (June returns), in some parishes the number of workers has increased. There are usually special reasons, however, for these isolated increases. The parish of Grindon, for example, where the number of workers has risen from 45 to 64, has been enlarged as a result of boundary revision, as is the case with Elwick and Dalton Piercy. Real expansion in employment does seem to have taken place, however, in the parishes of Embleton (28 to 46 workers), Butterwick-and-Oldacres (18 to 28), and Bishopton - with Little Stainton and Newbiggin - (52 to 64), all of which are highly rural and remote from door-step supplies of labour. The heaviest falls in the labour force took place where other work of a more remunerative nature was easily accessible. Coal-mining, chemicals, steel and engineering were obvious alternatives for farm workers near the towns, and most of these industries have been flourishing since 1939, and drawing men from the countryside.

The structure of the farm labour force has altered considerably since 1930, the proportion of women having fallen in a most striking fashion, and the casual labour having increased. Not directly comparable, the following figures never-the less show the chief trends:

1930 (42 parishes)

Regular workers			Casual workers	
Males 21 years and over	Males under 21	Females	Males	Females
767	384	211	150	152
= 46%	= 23%	= 13%	= 9%	= 9%

1960 (42 parishes)

	Regular workers					Part-time workers			Seasonal
Aged	Over 65	20-65	18-20	Under 18	Females	Over 20	Under 20	Females	
	33	660	105	166	47	89	17	33	207
	= 2.4%	= 48.6%	= 7.8%	= 12.2%	=3.5%	= 6.6%	= 1.3%	= 2.4%	= 15.3%

It can be seen that the older element has increased in the labour force, while the replacements from the younger ranks have diminished. Youths often work on farms till they come on to men's wages, when the lure of industrial wage-rates is then too strong, with the result that the turn-over in farm-lads is large.

The change to milking by machine has ended an era in the employment of women on the farms, many of which are entirely male-run. In the Monk Hesleden parish, a dairying area, only two out of the farm workers are females, compared with 20 in 1930, and in Fishburn parish one female (compared with 17) is employed. Four fifths of the female labour has left the industry in the Hartlepools region since 1930, and no doubt the growth of the trading estates, with factories employing hundreds of women and girls, has been an important contributory factor. But many farmers' daughters now set their sights higher than the milk stool, and become teachers, scientists, or the wives of non-farming workers.

As these returns are for the month of June when the hay harvest is usually in full swing in the Hartlepools region, there is inevitably a high proportion of casual help. In October on those farms which grow potatoes this proportion swells, the bulk of the extra labour being provided by women and in the colliery districts by children also. The work in the summer months can be performed by fewer workers by dint of late working in the long evenings, to the extent of continuing by the light of tractor headlamps in extreme cases. In general most farms are small enough to be run by the family with one regular employee for most of the year, and no matter how fast or efficient new agricultural machines become, the same amount of labour will be required. On farms with dairy cattle this is even more true, though the mechanisation of tasks formerly done by manual labour has cut the time needed to perform them.

The figures given above may be more conveniently summarised as follows:

	Permanent workers		Temporary workers	
	Men	Women	Men	Women
1930	1,151	211	150	152
1960	964	47	106	33
1960 figure as percentage of 1930 figure:				
	83.8%	22.3%	70.7%	21.7%

Labour requirements for cash crops have been estimated (1) as follows:

	1930	1950	1960	(hours per acre)
Potatoes	215	195	140	
Wheat	53	33	17½	
Barley	54	23	12½	

The effect of the tractor and the combine harvester is thus made plain, the latter being of especial value in the case of barley. Combine harvesting alone reduces the labour-hours per acre by about 20. The above figures are computed

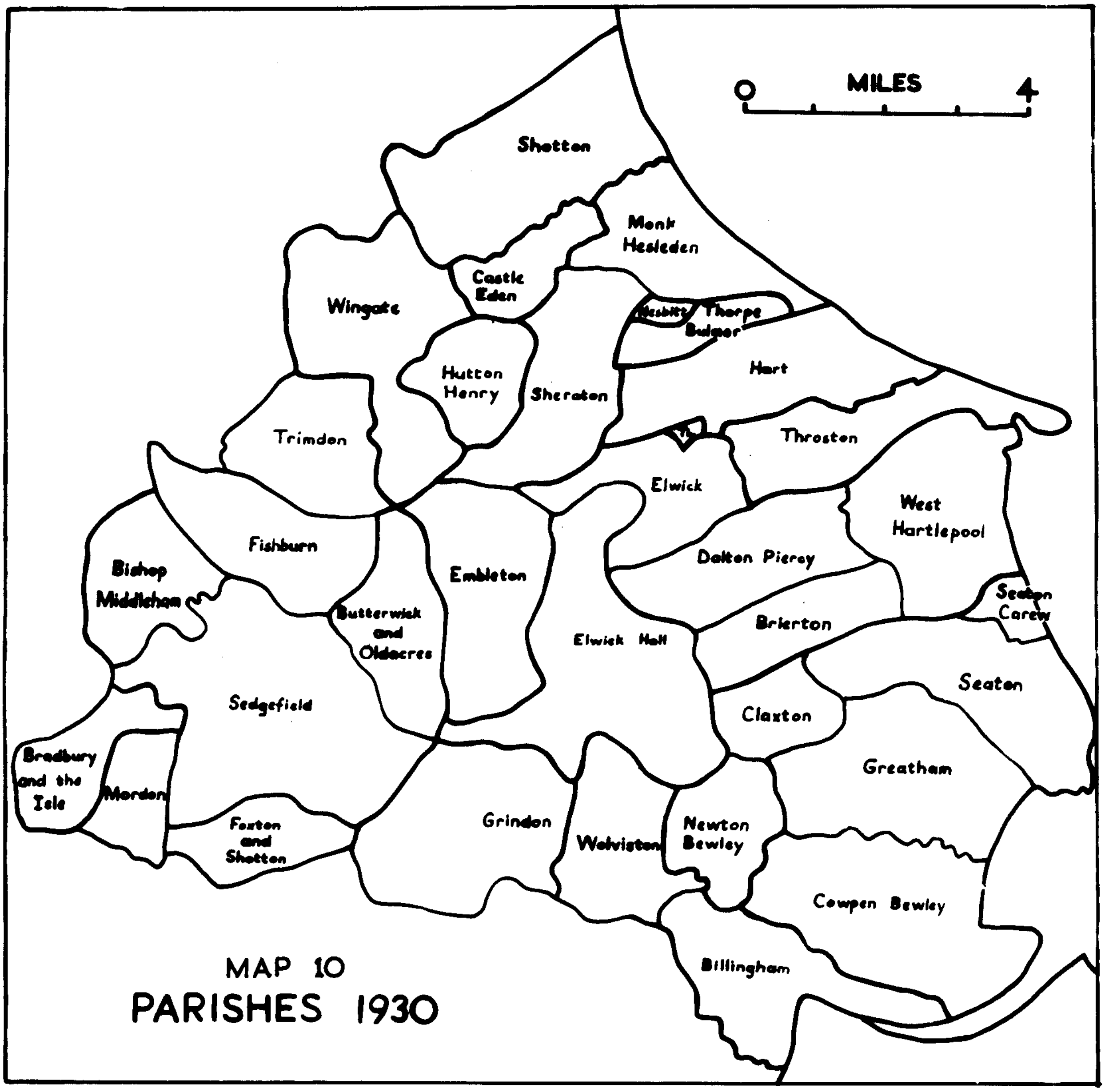
(1) J.S. Nix. Agriculture, June, 1961.

from the following detailed labour requirements:

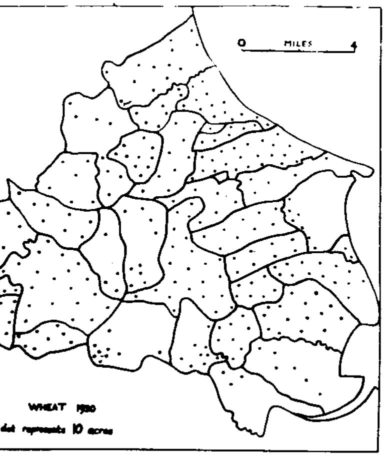
Potatoes	1960
Farmyard manure (two-thirds of the acreage)	14.0 hours per acre
Plough	2.8
Seedbed cultivations and fertilizer	3.1
Plant	10.0
After cultivation	4.1
Hand hoe (half the acreage)	12.0
Spray	1.5
Harvest, cart and clamp	60.5
Earth up (half the 1960 crop)	3.0
Clearing tops	2.0
Riddle, bag and load	27.0
	140.0

Cereals	Wheat 1960	Barley 1960
Farmyard manure (10% of wheat acreage 5% of barley)	2.1	1.0
Plough	2.0	2.0
Seedbed cultivations	1.4	1.4
Combine drill	1.3	1.3
Top dress (wheat), harrow, roll	1.2	0.7
Spray	0.3	0.3
Harvest and barn work	9.0	5.7
	17.5	12.5

Hand hoeing has declined partly because of the high expense of labour, and partly because of the great advance made in chemical weed control in the 1950's. This has meant that the increase in the potato acreage on many farms in the



MAP 10
PARISHES 1930



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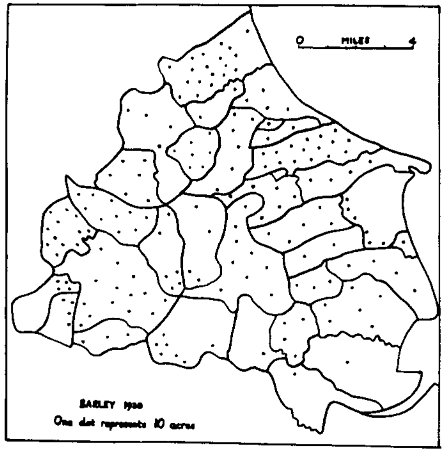

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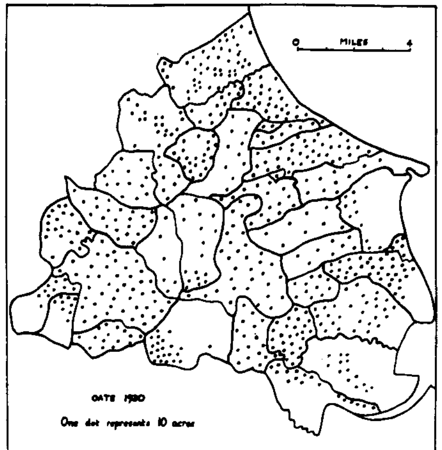

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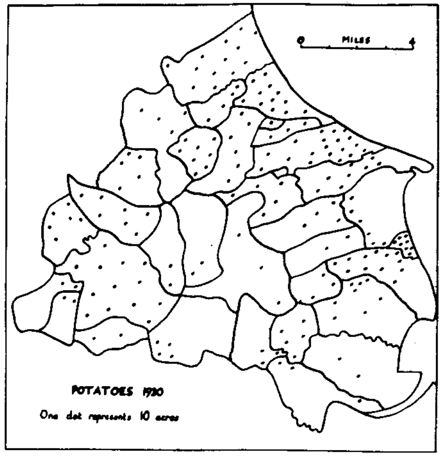

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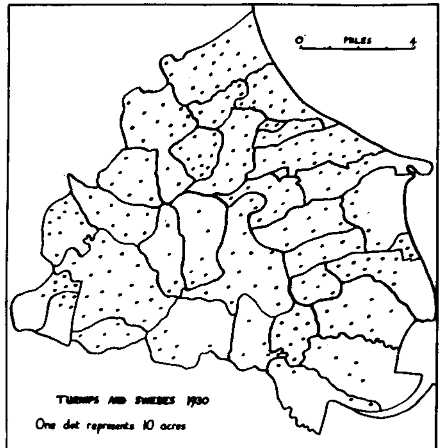

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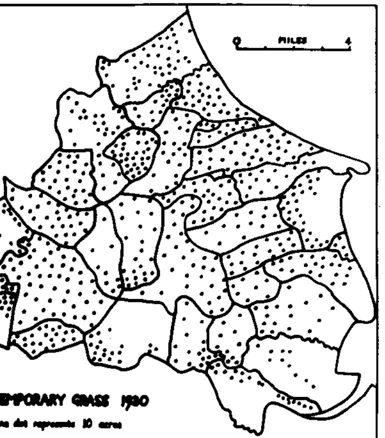

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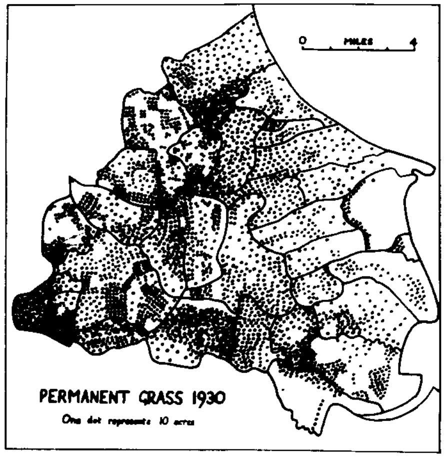

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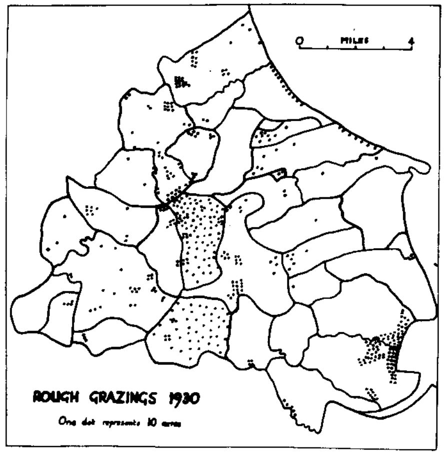

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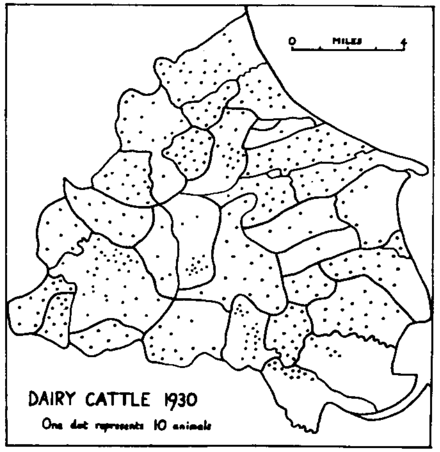

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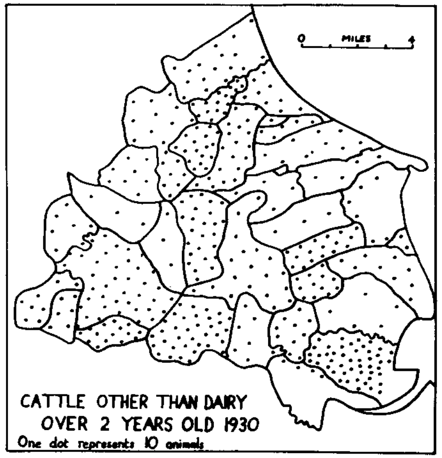

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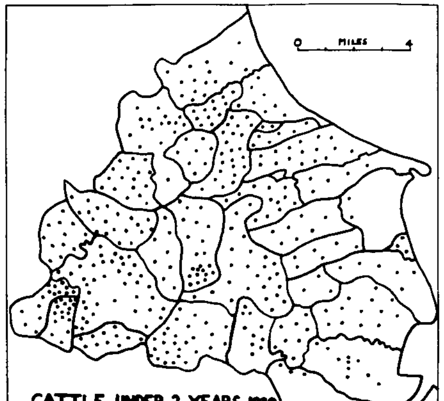
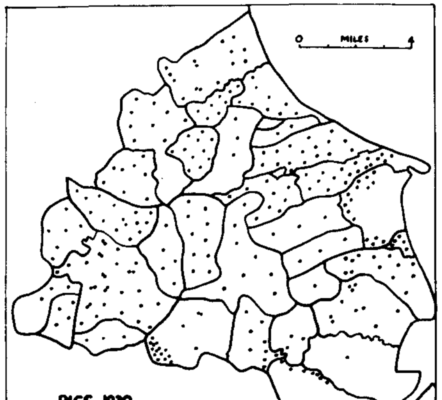
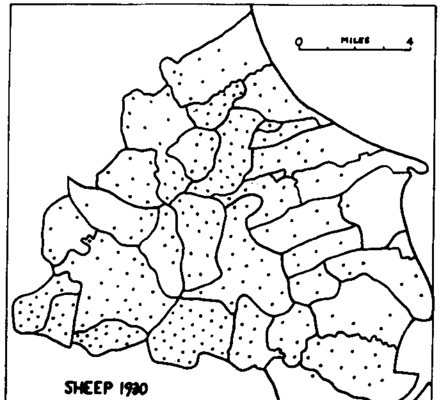
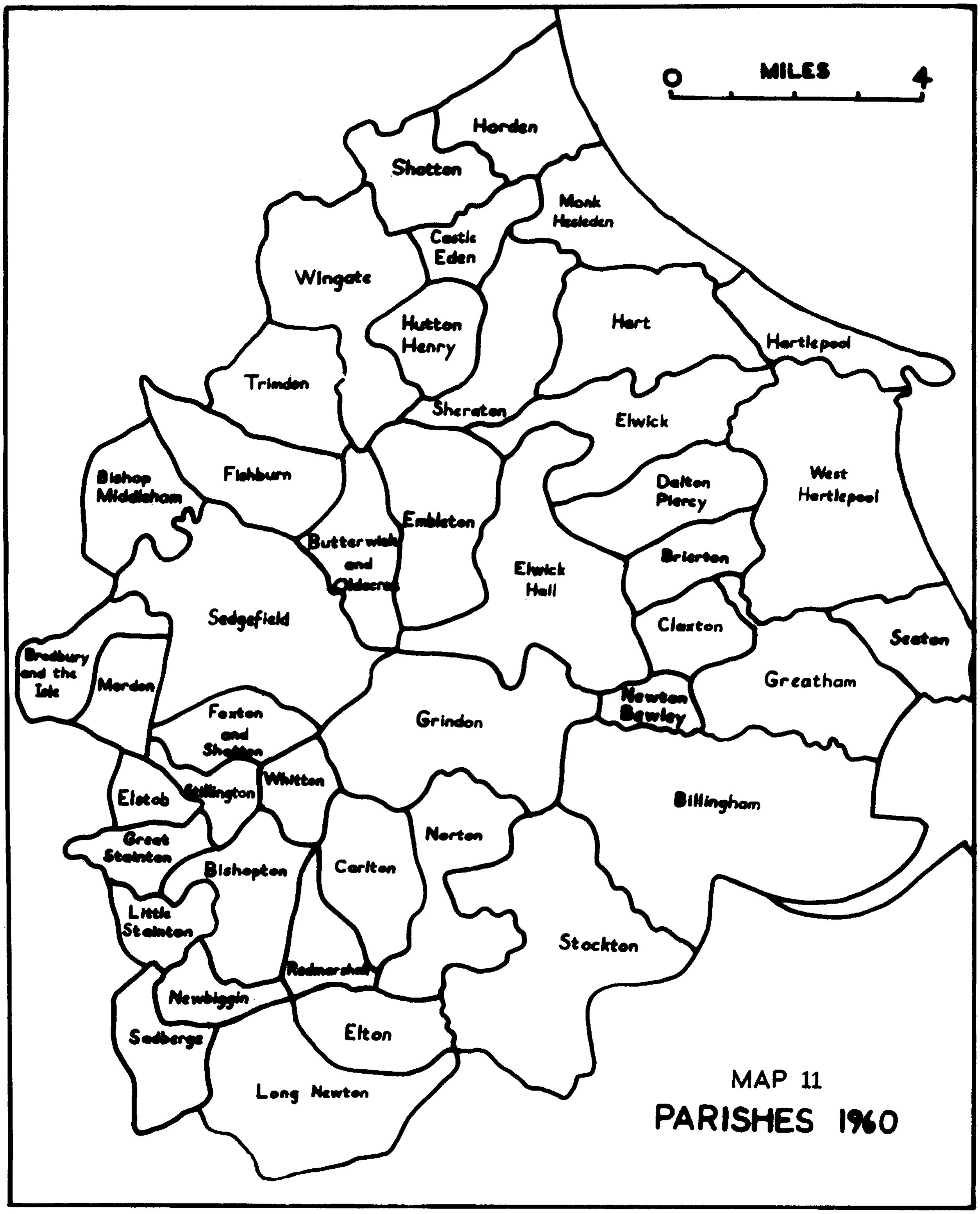


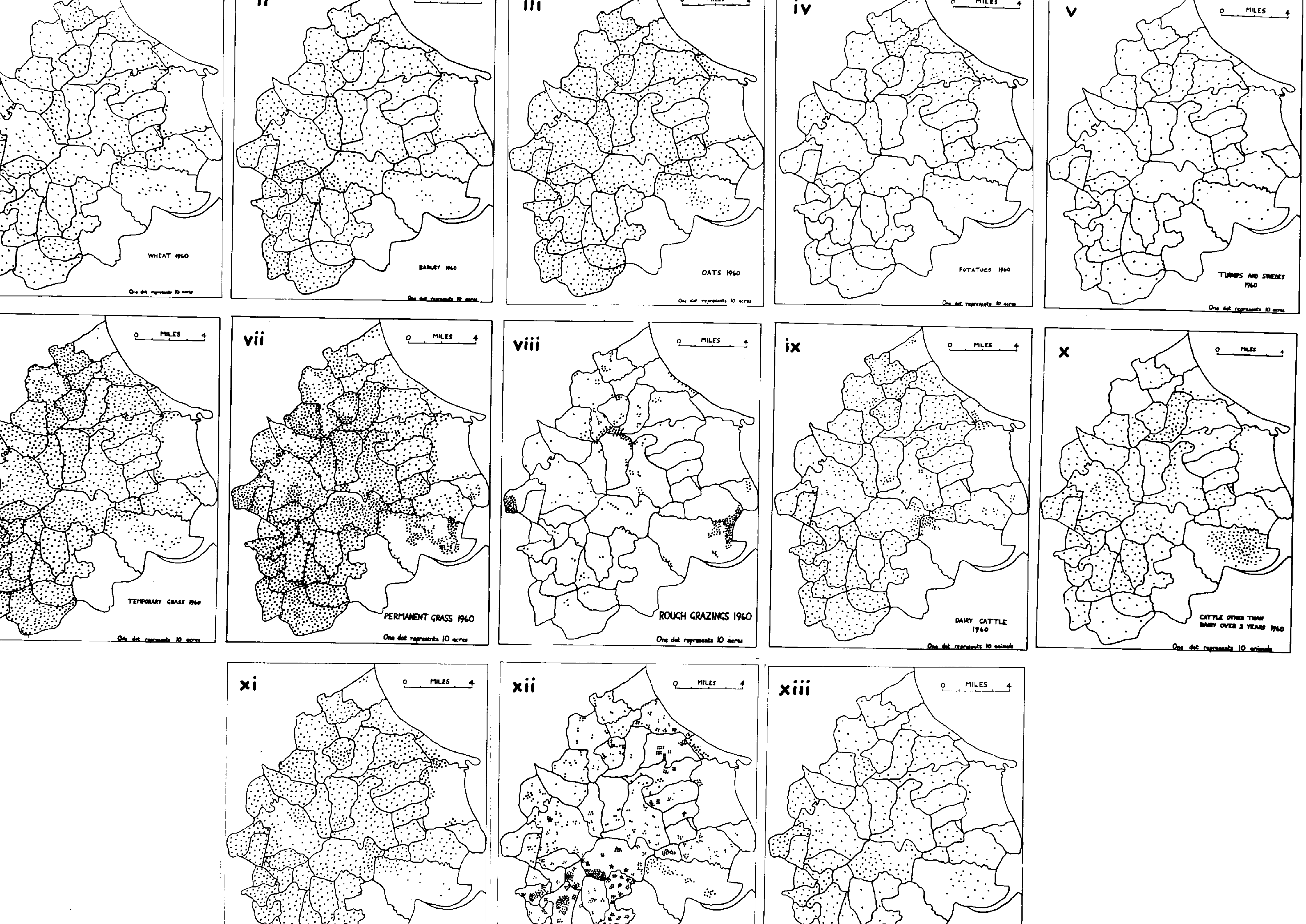






MAP 11

PARISHES 1960


WHEAT 1960
One dot represents 10 acres
ii
BARLEY 1960
One dot represents 10 acres
iii
0 MILES 4
OATS 1960
One dot represents 10 acres
iv
0 MILES 4
POTATOES 1960
One dot represents 10 acres
v
0 MILES 4
TURNIPS AND SWEDES 1960
One dot represents 10 acres
0 MILES 4
TEMPORARY GRASS 1960
One dot represents 10 acres
vii
0 MILES 4
PERMANENT GRASS 1960
One dot represents 10 acres
viii
0 MILES 4
ROUGH GRAZINGS 1960
One dot represents 10 acres
ix
0 MILES 4
DAIRY CATTLE 1960
One dot represents 10 animals
x
0 MILES 4
CATTLE OTHER THAN DAIRY OVER 2 YEARS 1960
One dot represents 10 animals
xi
0 MILES 4
xii
0 MILES 4
xiii
0 MILES 4

Hartlepools region has not necessitated an increase in the payroll. The difficulties of obtaining sufficient casual labour at the peak period in October make the potato crop a rare one in the more rural parishes.

The decrease in the labour force has thus been felt mainly on the larger farms, and they have been able to bear the loss because of their investment in machines and chemical aids.

THE CROP MAPS

The crop maps for 1960 (Maps 13 i-xiii) were constructed on the following principles:

1. Parish areas were taken as the distribution unit because of the availability of parish statistics of crop and grass acreages and numbers of livestock extracted by the writer from the records of the Ministry of Agriculture, Fisheries and Food, at Guildford, Surrey.
2. Each dot represents ten acres and on the animal distribution maps ten animals, except for sheep, where one dot represents 100 animals.
3. For greater accuracy, parkland, woodland, and urban areas were previously marked off on the crop maps. Parkland was not excluded, however, on the livestock maps, because many parks (e.g. Wynyard Park) are used in June for grazing.
4. The placing of the dots on the maps was determined by the writer's personal knowledge of the farms and their individual specialisations. Thus the distribution of pigs in the parish of Grindon, for example, is tightly clustered in 1960 around the south-west corner near Thorpe Thewles, where several farms make pig breeding their main line.
5. Although each dot represents ten acres this should not be taken as an indication of yield or quality of crop. Such information is not available except on a county basis.

The crops maps for 1930 (Maps 12 i-xiii) were constructed on the same lines except that the Land Utilisation Survey maps of the area for 1931-32 were used to determine the distribution of the dots on certain of the crop maps. For example the distribution of permanent grass was given exactly on the Land Utilisation maps and was followed as well as the dot method allows. The arable crops could also be plotted using this guide, though with less accuracy. In the case of the various animal distribution maps the writer's farm-to-farm enquiries determined the dot patterns in the majority of cases. It should be noted that some parish boundaries have been altered since 1930, making a direct comparison with the 1960 maps difficult.

A FARM SURVEY OF THE HARTLEPOOLS REGION

Although a statistical analysis of the agriculture on a parish basis gives a good overall impression of the total production and broad distribution patterns, it is still necessary to investigate individual farms to discover the exact structure of the farming in a region. If every farm is visited, walked over, and discussed with the occupier then many of the difficulties arising from the parish statistics can be avoided. For example, some farms lie in two parishes at once, some occupiers farm more than one holding in more than one parish, with odd results when numbers of holdings in a parish are studied, or when acreages are counted. When parishes are so small that their total number of holdings is less than five, then they are amalgamated with neighbouring parishes for statistical records by the Ministry of Agriculture.

The procedure adopted in the present survey was as follows:

1. Visits were made to all farms between Horden and the River Tees in a zone extending about four miles inland. This covered a total area of approximately 40 square miles, and an agricultural area of approximately 30 square miles. The occupiers were asked the questions which are given in Appendix 1.

2. Farms were also visited in an outer fringe zone surrounding the first area as far north as Easington Colliery, as far west as Wheatley Hill and Sedgefield, and as far south as Redmarshall and Little Stainton. The occupiers here were asked only the following questions.
   (a) Where are your farm boundaries on the Six Inch map?
   (b) What type of farming is practised? (This was judged from the point of view of the composition of output as given in publications of the Department of Agricultural Economics of Newcastle University).
   (c) Are you the owner or the tenant of your farm?
   (d) Have you a combine harvester?
3. A field by field land use survey was conducted in each of the years 1960, 1961, 1962, and 1963 in the area described in (1), and the results mapped on the Six Inch map.
4. For further detail on the marketing arrangements visits were made to the West Hartlepool abattoir, local dairies, the northern headquarters of the Milk Marketing Board, and Teesside Farmers Limited.
5. The regional officials of the Ministry of Agriculture were also visited for confirmatory detail.

FARM CLASSIFICATION

The farming in the Hartlepools region was classified by the National Farm Survey in 1946 as being of the type "General Mixed Farming", and was mapped as part of a zone of such farming extending all the way down the Vale of York. Such a vague description was made necessary by the large variety of farming enterprises undertaken in the region, by the varying combinations of farm types in close proximity, and by the diversity of enterprises on individual farms themselves.

There is diversity too in farm sizes. If farms of similar type are near one another then their sizes are often in contrast. Other features which produce farm-to farm variation are the degree of mechanisation, the intensity of stocking, the marketing practices, the skill of management, and the attention given to the conservation of soil fertility.

Although this would appear to create a kaleidoscope pattern of farm types, there may be detected a certain logic in the geographical distributions once a close study of individual farms has been made.

The first problem is one of definitions. At what point does a milk farm become a mixed farm? How can farms deriving their income from both fatstock and crops be separated into groups where the stress is on one side or the other? There is even a difficulty in deciding on what is a cash crop since this varies from farm to farm according to the domestic stocking position and the feeding policy. On some farms wheat, barley, oats, potatoes, and even hay are sold, despite the keeping of considerable numbers of livestock, whereas many other farmers with similar livestock numbers feed their oats, hay and a large part of their barley. Individual farms vary their practice from year to year, so that their crop acreages are not always a good guide to their income pattern.

Nevertheless it is the income pattern which must decide the type of farm and the dividing lines in the present study w ere chosen as follows:

1. Milk with subsidiary enterprises The contribution to Gross Output of milk on these farms was twice that of any other single enterprise, such as cropping, cattle, sheep, pigs or poultry.
2. Mixed On all these farms at least each of three enterprises (including milk) contributed 15% or more to Gross Output.
3. Livestock Fattening with Cash Cropping The main source of output on these farms was livestock (mainly cattle and sheep), with 30% or less of the output being accrued from cash crops.

4. <u>Cash Cropping with Livestock Fattening</u> The farms in this group are distinguished from those in the previous group by cash crops being of greater importance, and contributing more than 30% of Gross Output. This classification follows that of the Department of Agricultural Economics of King's College, Newcastle, but it does not provide for farms which are entirely arable, entirely grazing land, or for groups of farms in scattered locations which are under one management and play varying parts in a single overall system.

Within categories 3 and 4 there are sub-divisions according to the type of animal fattened and the method of feeding. Some farmers buy cattle of 1½-2 years (stores), either Irish or home-bred, while others rear calves to the slaughter weight. Calves are from their own cows or from local dairy farms which sell unwanted bull-calves, while feeding methods vary from single suckling to multiple suckling and pail-feeding. Buying store cattle requires a certain amount of capital since these beasts cost in the region of £60 each, so that many of the smaller farmers are unable to undertake such an enterprise. The time taken to feed these stores to slaughter weight is often as short as three months but the subsidy arrangements make this period the minimum, and in practice market prices usually ensure that fat stores are kept on farms a week or two longer.

Farmers who rear their own calves and fatten them may keep them only fourteen months if single suckling is practiced. Calving is arranged for early December, suckling takes until September, and after some summer grazing the calf needs only one winter's feeding indoors before being sold for slaughter in early spring when the peak subsidy is reached. This type of animal sells as "baby beef" for premium prices, heifers weighing 7-7½ cwt., bullocks 8-8½ cwts., and in the early 1960's the latter could earn, with subsidy, from £90 to £100.

With calves reared by the multiple suckling method, whereby three or four calves are suckled by a single cow at once (not all fattening farms have a sufficient supply of milk cows to practice single suckling), the daily gain of weight is less and the animals must be kept through two winters. Although they attain a greater weight the price realised is lower than that for the single suckled calf. The same applies to those calves fed on dried milk foods (pail-feeding), a method practised on farms where no supply of whole milk is available.

On the 404 farms in the Hartlepools region which were visited the types of farms undertaken can therefore be listed as follows:

1. Milk farms.
2. Mixed farms.
3. Fattening and Cropping farms.
   (a) Stores fattened.
   (b) Single suckled calves reared and fattened
   (c) Multiple suckling
   (d) Pail feeding of calves.

All four of these farms may also keep sheep and/or pigs.

4. Cropping and Fattening farms.
   (a) Stores fattened.
   (b) Single suckling of calves.
   (c) Multiple suckling.
   (d) pail feeding of calves.

All four of these farms may also keep sheep and/or pigs.

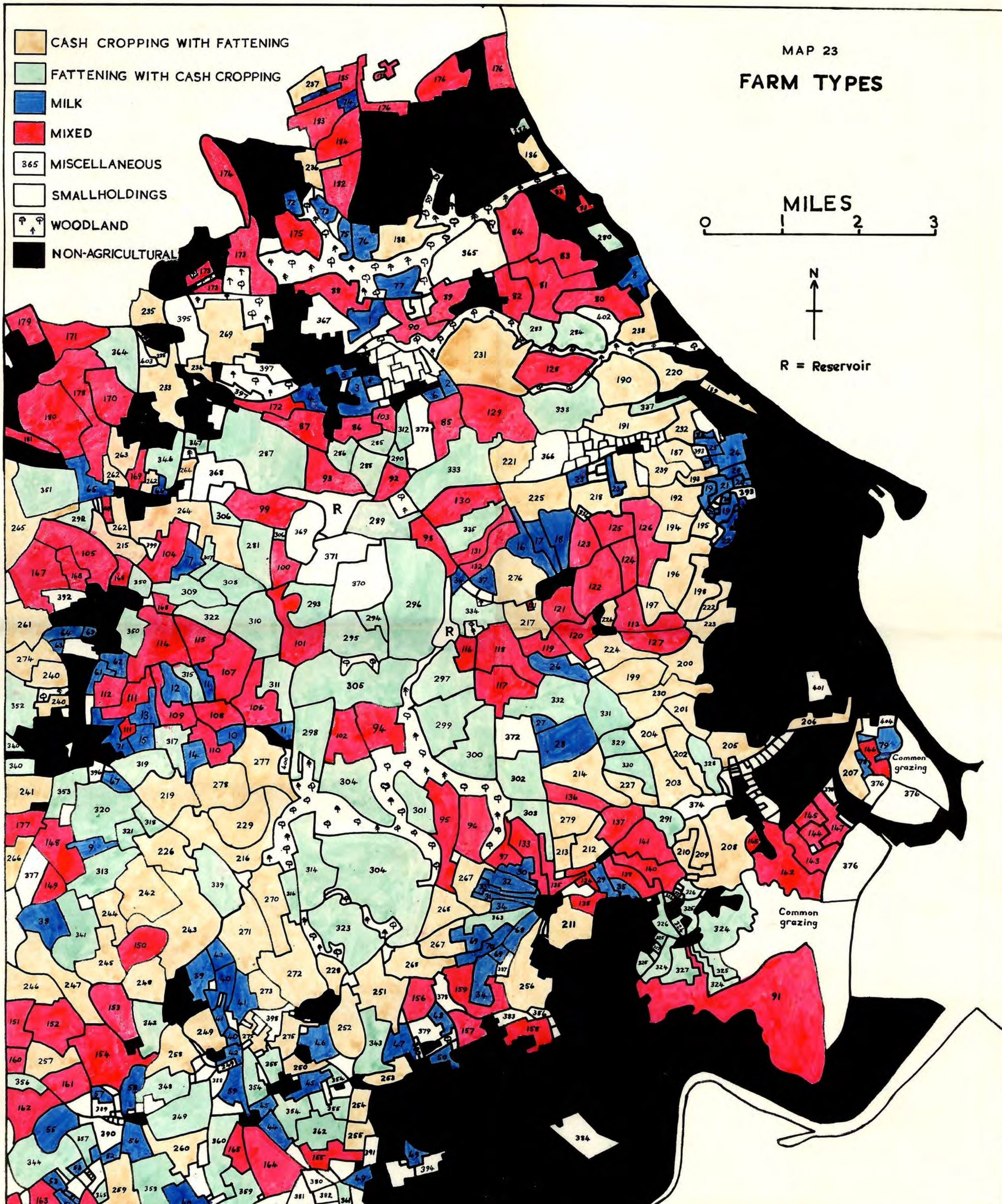
5. Miscellaneous Farms which do not fit into any of the above groups.

The list of these farms may be tabulated according to size and enterprise as follows:

Size in acres	Milk farms	Mixed farms	Cash cropping farms SS	MS	PF	Stores	Others	Fattening farms SS	MS	PF	Stores	Others	Miscell.
20-29¾	3	-	-	-	-	-	-	-	1	-	-	-	2
30-49¾	18	1	-	-	1	-	-	-	-	3	3	-	12
50-99¾	38	14	-	3	6	3	5	-	2	7	7	2	12
100-149¾	17	35	2	2	10	7	1	-	3	6	8	-	4
150-199¾	2	21	5	5	2	6	-	3	2	5	7	-	4
200-249¾	1	24	1	2	5	9	-	-	3	2	3	-	2
250-299¾	-	8	4	1	-	4	-	1	2	2	1	-	2
300-349¾	-	-	1	-	1	2	-	1	-	-	6	-	1
350-399¾	-	2	-	-	-	1	1	-	-	-	-	-	-
400-499¾	-	-	-	-	-	3	-	-	-	-	2	-	1
500-699¾	-	-	-	-	-	1	-	1	-	-	1	-	-
700-999¾	-	-	-	-	-	-	-	1	-	-	-	-	-
1,000	-	1	-	-	-	-	-	-	-	-	-	-	-
Totals	79	106	13	13	25	36	7	7	13	25	38	2	40
					94					85			

= 404 farms

Of the farms grouped as miscellaneous in the final column seven belong to the dairy chain of Vicarage Daries (owned by Mr. J.H. Thompson of Castle Eden) and although scattered over an area from Trimdon to Blackhall, are worked by a mobile squad of labour based at Wellfield Farm, Wingate, as far as their arable lands are concerned, while milking units and dairy herds are kept at Hart Moor Farm, Wellfield Farm, and Park House Farm, Trimdon. The other four farms (Red Hurworth, Murton Blue House, Murton Hall, and Dene Leazes) support the other cattle not currently being milked, and their followers. Guernsey cattle are kept, the milk being retailed in West Hartlepool and the colliery villages.


CASH CROPPING WITH FATTENING
FATTENING WITH CASH CROPPING
MILK
MIXED
365 MISCELLANEOUS
SMALLHOLDINGS
WOODLAND
NON-AGRICULTURAL
MAP 23
FARM TYPES
MILES
0 1 2 3
N
R = Reservoir
Common grazing
Common grazing

Mr. W. Forbes of Little Thorpe, near Easington, has two farms (Gunnersvale in Elwick Hall parish, and Leechmire near Hutton Henry) in the region, in addition to his home farm at Little Thorpe, which are similar to the Vicarage Dairies farms in that they support the followers and dry cows from a large dairy herd. While they grow substantial quantities of cash crops like potatoes they can scarcely be classified as either milk farms, mixed farms, or cropping farms.

Most of the remaining miscellaneous groups are farms which keep calves to be later sold as stores to the fattening farms, or purely arable farms, or large market gardens. The list given in Appendix 5 shows the exact type of farming.

Agricultural holdings not included in the above table are those small-holdings created by Durham County Council at Hart and at Hutton Henry, the tiny market gardens at Greatham, and scattered fragments of land where poultry are kept, usually by retired people or by persons chiefly occupied in work other than farming.

This analysis of the farm size shows that about half (194 to be exact) lie within the range of 50 to 150 acres, with as many between 50 and 100 acres as between 100 and 150 acres. In addition there are 114 farms between 150 and 250 acres. There are so very few large farms over 350 acres that these may be individually identified:

1. Saltholme, a mixed farm near Port Clarence at Teesmouth, was always over 1,000 acres, and became 1,634 acres when Imperial Chemical Industries merged it with Belasis Farm and Coleman's Hook Farm. Apart from the manager and a secretary ten men work the farm which is fully mechanised with seven tractors, a rotavator, a combine harvester, and pick-up baler. 100 dairy cattle used to be kept but there are now only 40, whereas the beef herd has been expanded, about 500 head of store cattle (mainly Irish, purchased at Darlington mart) being fattened for three months at any one time. About two-thirds of the farm is under grass

(914 acres permanent, 59 acres temporary) and some of this has been reclaimed from marshland by draining, harrowing, and applying nitro-chalk. Arable crops in 1961 included wheat (20 acres), barley (33 acres), oats (186 acres), and potatoes (23 acres). Sheep (658 Whitefaced, Greyfaced, and Mules) and pigs (11 breeding sows) are also kept.

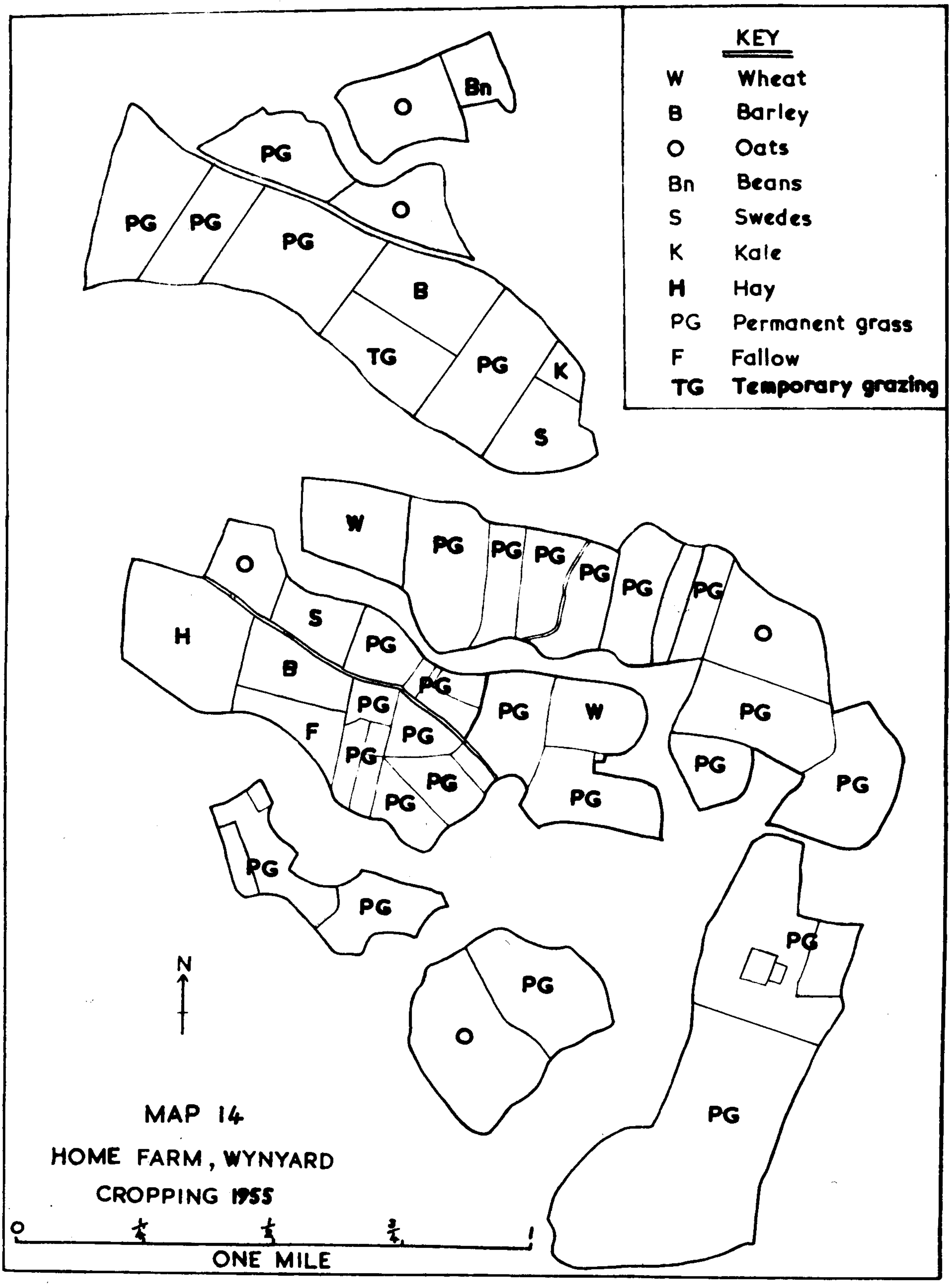
2. Sheraton Hill Farm, a 365 acre mixed farm, lies on the north and north-east flanks of Sheraton Hill east of Hutton Henry, and is owned and run by Mr. J.O. Brewis and Sons. The labour force, apart from the owner, consists of five men, and the equipment includes three tractors, a rotavator, a combine harvester, and a pick-up baler. The dairy herd, well-known throughout the county as the Hesleden Herd, includes about 130 Friesians, with many exhibition prizes to its credit. Less than half the farm is under grass, while arable crops include wheat (45 acres), barley (12 acres), oats (77 acres), and potatoes (32 acres). Other stock include 200 Scotch white-faced sheep (Cheviot X Border Leicester) and 80 store pigs bought at eight weeks and sold for pork at twelve weeks.

3. Manor Farm, Cowpen Bewley, is 450 acres in size and is rented by Mr. J. Hall, a well-known cattle dealer, from Imperial Chemical Industries. The acreage is somewhat fragmented, comprising three large areas respectively south, east and west of the village, with smaller fields also on the north. Although there is some arable (18 acres of wheat and 40 of oats, 17 of turnips and 95 acres of grass seeds) the farm is used mainly for fattening Irish store cattle, or as temporary accommodation for the large numbers of cattle and sheep handled by Mr. Hall in his capacity as a dealer. Three-quarters of the farm is under grass and a flock of pure Suffolk sheep is bred, while over 200 Halfbreds are reared. A handful of store pigs for pork completes the list of livestock.

4. Hulam Farm, of 564 acres, rented by Mr. J.H. Murray, an auctioneer, from the National Coal Board, is a compact fattening farm on an unusually flat stretch of

the East Durham Plateau on the south side of Hesleden Dene, a gorge-like valley cut into the Magnesian Limestone well below the boulder clay and sand lenses. Close by is Sheraton Hall Farm, also run by Mr. Murray, the two farms making 900 acres and being worked by a joint force of eight men. Both farms are fully mechanised, each with a combine and pick-up baler. Since the farmer is also an auctioneer at Castle Eden, Haswell and Stockton marts, a large number of store cattle (mainly Irish) is handled, and about 500 are being fattened at any one time. Half of Hulam and about three-quarters of Sheraton Hall are under grass, but wheat and barley are grown as cash crops, and oats for fodder. Hulam grows 26 acres of potatoes (thereby qualifying as a cash cropping-with-fattening farm) though Sheraton Hall, on heavier soils, has only 2½ acres. A flock of 100 pure Border Leicesters is kept and about 1,000 cross-bred sheep are fed on the combined farms.

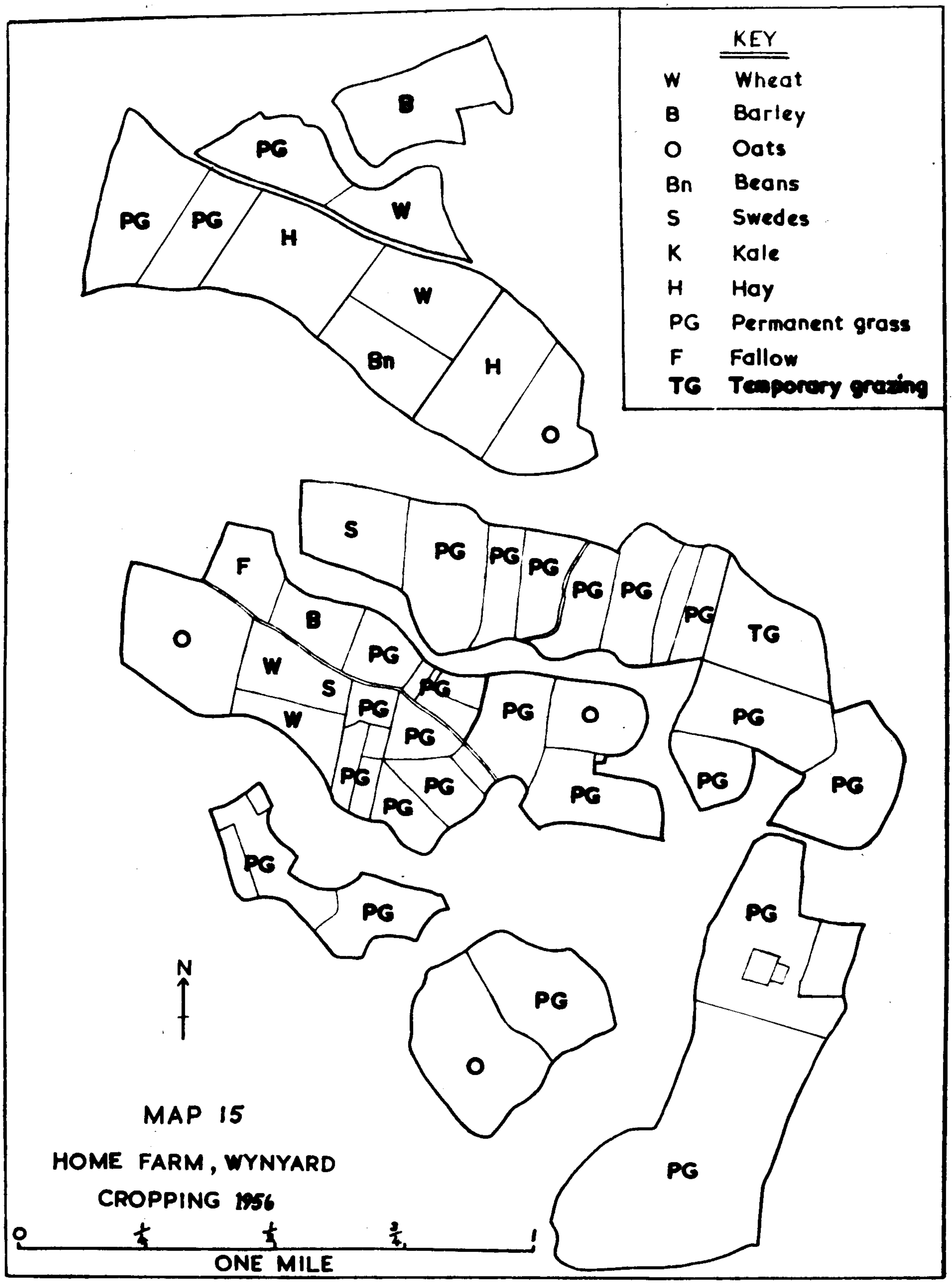
5. White Hurworth Farm, 595 acres, rented by Mr. D. Sanderson from the N.C.B., is a rearing and fattening farm on the gentle south-facing slopes of the upper Skerne valley between 400-500 feet, half a mile south-east of Trimdon Colliery. Compact in shape it contains substantial areas of rough grazing and badly drained permanent grass. The tenant is helped by five other workers, and the farm is fully mechanised, with a combine, a grain drier, and a baler. In 1963 the tillage included 72 acres of wheat, 100 barley, 32 turnips, 18 kale, while the grass, supplemented by the 171 acres of Mr. Sanderson's other farm, West Murton Blue House, which were largely grass, fed 1,000 breeding ewes (100 Scotch, Dorset Horns, X, Mashams, Greyfaced, and Suffolk X), 200 gimmer hoggs, 40 hoggs (previous year's lambs) and mainly Irish stores. 7 Breeding sows are kept to sell store pigs. A regular supply of cattle and sheep is sent to a West Hartlepool butcher every week.



MAP 14

HOME FARM, WYNYARD

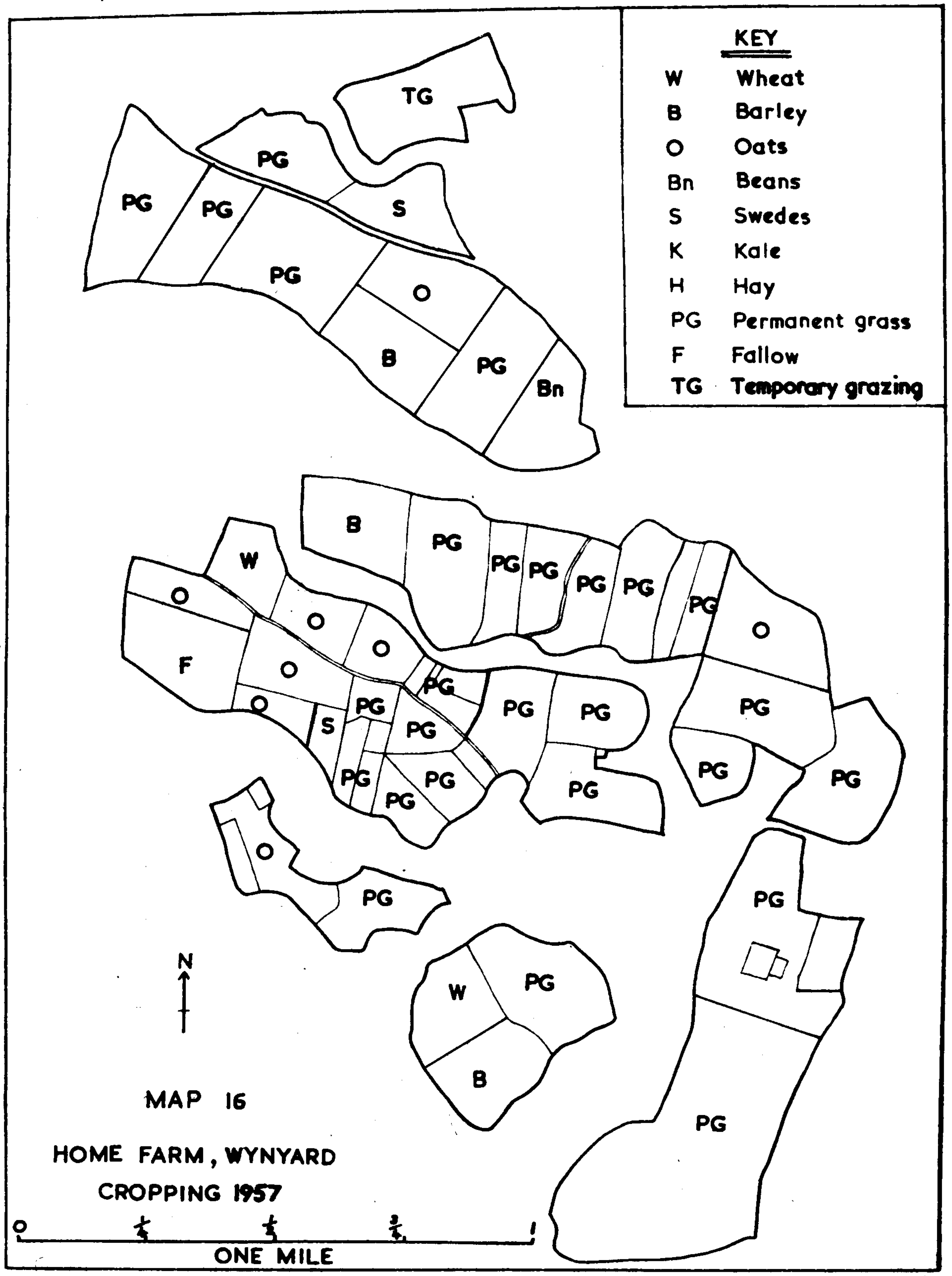
CROPPING 1955



MAP 15

HOME FARM, WYNYARD

CROPPING 1956


KEY
W Wheat
B Barley
O Oats
Bn Beans
S Swedes
K Kale
H Hay
PG Permanent grass
F Fallow
TG Temporary grazing
TG
PG
PG
PG
S
PG
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B
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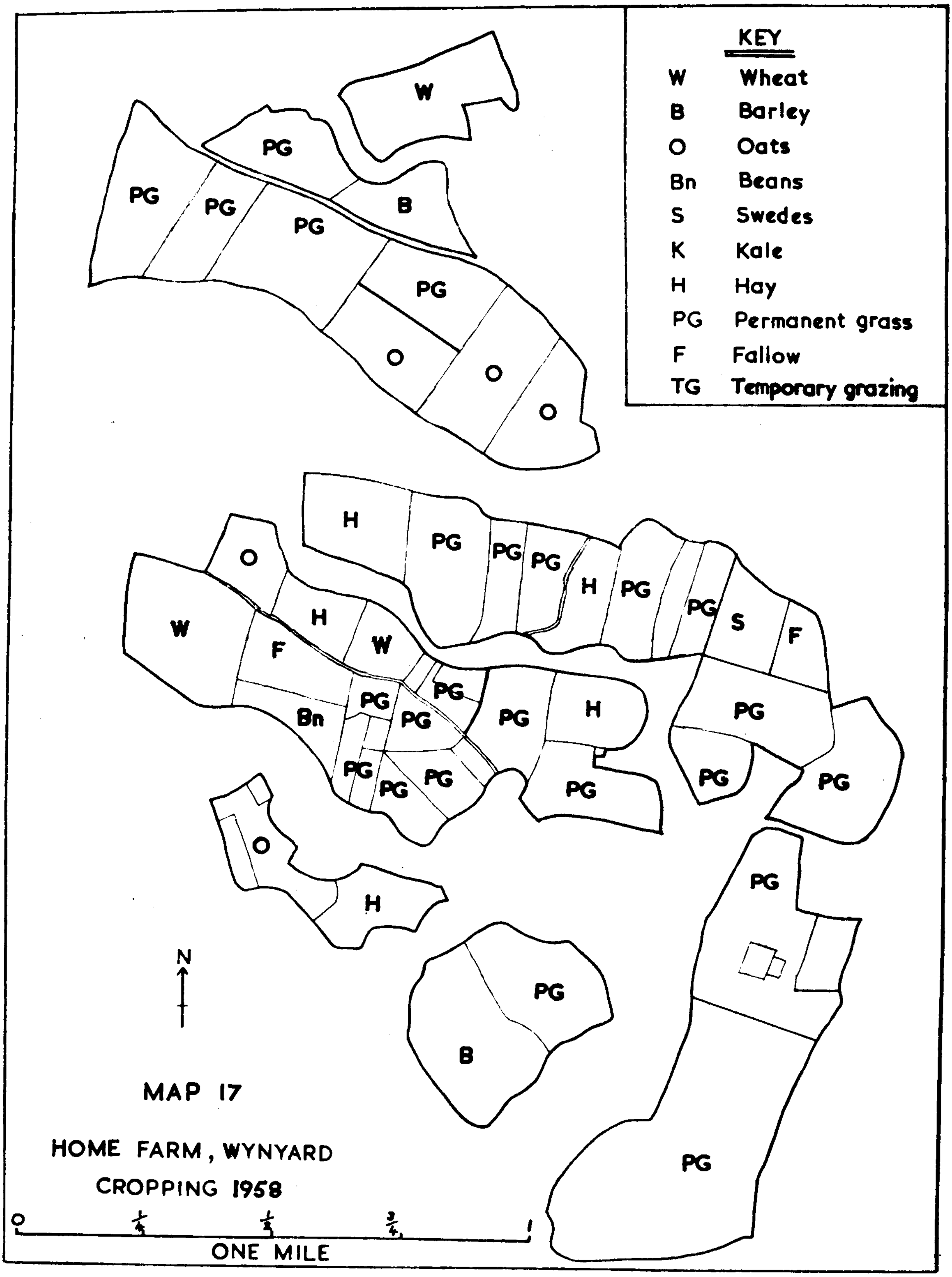
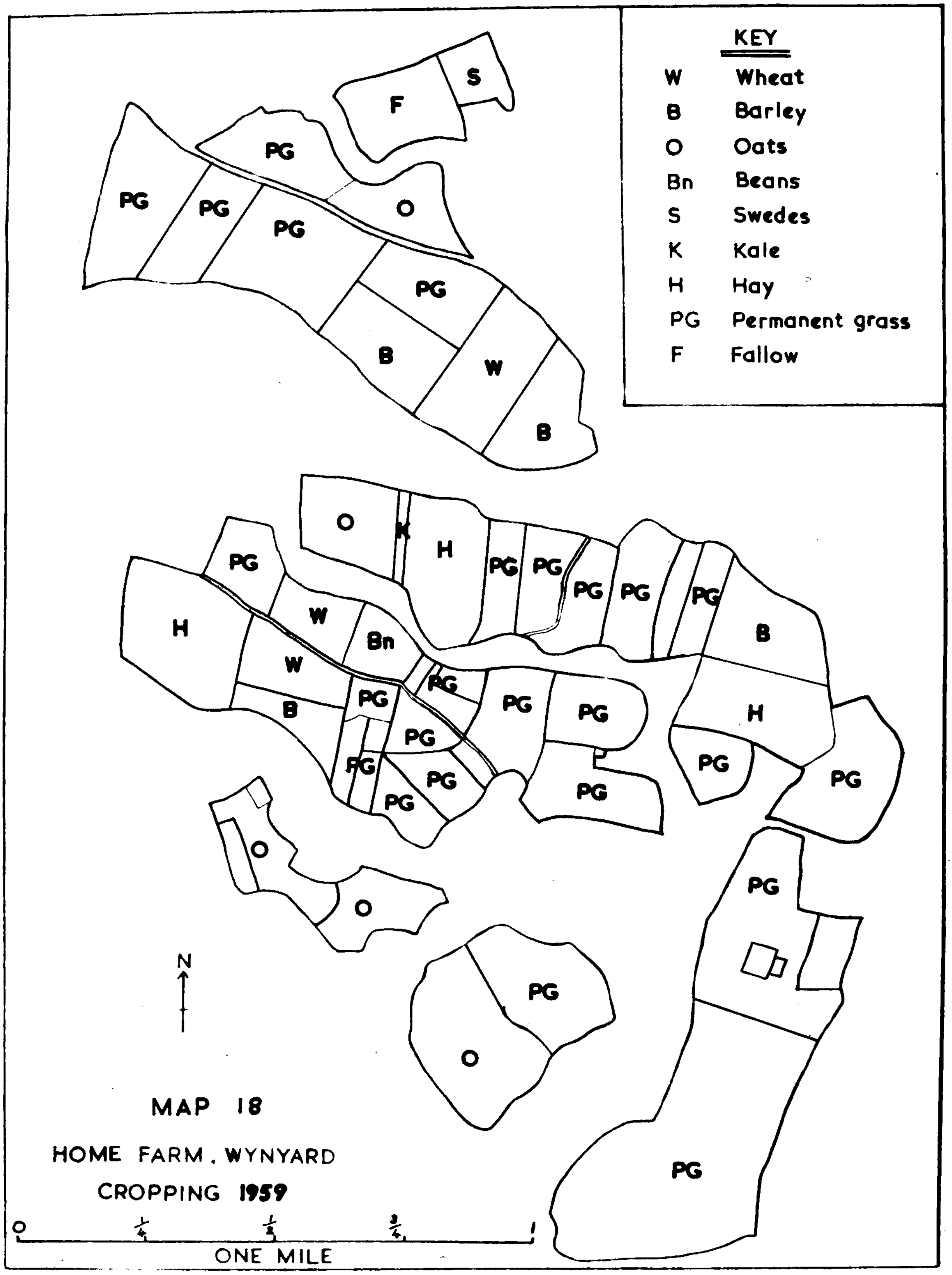
MAP 16
HOME FARM, WYNYARD
CROPPING 1957
0
¼
½
¾
1
ONE MILE



MAP 17

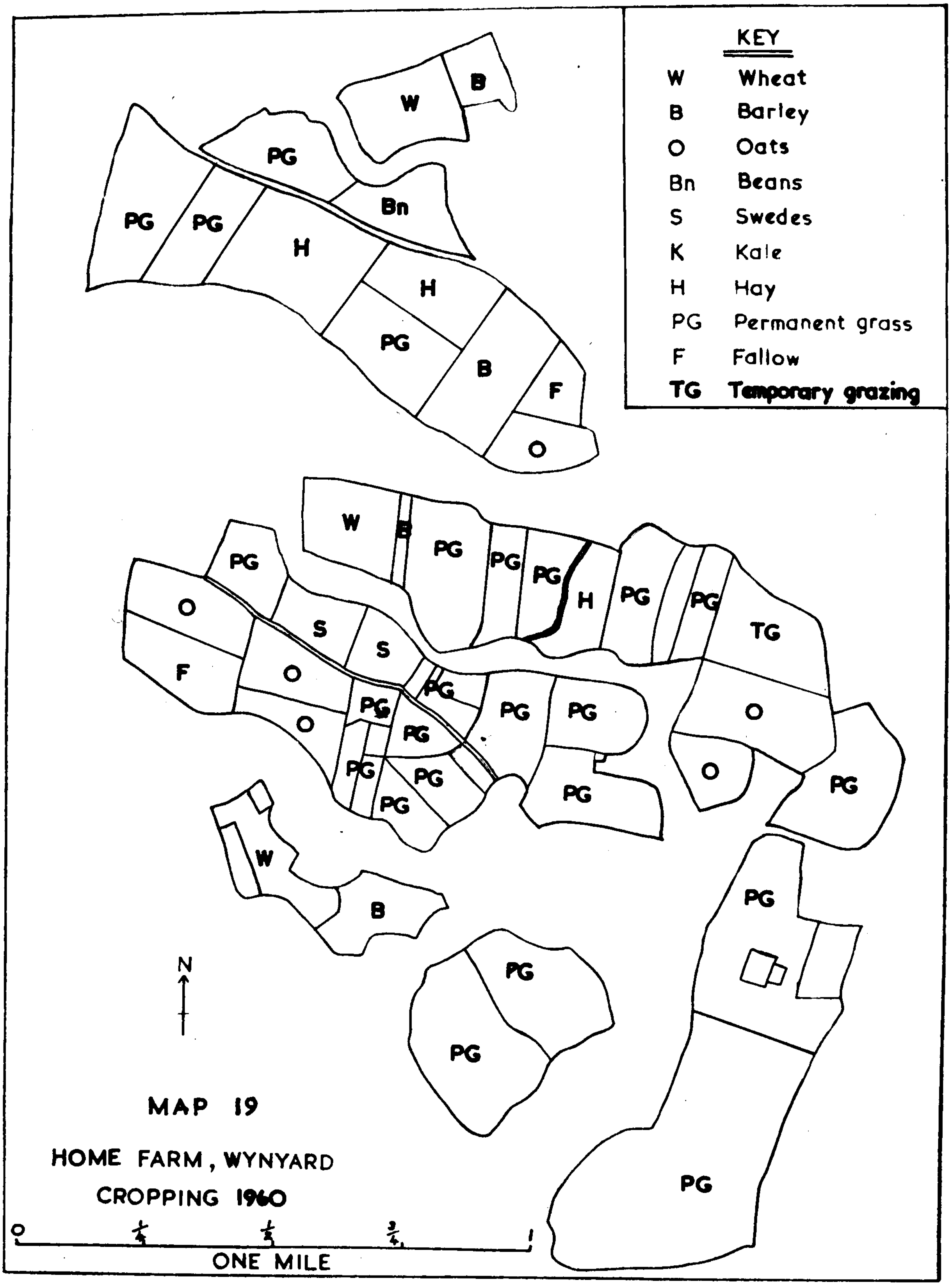
HOME FARM, WYNYARD
CROPPING 1958



MAP 18

HOME FARM, WYNYARD

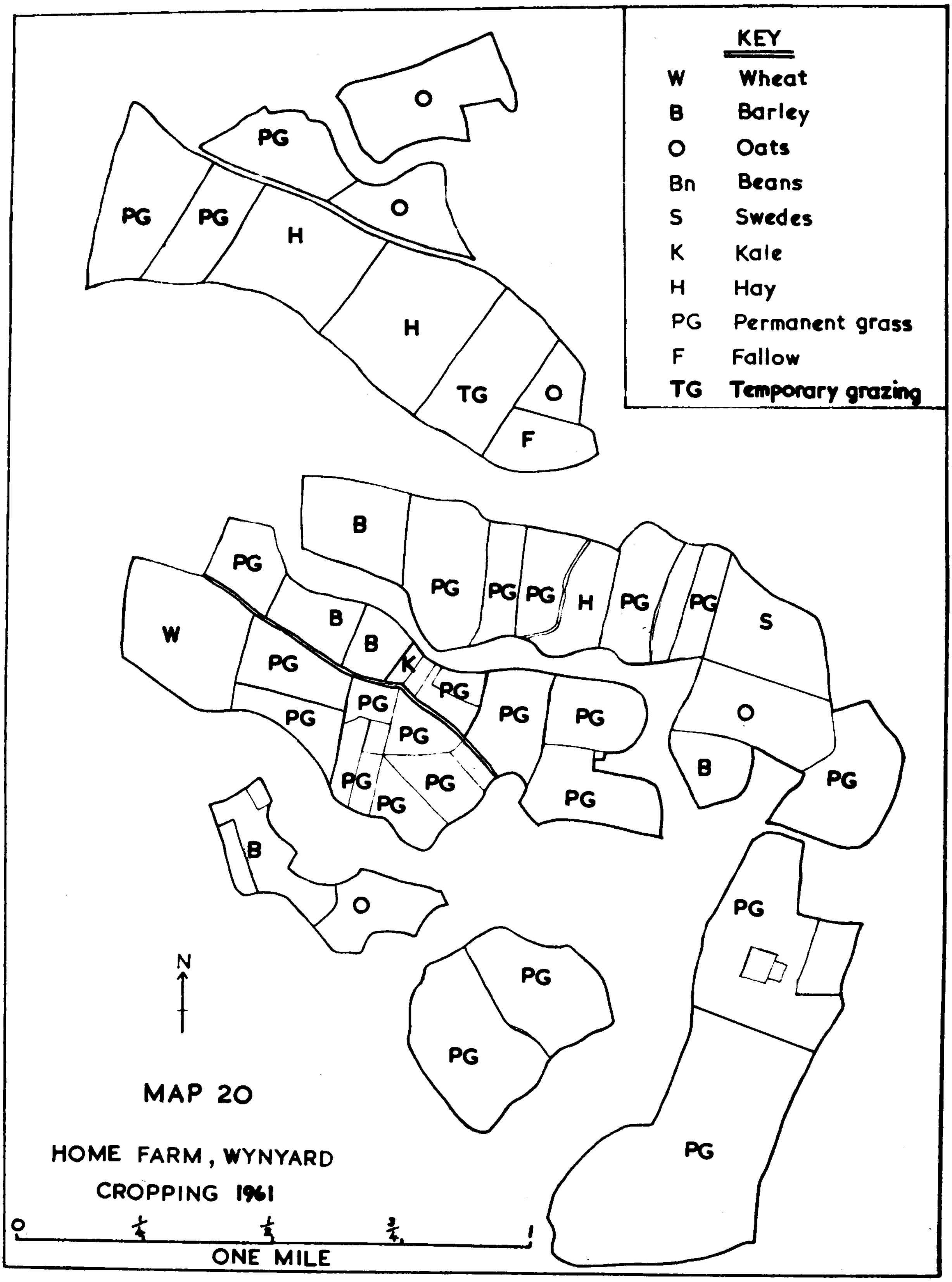
CROPPING 1959



MAP 19

HOME FARM, WYNYARD

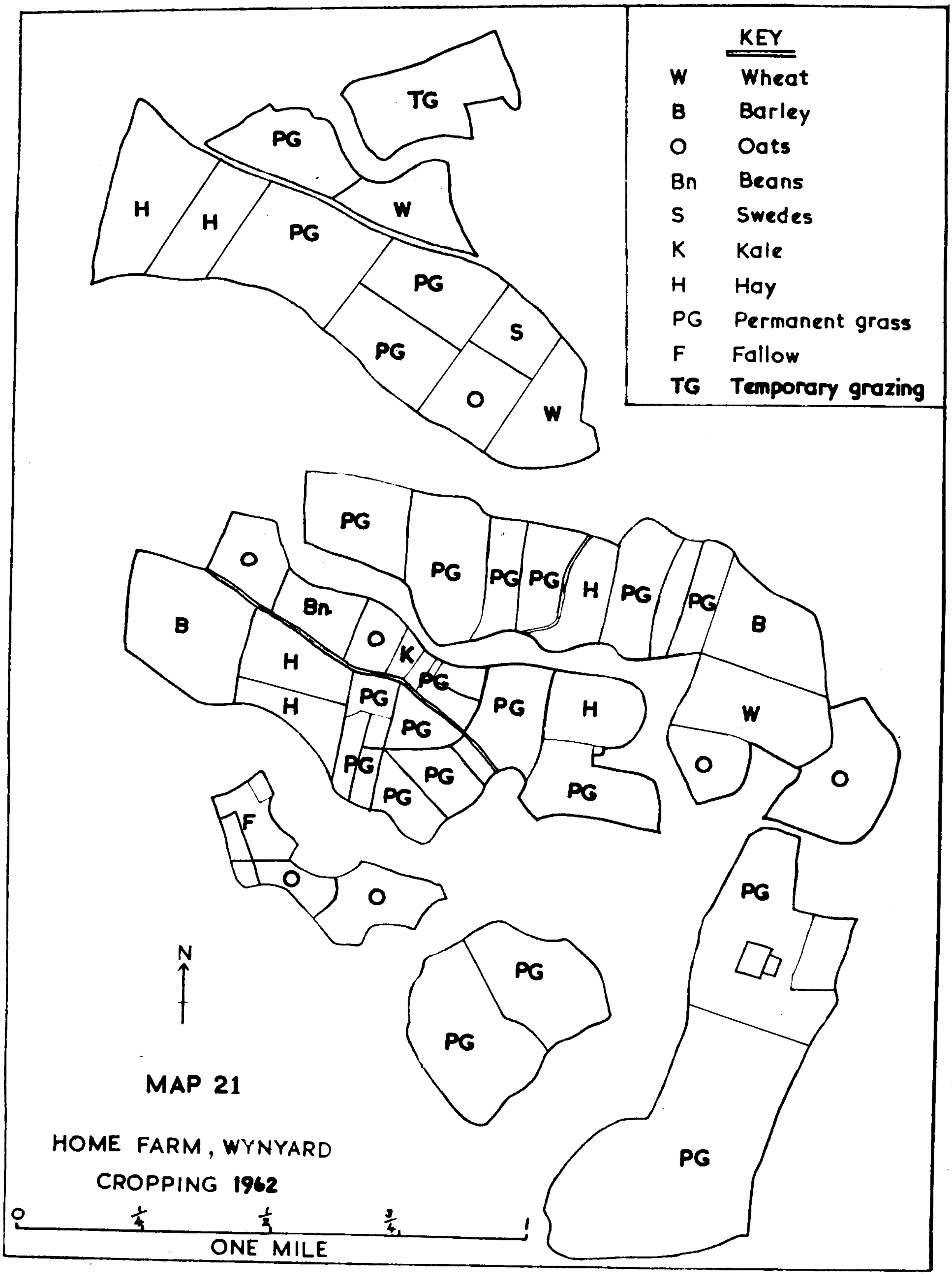
CROPPING 1960



MAP 20

HOME FARM, WYNYARD

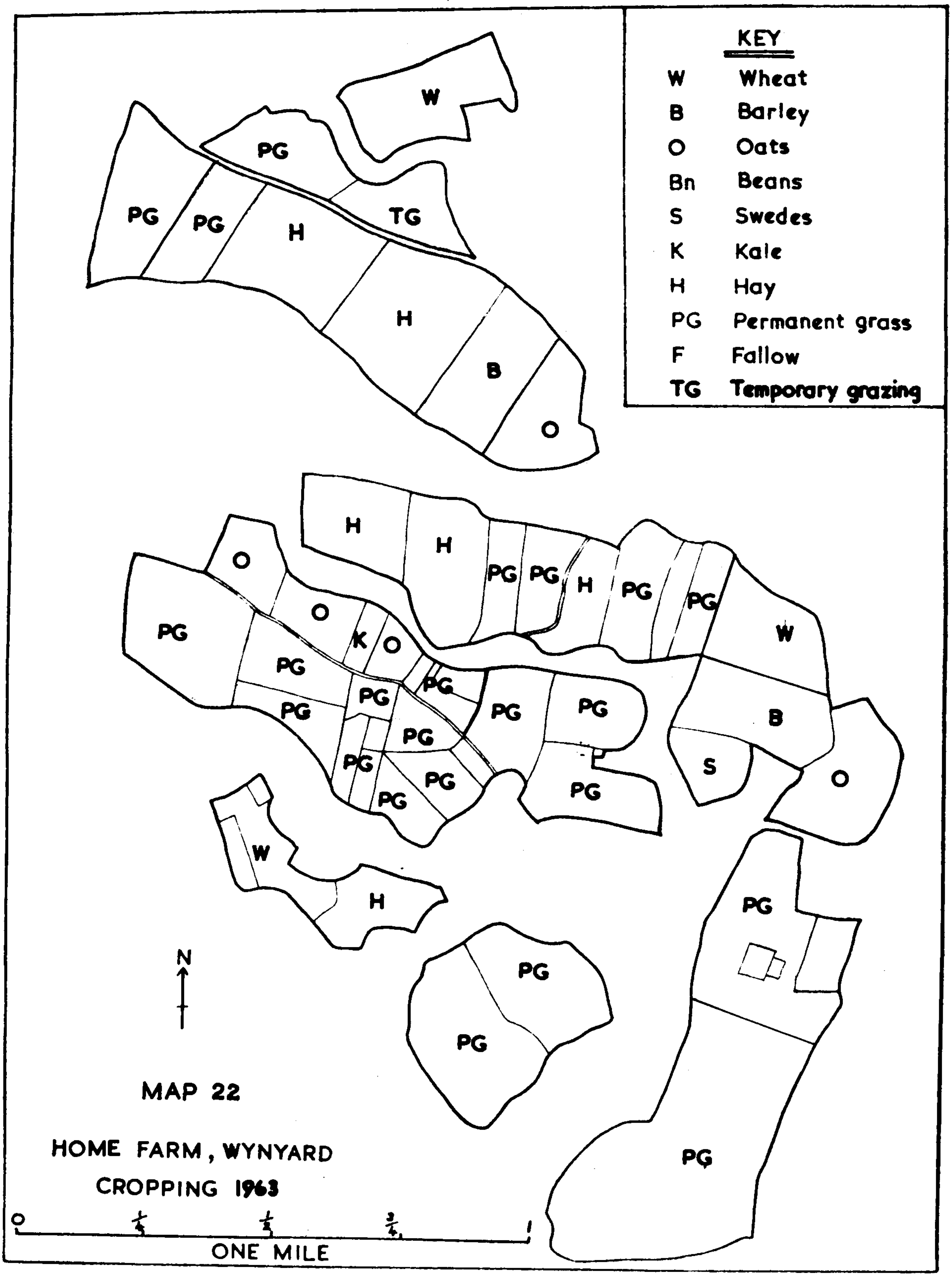
CROPPING 1961



MAP 21

HOME FARM, WYNYARD

CROPPING 1962



MAP 22

HOME FARM, WYNYARD
CROPPING 1963

6. Cole Hill Farm, 485 acres, owned and occupied by Mr. R. Nichol, is a fattening farm between 250 and 400 feet, on the south-east slopes overlooking Crookfoot Reservoir, two miles south-west of Elwick. The farm is rectangular in shape, with its longer axis north to south. Four regular workers live on the farm, but the turnover in labour is high as the situation is rather remote from villages, so much use is made of contractors for harvesting, although all the latest machinery is available. Three-fifths of the farm is under grass (83 acres temporary grass and 209 acres permanent) and the arable includes 16 acres of wheat, 54 barley, 39 oats, 16 turnips and 3 potatoes. About 100 Irish store cattle are always on the farm, but there is usually a small number of single-suckling cows since some of the stores bought are in-calf heifers. 150 breeding ewes (Mashams and Halfbreds) are also kept, and lamb replacements are bought in July, August and September at Rothbury, feeding on turnips till the spring.

7. Wynyard Home Farm, 900 acres, is owned by Lord Londonderry, and lies at the centre of the extensive Wynyard Estate with its numerous tenant farms, mainly on the south-west side of the Wolviston-Sedgefield road, halfway between these two villages. Cropping and livestock are managed by separate bailiffs. Eight regular workers are housed on the estate, and although the chief aim of the stock side is beef and fat lamb production, a small milk herd is kept to supply the needs of the estate residents. All the latest machinery is employed, one combine sufficing for 200 acres of cereals (in 1963 62 of wheat, 56 barley, 80 oats), most of which, apart from the wheat, is fed on the farm. 140 cows of beef breeds (mainly Aberdeen Angus X Shorthorn) are kept on a single suckling basis, giving 140 calves, usually about January to February, which are fed off indoors to sell fat from the second spring onwards. 200 stores are bought as replacements each autumn to keep up a steady supply of beef to the butcher. 4 Angus bulls are replaced about every eight years. 300 Halfbred ewes and

8 pure Suffolk rams are kept, and store lambs are purchased at the August Border sales as replacements. Every year 100 older ewes are sold to local farms, being replaced by 100 Halfbred ewe lambs from the Border. A field-by-field rotation pattern is shown on Maps 14-22.

8. Embleton Farm, 525 acres, is on the Londonderry estate and is rented by the Thompson brothers, who rear and fatten sheep and cattle. The farm lies on very gentle east-facing slopes on both sides of the Stockton to Sunderland railway, four miles N.N.E. of Sedgefield, at a height of 250 to 300 feet. The calves are single-suckled and sold at about fourteen months old. Labour is difficult to obtain and most of the combining of corn is done by contractors.

9. Greatham Hall Farm (or Hospital Farm), 365 acres, on the south-west side of Greatham village, is rented by Mr. R.F.A. Bell from Greatham Hospital (Church Commissioners). Beef cattle bought at two years old are fattened for three months only, 100 head at any one time. About 60 Halfbred ewes are kept for fat lamb production. Arable is very important on this farm and the mellow loams give high yields. 200 acres of cereals are grown (in 1961 15 of wheat, 112 barley, 75 oats) and 17 acres of potatoes. The former dairy herd was discontinued from 1955. Mr. Bell employs four men and has two combines (this is one of the first farms in the region to finish harvesting).

10. 450 acres of mainly rough grazing make up the holding rented by Mr. F. Davison on Seaton Snook, immediately east of Graythorp village, and reaching the sea. Sheep are fattened but the chief interest is in dealing in sheep and cattle which are brought in from all parts of Britain by road for sale in the local marts. There are no farm buildings and no labour is employed except at shearing time when about 1,000 sheep may have to be sheared. Turnips and hay are purchased for winter feeding. Stock may be accommodated on the coastal grassland for any period from a few days to several months, according to the trade.

11. Horden Hall Farm, totalling 360 acres, is made up of several fragments: 235 acres represent Horden Hall itself and Warren House on the coast north of Horden, rented from the National Coal Board; 97 acres are owned by the farmer, Mr. A.F. Howard, at Little Thorpe, a holding known as Springwell Farm; and 28 acres (a figure constantly being reduced as building proceeds) are held by licence from the Peterlee Corporation. The chief enterprise is milk production, and retailing in Easington Colliery. 70 Ayrshires and their followers are kept, bull calves being sold at Stockton mart, and the young heifers being reared at Little Thorpe. The tillage includes (in 1962) 59 acres of wheat, 53 barley, 27 oats, 41 potatoes, and 18 roots, with a flexible 7 year rotation to include a 3 year ley. The farm is fully mechanised with both combine and grain drier.

12. Sands Farm, 400 acres, is owned by Mr. G. Lawson. It stands adjacent to Sedgefield on the south-west side and includes the Sedgefield Race Course. The land is rolling on account of sand and gravel mounds and in dry summers there may be scorching of cereals on the excessively drained soils. 120 acres of corn are grown, mainly barley, 20 acres of potatoes, and 28 of turnips. Irish stores are fattened and sheep are bred (120 ewes).

13. West Shotton Farm, 400 acres, is owned by Mr. W. Craggs. It lies two miles S.S.E. of Sedgefield and is worked as one farm with Low Shotton Farm, also owned by Mr, Craggs, making a total of 700 acres. 350 acres of corn are grown and Irish store cattle are finished; ewes and sows are kept for breeding, and about 30 acres of potatoes are grown.

14. Garmondsway Middle Farm, 490 acres, is rented from Sherburn Hospital by the Rutter brothers. It lies halfway between Trimdon and Cornforth, straddling the 500 foot ridge between the scarp foot and dip-slope of the East Durham Plateau, immediately east of the A177 road. About 200 acres of corn are grown and the stock includes 300 breeding ewes and Irish store cattle.

15. Wingate Grange, an N.C.B. farm of 370 acres, is rented by Mr. A. Flowers. It lies immediately west of Wingate village and south of the road to Durham, sloping towards the Crimdon Beck which bisects the farm from east to west. Usually a considerable number of cattle are fattened, but at the time of the writer's visit (1963) recurrent disease (Johne's) had been the cause of a temporary lapse of this branch of the farm's activities. 170 acres of corn shared the farm with 120 breeding ewes.

These farms are shown on Map 23, covering the area surveyed.

The table on P. 171 shows that the smaller farms are predominantly dairy farms, falling into the two categories of milk farms and mixed farms, according to the proportion of their gross output derived from the sale of milk. The farms of less than 50 acres have very little room for cash crops and therefore they are chiefly milk farms. A typical example in the Hartlepools region is Letch Farm, Newton Bewley, a 50 acre milk farm where the tenant, Mrs. O. Parker, works a 38 strong milk herd with the help of her son and her brother. The list of equipment in 1961 included a tractor, 2 trailers, grass cutter, hay turner, 2 ploughs, roller, harrows, scuffler, potato digger, riddle, corn drill, turnip drill, turnip chopper, and a milking machine. The crops in 1961 were 10 acres of oats, 1 acre mangolds, 2 potatoes, with the rest under grass (17 acres permanent and 19 temporary). The arable fields are rotated alternately between corn and roots. Six tons of fertilizer are used each year and the yields are 25-30 cwt. of oats and 2-2½ tons of hay per acre. About half of the 38 cattle are milk cows, while the rest are followers, younger animals which will eventually replace the older, unless they spring from a mother with a poor milking record, in which case they may be fattened for slaughter. Letch Farm also has 200 hybrid hens for egg production, the eggs being sold to a Darlington firm of egg-packers, and there are 30 bacon pigs (Landrace breed) which will be sent to the Vale of

Mowbray factory at Leeming in Yorkshire, or to a simila. firm at Malton. Combining, threshing and baling is done by a Wolviston contractor since there is too little corn to justify the purchase of the expensive machinery which is needed.

On this type of small farm, therefore, the monthly milk cheque provides the bulk of the farmer's income, though pigs and poultry contribute a welcome addition.

Even in the group of farms between 50 and 100 acres milk farms form the majority, with 38 out of 99, while there are 14 mixed farms, and of the 47 other farms at least 8 have gone out of milk in the last twenty years. The increasing stringency of the regulations governing milk production has been one cause of the switch from milk, but undoubtedly some farmers have given up on grounds of a more personal nature - increasing age, the desire for longer leisure time, and the difficulty of obtaining labour for the awkward hours involved in milking.

On the smaller medium sized farms, between 100 and 150 acres, mixed farms are predominant because there is more space on farms of this size for the cash crops which relegate milk to less importance in the gross output. In the 150 to 200 acre group cash cropping and mixed farms are of about equal importance, with 18 and 21 respectively out of a total of 62.

After the 200-250 acre group, in which mixed farms predominate, with 24 out of 52, milk herds cease to be important, and beef cattle and sheep replace them on the larger farms. On these farms the relative importance of cash crops in the gross output depends largely on the type of land, the heavier soils being left under grass in the poorer districts, which therefore tend to have fattening farms, while cropping farms occupy better land. It is significant that the largest farms in the south-east of the county are fattening farms.

An attempt has been made to keep the classification of farms up to date to the beginning of 1964, there having been several changes in the region covered between 1961-64, both in farm ownership and in the main policies pursued. In some cases the distinction drawn between milk and mixed farms, and between cropping and fattening farms, is so fine that border-line types may actually vary from one to the other in successive seasons simply by growing an extra field of corn or potatoes, or by retaining more calves for fattening.

FARM TENURE

Out of 404 holdings in the Hartlepools region 226 were owner-occupied and 178 occupied by tenant farmers in 1964. This is not the full story, however, because some farmers run more than one farm. There are 42 of these multiple holdings whose combined areas under a single management may vary considerably, some contiguous, some fragmented, and some separated by several miles from each other:

7 holdings

H. Thompson - Dene Leazes (300 acres) near Castle Eden, Hart Moor (170), Wellfield (200) at Wingate, Park House (199) near Trimdon, Red Hurworth (171) near Trimdon, Murton Hall (283) near Trimdon, and Murton Blue House (130) near Trimdon.

4 holdings

G. Nichol - Claxton (127 acres), Lower Claxton (125), Middle Stotfield (262), and Brierton Moor House (168) near Greatham.

3 holdings

T.E. Watson - Northfields (246 acres), White House (66) at Norton, and Oldacres Hall (296) near Wynyard.

W. Noddings - West Farm (139 acres), Hall's Field (65), and Low Burn Toft (215) near Wolviston.

Miss Nichol - Catlaw Hall (120 acres), Pike Whin (180), and Red Barns (37), Wingate.

3.holdings (continued)

H. Bird - Benridge (74 acres), near Blackhall, Parklands (35) near Castle Eden, and Oakerside (154) at Shotton.

Imperial Chemical Industries - Saltholme (1,278 acres), Belasis (204), and Coleman's Nook (152) between Port Clarence and Cowpen Bewley.

2 holdings

H. Allison - Cowley House (250) at Sedgefield, and a farm outside the region.

J. Atkinson - Springwell House (110) and West Pasture (97) near Newton Bewley.

F. Barrone - Lamb's Close (31) and Head's Hope (100) near Hutton Henry.

B. Bell - Seaton Grange (78) and Greenabella (93) at Seaton Carew.

R. Bird - High Throston (129) and Reservoir Farm (37) near Hart.

R. Blythman - Woogra (130) and Manor Farm (100) at Bishopton.

Bowes Bros. - Ox Close (59) and Cote Nook (126) at Sedgefield.

J.O. Brewis & Son + Sheraton Hill (365) and High Hesleden (271).

T. Brown - Priory Farm (150) at Dalton Piercy, and North Urn Farm (100) at Elwick.

R. Clifford - Ten O'Clock Farm (160) and Butterwick Moor (273) near Sedgefield.

Frank Craggs - Knotty Hill Farm (182) at Sedgefield, and East Close (240).

Fred. Craggs - Diamond Hall (300) and Measless (89) at Sedgefield.

W. Dryden - Blue House (118) and Claxton Grange (186) near Greatham.

W. Forbes - Gunnersvale (160) and Leechmire (200) near Hutton Henry.

F. Grieves - Dovecote (140) at Elwick and a farm at Coxhoe (outside the region).

J.S. Hall - Middlefield (200) at Norton and Mill Farm (75) at Thorpe Thewles.

A Hart - North Farm (150) and Low Farm (200) at Foxton.

J.P. de Harvard - Redmarshall Mains (260) and Church Farm (115) at Redmarshall.

T. Hopper - Deaf Hill Farm (283) and North Moor Farm (98) at Trimdon Grange.

W.G. Johnson - Hely House (212) at Sedgefield and Swan Carr (200) at Bradbury.

P.G. McLaren - Manor Farm (300) and Orchard Farm (116) at Thorpe Thewles.

J.H. Murray - Hulam (564) and Sheraton Hall (336) at Sheraton.

W.T. Hutchinson - Amerston Hill (73) and High Stotfold South (209) near Dalton Piercy.

H. Robson - Catcote (147) and Tunstall Hall (56) at West Hartlepool.

R.V. Rutherford - White House (112) and Strawberry Hall (95) at Shotton Colliery.

D. Sanderson - White Hurworth (595) near Wingate and West Murton Blue House (171).

C. Sanderson - East Holling Carr (127) and Whyn House (203) near Trimdon.

J.G. Scotson - Sundial (37) and Fairfields Farm (122) at Newton Bewley.

H. Shann - Ryal (150) and Howle Hope (86) at Sedgefield.

R.W. Snowdon - Low Hills (120) and White House (80) near Easington.

Stockton Co-operative Society - Summerville (75) and Norton Hardwick Farm (75) at Stockton.

A.F. Taylor - Low Raisby (228) and High Raisby (100) at Kelloe.

S. Thompson - Southfields (170) at Great Stainton and North Farm (174) Stillington.

H.E. Tinkler - Mill House (253) and Bridge House (151) at Fishburn.

A. Wilson - Kelloe Hall (220) and Hole House (103) at Kelloe.

While some of these combinations contain farms run by different members of the farmer's family, and organised as different types according to the present classification, the extent of co-operation, the joint use of equipment, and the timing of operations make them one unit from an economic point of view. There is often a dichotomy in the husbandry where two farms are worked as one unit, especially in the case of milk farms, one holding being used for rearing, and the other, with its byres and milking equipment, for cows in milk. This is the case with the chain of farms owned by Mr. H. Thompson (Vicarage Dairies), rearing being carried on at Murton Blue House and Red Hurworth farms, and milking at Wellfield, Hart Moor, Dene Leazes, Murton Hall and Park House.

The following table shows the pattern of farm-tenure related to the type of farming:

Size	CROPPING FARMS		FATTENING FARMS		MIXED		MILK		MISCELLANEOUS	
	Owners	Tenants	Owners	Tenants	O	T	O	T	O	T
20-29¾ acres	-	-	1	-	-	-	1	2	2	-
30-49¾	-	1	4	2	-	1	11	7	7	5
50-99¾	10	7	9	9	6	8	23	15	6	6
100-149¾	13	9	8	9	22	13	12	5	2	2
150-199¾	13	5	11	6	6	15	-	2	4	-
200-249¾	12	5	4	4	7	17	1	-	2	-
250-299¾	6	3	5	1	3	5	-	-	2	-
300-349¾	3	1	2	5	-	-	-	-	1	-
350-399¾	-	2	-	-	2	-	-	-	-	-
400-499¾	2	1	1	1	-	-	-	-	-	1
500-699¾	-	1	-	2	-	-	-	-	-	-
700-999¾	-	-	1	-	-	-	-	-	-	-
1,000 +	-	-	-	-	1	-	-	-	-	-
Totals	59	35	46	39	47	59	48	31	26	14

While the majority of the small farms are run by owner-occupiers, it is perhaps surprising to find how many tenant farmers are also in milk, with heavy investment in buildings and equipment on property that is not their own. This is partly due to the fact that one way of making a satisfactory income on a small farm is to produce milk intensively, and partly to the tradition of mixed farming in the region with a steady demand for calves from the fattening farms. In addition, since the war tenants have been given security of tenure, and a measure of financial assistance in improving farm buildings. A special feature of post-war dairying has been the provision of the Artificial Insemination Service; the

Milk Marketing Board set up their first Cattle Breeding Centre in the north at Shincliffe, near Durham, in 1946, and the need to maintain a bull has disappeared from dairy farms.

There has been a steady increase in the number of owner-occupiers since the depression of the inter-war period as young, energetic and thrifty couples move up the rungs of the farming ladder, and as some of the bigger land-owners give up land which has become increasingly less attractive as a means of capital investment. On the fringes of the towns, where land values have become inflated by the demand for building space, farms have gone off the market completely as far as farmers are concerned, but in the rural areas the market is more fluid. There are four important land-owners in the Hartlepools region:

(a) The National Coal Board, which owns much of the farm-land on the coalfield as a legacy from the coal-owners;

(b) The Church Commissioners who own a large block of land between Greatham and Wolviston;

(c) Durham County Council, who own land at Seaton Carew, land at Hutton Henry, land immediately north-west of West Hartlepool, at Hart and at Wolviston. Most of this land is divided up into smallholdings as a result of the legislation of the 1930's.

(d) Lord Londonderry, who owns the lands around Wynyard Hall.

Companies like Imperial Chemical Industries, the Cerebos Salt Company, Hartlepools Water Company, and bodies like West Hartlepool Corporation and the Hartlepool Golf Club also own farmland for various purposes, allowing tenants to farm the land. I.C.I. also run a farm at Port Clarence (Saltholme) which is the largest in the County. It is however affected near the chemical works by fumes, underrun by salt and anhydrite workings, and carries a number of pipe-lines from Billingham on their way to Wilton, south of the River Tees.

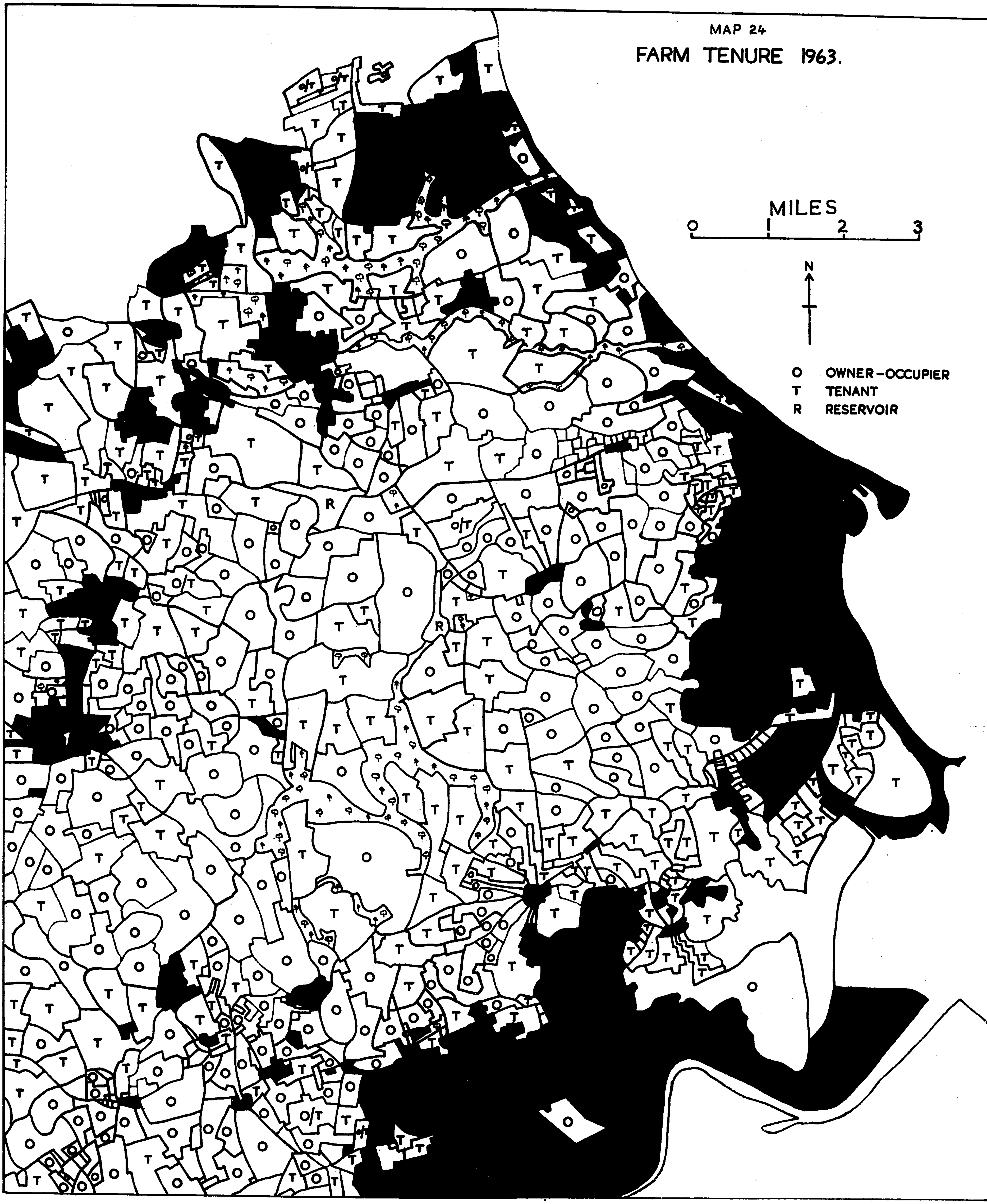
Relatively few rented farms come on to the market, and when they do, the competition for them is extremely keen, tenders reaching £5 or £6 an acre. This makes it difficult for a man starting in agriculture no matter how well qualified he may be. Yet despite the rising rents of the post-war years the tenant farmer still has the advantage over the man who would buy a farm, since the capital requirements are much lower. An owner-occupier must pay interest of five to six per cent on his borrowed capital, and as soon as land costs over £100 per acre the repayments become greater than a tenant's rent on the same land. Here again government policy has a strong grip on farming, since the monetary policy makes money easier or harder to borrow.

Apart from the handful of small private landlords who may eventually sell their farms it would appear that in the Hartlepools region the present distribution of tenant farms and owner-occupied farms will survive for a considerable length of time. The exception lies around the towns of West Hartlepool, Hartlepool, Billingham and Stockton, where the rapid rate of building over agricultural land seems likely to continue. Farmers who sell such land at high prices are among the few who can afford to bid for the freeholds that so rarely come up for sale further from the towns.

The 1961 distribution of owners and tenants is shown on Map 24.

FARM LABOUR

The average labour force (including the farmer himself) on the farms in the Hartlepools region varies as follows:


MAP 24
FARM TENURE 1963.
MILES
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O OWNER-OCCUPIER
T TENANT
R RESERVOIR

Size in acres	Farms with a dairy herd	Non-dairy farms
20-29¾	1	1
30-49¾	1 to 2	1
50-99¾	1 to 3	1 to 2
100-149¾	2 to 3	2 to 3
150-199¾	2 to 4	2 to 4
200-249¾	3 to 5	2 to 4
250-299¾	6	2 to 5

As the size increases above 300 acres the ratio of extra workers needed falls off. At Hulam, for example, a fattening and cropping farm of 900 acres, only 8 men are required, while on Saltholme (1,634 acres) where Irish stores are fattened and a 40-strong dairy herd is kept, only 11 men are needed.

Once over 50 acres a farm with a dairy herd appears to require one extra worker compared with a non-dairy farm of the same size. Variations from these average figures are sometimes wide, however, according to the individual needs of farms. An ageing farmer needs more help, a large subsidiary pig or poultry enterprise may require an extra worker, while special methods of rearing livestock consume more time than others. Thus adjacent farms at Hart, (Whelly Hill, with store cattle grazing unattended for weeks at a time and three workers on 236 acres, and Home Farm, with single suckling of home bred calves and five workers on 254 acres) can have quite different wage bills.

Many of the farms near West Hartlepool employ one or even two boys from the town, especially if the farmer's own children are too young or have grown up and left the farm, but the town youths do not usually stay in farming for long. Since they have not been brought up to farming and since the hours of work compare badly with those of their friends who work in industry, they usually leave their jobs after only a year or two. Many cases of a quick turnover in labour were found by the present writer, and nearly all of these were youths from the towns. Those who stay find the wages satisfactory until they reach the age of twenty when the rates of pay fall badly behind manual labourers' wages in towns. The little "extras" which come the way of many farm workers, such as eggs, potatoes or poultry, are not sufficient to overcome this drawback. A house for the hind is always an attraction but unfortunately few of the small or medium farms possess these tied cottages. Hulam houses five of its workers and Saltholme ten, but these giant farms are obvious exceptions.

The female worker is a rarity, and is usually a farmer's daughter who helps out in the years between leaving school and marriage. The electric milking machine has been an important contributory factor in this disappearance of women from agriculture, while better-paid occupations in the towns have made farming, always an unglamorous and hand-roughening business, extremely unattractive. Casual gangs for weeding have been made redundant by weed-spraying.

Farm mechanization has not cut the number of regular workers needed on the farm (except marginally on the larger holdings) so much as it has speeded up most jobs, and the servicing and maintenance of a tractor is a far cry from the hours spent on grooming and feeding horses.

Specialisation among the workers on the farms is possible only on the largest holdings, as at Hulam, where there is a foreman, a shepherd and a shepherd's boy. At Wynyard Home Farm there are two sides, the cropping and the livestock, each in the care of a separate foreman.

MECHANIZATION OF FARMS

During the Great War of 1914-18 one or two tractors appeared in the Hartlepools region but they were more of a curiosity than anything else and for most of the year stood idle under sheets. The mechanical breakdowns experienced and the natural conservatism of the local farmers resulted in the return of the horse teams wherever the tractors had made their temporary incursions. It was not until the large-scale ploughing-up campaign instigated by the government at the beginning of the 1939-45 war, and stimulated by the County Agricultural Executive Committees, that tractors came to S.E. Durham to stay. Since then the gradual improvements in the tractors themselves (for example, in their power and in their fuel switch from paraffin vapourising oil to diesel fuel oil) and in the multiplicity of attachments driven by the "power take-off" of the tractor have converted the farmer and his workers into skilled machine operators. Every farm now counts its machines as an important part of the fixed costs in the farm's accounts, and the care and maintenance of machinery has replaced the stable work associated with horses. The high allowances granted by the income tax authorities for investment in machinery have strongly influenced the mechanization since the war, being most attractive to the wealthier farmers, paying a high marginal rate of tax, and preferring to invest in machinery rather than to see the same money go to the Inland Revenue. Many small farms, however, could not afford the change to tractors and other machinery until well after the war was over, and purchased their first tractors in the early 1950's, at a time when the more prosperous were buying their first pick-up balers and combined harvester-threshers. There is an obvious division between those farms which need a combined harvester and those whose corn acreage is too small to justify the purchase of such a machine, which may cost more than £2,000. The smaller men make do with hiring a local contractor, either to combine the standing corn or to thresh the stacks of corn which they themselves have cut with the reaper-binder.

The tractor has made far-reaching changes in the cultivation schedules of farms in the Hartlepools region, for the sheer speed of ploughing after harvest means that the soil receives more cultivations than with horse teams. Winter frosts are then more beneficial in breaking down the clods, and the land is more quickly ready in spring to take the working prior to sowing. Farms on the heavier soils which used to lay away 15 acres in every 100 as fallow now use the same land for crops, and their productivity has shot up. The engineering developments which have made the tractor's power available for attached implements now eliminate much heavy lifting and tedious manual work. Hedges can be clipped, farmyard manure carried and spread, grass cut for silage and stacked, hay and straw baled and stacked, corn threshed and ditches cleaned by tractor-driven appliances. Apart from all this the tractor is used as a towing vehicle for trailers and even as a bull-dozer for clearing snow drifts.

The present survey shows that most farms in the Hartlepools region possess at least two tractors, as the following table shows:

Size of farm in acres	Number of tractors used 1	2	3	4	5	6	7
20-29¾	1	1	-	-	-	-	-
30-49¾	7	-	-	-	-	-	-
50-99¾	7	10	1	-	-	-	-
100-149¾	7	17	2	-	-	-	-
150-199¾	2	9	4	-	-	-	-
200-249¾	-	3	7	3	-	-	-
250-299¾	-	-	4	1	-	-	-
300-349¾	-	-	1	-	-	-	-
350-399¾	-	-	2	-	-	-	-
400-499¾	-	-	-	1	-	-	-
500-699¾	-	-	-	1	1	-	-
700-999¾	-	-	-	-	-	-	-
Over 1,000	-	-	-	-	-	-	1

(Farms with quoted number of tractors)

These figures cover 110 farms of which 17 were parts of multiple holdings run as one unit and sharing tractors.

Farms with only one tractor are usually those where another tractor can easily be obtained at vital times by borrowing from a member of the farmer's family.

Broadly speaking a cropping farm needs at least two tractors because at harvest times one is required for the cutting or lifting of the crop and one for leading it to the storage building. In some cases, such as the harvest of green grass for silage, three tractors are most efficient, one cutting, one leading, and the other building and grading the silage stack. As farms increase in size as extra tractor is needed for each 100 acres, though much depends on the number of projects undertaken, especially those requiring ploughing. With about 350 acres of arable, Mr. G. Nichol's four farms (totalling 684 acres) need five tractors, while the much larger Saltholme (1,634 acres) with 400 acres of arable needs only seven tractors. Town Farm at Greatham has 105 acres of which 100 are ploughed for crops or temporary grass, and three tractors are needed; Stotfold Moor, 151 acres, needs only one tractor because two-thirds of the farm is under grass.

The most expensive machine is the combined harvester-thresher, which came on to farms in the Hartlepools region during the war years (1939-45), though most were first purchased in the early 1950's. It is surprising to find how many of the smaller farms have them, and this is an obvious reflection of the influence of the tax allowances to be gained from the purchase of machinery. Some of the larger farms still hire contractors to do the combining of corn and later the threshing of such corn as has been cut by the binder - usually in winter when bedding straw is needed for stock - but these are mainly the farms of older men who are reluctant to change their traditional methods, or farms where casual labour is difficult to obtain for the corn harvest.

The following table shows the 1963 distribution of combines related to farm size and type:

Size of farm	Cropping farms		Fattening farms		Mixed farms		Milk farms		Miscellaneous farms	
(acres)	Com.	No com.	Com.	No Com.	Com.	No Com.	Com.	No.com.	Com.	No com.
20-29	-	-	-	1	-	-	-	3	-	2
30-49	-	-	-	5	-	-	-	17	-	12
50-99	2	6	3	12	-	10	5	32	-	8
100-149	2	11	4	9	9	19	2	13	1	2
150-199	14	4	3	9	10	9	-	2	-	-
200-249	12	2	4	4	15	7	2	-	-	-
250-299	10	-	4	1	7	1	-	-	-	1
300-349	4	-	4	2	3	-	-	-	-	-
350-399	4	-	2	-	3	-	-	-	1	-
400-499	5	-	3	-	1	-	-	-	-	1
500-699	2	-	1	-	-	-	-	-	-	-
700-999	1	-	2	-	-	-	-	-	2	-
1,000 +	-	-	-	-	1	-	-	-	-	-
Totals	56	23	30	43	49	46	9	67	4	26

The milk farms do not have the cropping acreage to justify a combine while among the mixed farms it is mainly those above 200 acres which can afford it. In the case of the fattening-with-cropping farms and the cropping-with-fattening farms the effect of size is clearly seen in the table. Fattening farms on the whole need to be over 200 acres before they buy a combine, and cropping farms need to be only 150 acres because of their higher proportion of cereal crops. The largest farms, which often have over 200 acres under corn, sometimes possess two combines, as in the cases of White Hurworth, Greatham Hall Farm, Hulam (with Sheraton Hall Farm) and Claxton Grange (with Blue House).

The acreages under corn of the 148 farms in the region which possess combines wereas follows:

Corn acreage	20-39	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-119
No. of farms	3	7	11	12	9	13	15	13	24
Corn acreage	120-139	140-159	160-179	180-199	Over 200				
No. of farms	14	10	4	2	11				

Thus there were combine harvesters on 148 farms (actually serving 199 since 51 other farms are run by owners of combines), or roughly one in three (and serving one in two). The alternative to possessing a combine is to engage a contractor (or to cut the corn with the binder and stook it) and a considerable amount of this type of work is available in the Hartlepools region for contractors from West Hartlepool (H. Stephenson), Greatham (T. Hutchinson), Wolviston (P. Robinson), Norton (G.E. Knaggs; Wright Bros.), Trimdon (R. Elliott), Elstob (G.E. Spikings), and Bradbury (J.H. Young). The cost of combining by contractors is about £4 per acre, and that of threshing by contractors £15-£16 per day, plus the cost of labour, often casual on the small family farms.

In the inner belt of farms first visited in 1961 37 out of 116 farms had combines (this had increased to 44 by 1963) and the average farming experience of the combine owners was thirty years. This indicated that most of them had been farming long enough to accumulate the capital needed to buy this expensive piece of equipment, which may cost between £2,000 and £3,000. With a large acreage of corn (over 100 acres) the combine soon repays its purchase price, but the table above shows that the sheer convenience of being able to combine at just the right time has caused farms with only 60-70 acres of corn to obtain one. With less than this acreage of corn farms are forced to buy seuond-hand combines, or the smaller sizes, and to operate as contractord for neighbouring farms, if they are to be able to meet the depreciation on the machine.

Few farms possess corn driers. Of the 116 inner belt farms only 22 had driers (of various types) in 1961. The farms with driers can store their grain to await the higher subsidy payments which increase from September to June. Many of the smaller farmers need the ready cash which their grain earns in autumn, and there is little likelihood of such men installing corn driers, for this reason as well as that of shortage of capital.

Pick-up balers are in more general use, 55 of the 116 farms owning one, while 53 had rotary cultivators (also known as rotavators) which are a major advance in the field of cultivating machines since they do the work of plough, disking implements and harrows all in one operation. The machine which is least seen in the Hartlepools region is the cutter-blower for the harvesting of grass silage, which has not yet in the early 1960's been generally adopted, only 7 farms out of the inner 116 possessing one. Elevators were found on 47 farms, being used mainly for the stacking of baled hay and cereals (both baled and in sheaf).

The rest of the expensive implements can be listed as follows: fertilizer spinners on 57 farms; chemical sprayers on 56; manure spreaders on 33; and manure loaders on 25 farms. About twenty of these farms appeared in most of the lists of machines owned, and can be considered as highly mechanised. One minor feature is the tendency to local concentrations of recently introduced machines and implements, showing the value of demonstration as a means of advertising. For example at Greatham seven small farms which are not distinguished by their outlay on machinery all possess manure loaders, which themselves are not common in the district; while between Elwick and Dalton Piercy five small farms not in other lists are among the 33 which own manure spreaders.

The machinery and implements possessed by every farm include the following: grass cutter, hay turner (recently replaced on some farms by a new type of tedder), scuffler (cultivator, or grubber), binder (these were disused on farms possessing combines), ploughs (usually two or three, but up to six on the large farms), harrows (two or three sets were general, with more on the big farms), discs (one set nearly everywhere, but often disused where a rotavator was owned), rollers (one set was most common), corn drill or combined corn/fertilizer drill, turnips and seeds drill, turnip pulping machine, potato planter (on two-thirds of the farms in what is an important potato belt), potato spinner, potato riddle, weighing machine (on all the fatstock farms), milking machines (on all the milk and mixed farms), and grain-grinding machines (though some small farms send their grain to be ground into fodder meal by Teesside Farmers Ltd. in West Hartlepool).

Map 25 shows the distribution of combines in the district surveyed, though it must be remembered that some of these combines are shared by brothers on neighbouring farms, or by father and son, and in some cases by seven or eight farms in a unit linked by a family bond. Each machine has been indicated only once, however, since a false impression of the extent of mechanisation might be given if all farms in these multiple units were shown.

Machines and implements are supplied to farms in the Hartlepools region by firms lying in the more central inland towns, such as Darlington, Stockton, and Durham. Most farms deal with more than one firm since the suppliers handle equipment as agents of national manufacturers, and a single agent may not stock all the gear a farmer wants. Although there is a tendency for a farmer to stick to the same supplier or suppliers (which accounts for many farmers who have come from coalfield farms to the south of Durham still buying implements from the well-known firm of Paxtons of Pity Me) the entry into the machinery trade of Teesside Farmers, a co-operative society, in the 1960's, has already cut deeply into the market. Of the farmers questioned in the inner zone around West Hartlepool 61 deal regularly with Ord and Teasdale (Stockton and Darlington), 27 with H. Young of Darlington, 20 with Paxtons of Pity Me (Durham), 19 with Teesside Farmers (Head Office at Darlington, machinery depot at Newton Aycliffe), 14 with J.

Measham of Darlington, 12 with Teesside Agricultural Engineers of Darlington, 9 with Gills of Leeming Bar and Northallerton, and 4 with Tipton and Morley of Barnard Castle and Darlington. Of these 166 dealing arrangements only 33 were with one supplier only. Occasionally firms at a distance were mentioned as machinery suppliers, for example, Elders of Berwick, Fewsters of Hexham, Kellett and Pick of Northallerton, Reeds of Shiremoor, West Cumberland Farmers of Hexham, and Turners of Lazenby, reflecting the markets visited by the farmers concerned.

Repairs to agricultural machinery are undertaken by the suppliers, as is routine servicing and maintenance, but in general local garages make minor repairs, which are mainly welding jobs, and the farms do the oiling and greasing, leaving only major repairs to the supply depots because of the high cost. Few farms possess well-equipped workshops and consequently there is a steady flow of work for garages in West Hartlepool, Stockton and in all the villages. Blacksmiths survive at Elwick and Hart, though their work is largely on implements and machinery, especially welding.

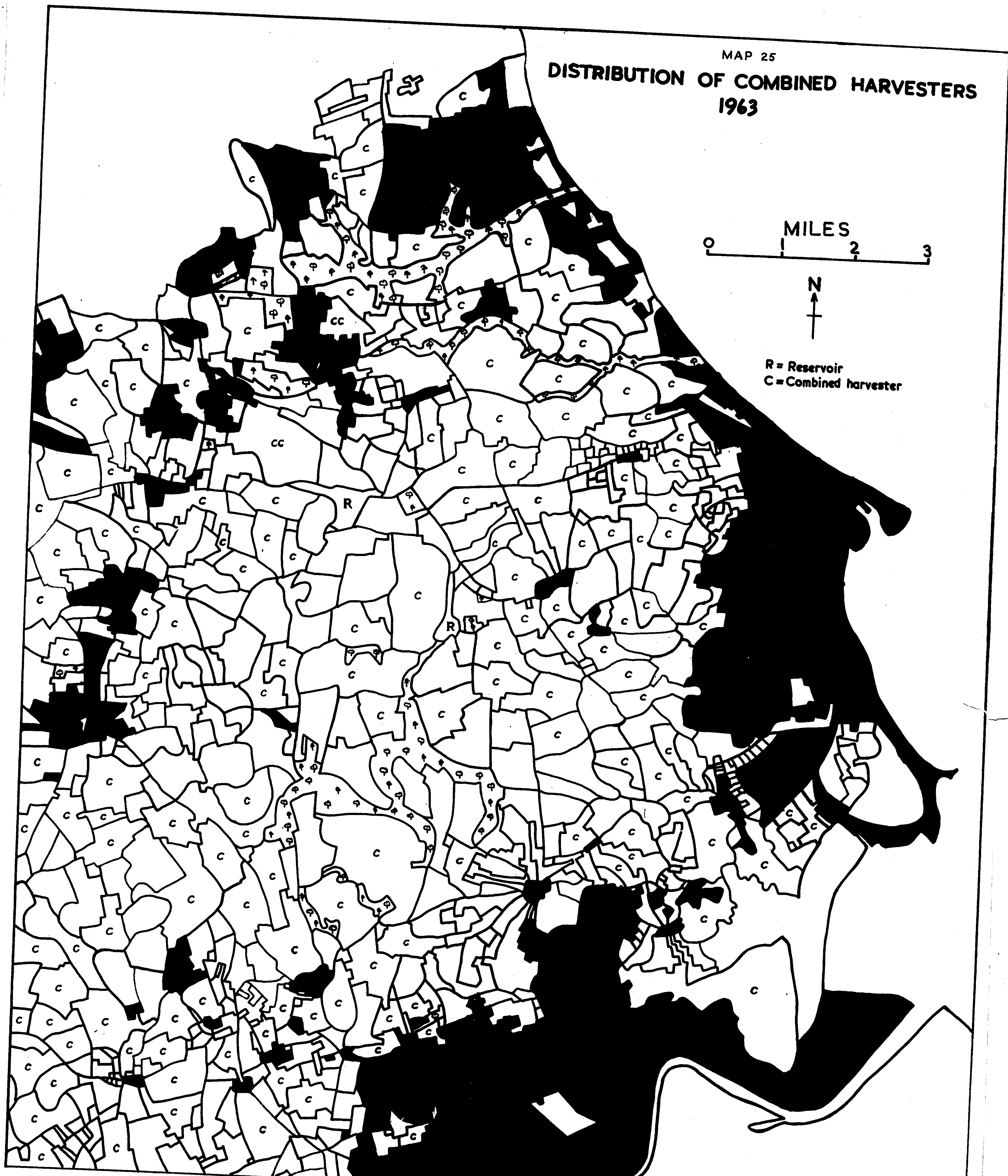
Most of the tractors in use in 1961 were run on diesel oil, few of the older paraffin-burning models remaining. Storage tanks were permanent fittings, some holding 200 gallons, some 500 gallons. Oil tankers from depots at Thornaby (Shell), Middlesbrough and Darlington (Esso), Stockton (Fina), Northallerton (Regent), and Sunderland (Majors) call at the farms when fresh supplies are summoned by telephone. Consumption depends on the number of tractors in full use and upon possession of oil-burning equipment like grain driers. While tractors burn anything from 300 to 800 gallons a year, self-propelled combines burn about two gallons an hour (100 gallons for five ten-hour working days plus threshing if corn is not combined) and corn driers burn two gallons an hour (or more if higher temperatures are required to deal with a wet harvest) which may take an extra 100 gallons for 30-40 acres of corn (N.B. if a farmer can afford to lay out £2,500 for metal-mesh silo grain bins a tractor-driven fan will dry corn at a fraction of the cost on an oil-burning drier). Thus the farms provide a large and growing market for oil products, a small 22 acre holding like Tilery Farm, Hart, using 200 gallons a year for a single tractor on 16 acres of arable, while the big farms with up to 200 acres of corn, one or two combines, and an oil burning corn drier may require 4,000 gallons.

CROPPING HUSBANDRY

Since the governments of the postwar years have introduced first guaranteed prices and then deficiency payment schemes (whereby the government makes up to farmers the difference between the average market prices and the standard prices fixed at the Annual Price Review) cereals have paid very well, and all farms in the Hartlepools region with suitable soils have expanded their corn acreages. Potatoes have shared in this prosperity because of the excellent urban market in S.E. Durham; the popularity of the fish and chip supper (and even lunch) has probably increased with the larger numbers of women who go out to work, while a local stimulus to potato growing has been the opening of a potato crisp factory at Peterlee. The Potato Marketing Board is an insurance against gluts so that most farms which can obtain the necessary harvest labour have increased their potato acreages. Thus corn and potatoes rank very high in the income returns of many farms in the Hartlepools region, and most of the expense of mechanisation since 1945 has been for the sake of these crops.

Standard gross margins (1) for wheat (£30 per acre), for barley (£33), for oats (£21), and for potatoes (£55) compare very favourable with those for any

(1) Gross margin of an enterprise is the contribution of that enterprise to the centre to pay off the fixed costs. It is obtained by subtracting variable costs from the gross output of the enterprise. For grazing livestock the gross margin is the result of charging both the concentrates fed and the variable costs of the forage acreage. It is possible then to compare directly the gross margins of land under various crops and stock on an enterprise or "per acre" basis. (D.B. Wallace. AGRICULTURE. May, 1961).


MAP 25
DISTRIBUTION OF COMBINED HARVESTERS
1963
MILES
0 1 2 3
N
R = Reservoir
C = Combined harvester

other farm enterprise, such as milk (£30 per acre), yard-fed beef (£9), or store sheep (£8), but for a variety of reasons purely arable farms are rare in the Hartlepools region. At Greatham Mr. J.J. Brown has laid out the 105 acres of Town Farm as follows: wheat 2 acres, barley 32, oats 20, potatoes 21, temporary grass 21, permanent grass 5, and roots 10. The only animals kept are 8 to 10 store cattle which eat up the turnips in winter before being sold in the spring. At Norton Mr. T.E. Watson has made White House Farm entirely arable because he has two other farms to cater for the needs of his suckler herd. Collinclose Farm at Billingham, surrounded by housing and industrial enterprises, is an arable farm with few cattle, but many poultry and much market garden produce. At Fishburn Mr. G. Walker has no buildings on his tenant farm and confines his activities at the moment to cash cropping. Mr. B. Bell, with his milk herd at Greenabella Farm, Seaton Carew, has turned all of the 78 acres of Seaton Grange over to arable, since there are now no buildings and the holding has become encircled by housing and industry. Benridge Farm at Blackhall belongs to a farmer who has two other farms which cope adequately with the milk herd and followers, so this holding has become wholly arable. This type of farm is alien to the traditional practice but this is not to say that it is second-best, and in fact some of these arable farms are on highly desirable lighter land (e.g. at Norton and Greatham).

Most farms, however, tie their cropping partly to a scheme of animal husbandry, and although most farms in the region keep cattle, those near the towns are wary of keeping sheep on account of the danger from dogs. There are distinct differences in the cropping patterns according to the livestock kept. On a dairy farm, for example, where the whole herd must be kept throughout the winter, the area given over to fodder crops inevitably reduces the acreage on which cash crops may be grown. If a farm is sufficiently small cash crops cannot be grown at all because of the demands of the livestock. This explains the predominance of milk in the output of many small farms. At the same time, however, livestock provide the land with valuable manure and cut the cost of artificial fertilizer. 50-60 acres seems to be the size at which farms in the Hartlepools region cease to be able to grow cash crops if they keep a herd of cattle (usually milk cattle); over 60 acres there is generally room for a few acres of corn or potatoes for sale. Near Greatham, near Hart, and at Hutton Henry are smallholdings which are almost entirely arable, those at Greatham including several market-gardens and greenhouses. At the other extreme are small farms like Pawton Hill which has its entire 31 acres under grass for its herd of 24 milk cattle, and nearby Greenacres, with 32 acres in temporary grass, 2 acres of turnips, 3 acres of kale, and 3 acres of potatoes, and supporting 25 milk cattle. Such small farms are obliged to buy the bulk of their winter fodder, especially concentrated grain mixtures and oilcake, bedding straw and even roots. The larger farms also keep their roots crop, oats, and some of the barley for feeding livestock, carefully balancing the numbers of animals with convenient proportions of grazing, of hay meadow, and of fodder cereals and roots (unless extra grazing can be hired from farms with a surplus). The pressure on any farm's grass is greatest in the period from May to July, before haytime, but when the hay fields are later available for grazing the situation is considerably eased.

A contrast in cropping systems between farms of identical size but with different livestock policies is afforded by Hall Farm, Greatham (365 acres) and Sheraton Hill Farm (365 acres) near Hutton Henry. The former maintains a herd of 100 store cattle, most of which are sold during winter, and 55 breeding ewes whose lambs are sold fat by September. The latter has a herd of 130 dairy cattle (including followers) and 60 breeding ewes. Their 1961 crop acreages were:

Hall Farm - wheat 45, barley 112, oats 73, potatoes 27, turnips 1, hay 69, grazing 66.

Sheraton H - wheat 45, barley 12, oats 77, potatoes 32, turnips 13, hay 83, grazing 66.

The beef farm does not require either the hay or the turnips needed by the dairy farm, and consequently in 1961 was able to grow 63 acres more of cash crops.

On a smaller scale the same contrast emerges when adjacent farms at Greatham are compared ! West Meadows, 84 acres, which is a beef farm, fattening about 30 store cattle, and North Close, 85 acres, which is a milk farm, with a herd of about 50 (including followers):

W. Meadows - wheat 7, barley 15, oats 21, potatoes 5, roots 3, hay 10, grazing 21.

N. Close - wheat 8, barley 15, oats 11, potatoes -, roots 4, hay 28, grazing 16.

Here the dairy farm must forego growing potatoes in order to grow sufficient hay for the winter.

A third example, again with farms of identical size, proves the same point. Whelly Hill Farm, 236½ acres, with about 40 beef store cattle and 130 breeding ewes, is compared with Naisberry Farm, 233 acres, which has 32 milk cattle and 100 ewes.

Whelly Hill - wheat 14, barley 47, oats 35, potatoes 8, roots 11, hay 30, grazing 91.

Naisberry - wheat -, barley 52, oats 27, potatoes 22, roots 5, hay 50, grazing 78.

Variations in the type of sheep husbandry can also affect the cropping system. While some sheep rearers sell fat lambs during the summer and have only the breeding ewes to feed in the winter, others (e.g. Whelly Hill, as above) retain their lambs till mid-winter in order to gain the highest prices and manure the pastures thoroughly. This over-wintering requires extra supplies of turnips and in bad winters (e.g. 1962-63) extra hay.

Supply of seed

The seed trade is carried on at two levels, nationally by the seed firms whose names are household words in farming, and locally by the agricultural merchants who supply also fertilizer, sprays, feeding stuffs and equipment. Most of the cereal seed used is home produced but grass and clover seeds are also imported, especially from Commonwealth countries. Potato seed is largely brought from southern and central Scotland. Cereal seed can be divided into three classes. The "pedigree" seed, which comes from the specialist seed houses, is grown and processed under strict supervision and sold at quality prices. Next, the "field approved" seed sold by the larger merchants is officially sponsored by the National Institute of Agricultural Botany, whose Field Approval Scheme started in 1947 when 38,000 acres were inspected. In 1960 211 seed merchants and 5 seeds growers' organizations, using over 700 inspectors, participated in the scheme, inspecting 162,000 acres. Today the Cereal Field Approval Scheme accounts for about 30% of barley seed and about 40% of the wheat seed bought by farmers. Finally there is the trade in "commercial" seed that is based on good quality stocks which are true to variety and which reach satisfactory standards of germination (1).

In the Hartlepools region the agricultural merchants who can supply seeds are found in West Hartlepool (Teesside Farmers; Foster and Armstrong), in Stockton (H. Foster & Son; Maddox's Ltd.; W. Wilson; Thomas Mellanby), in Sedgefield (R.W. Weatherall), in Bishop Auckland (Ferens Bros. Ltd.) and in Darlington (Kent and Brydon; C.H. Varley; Teesside Farmers Ltd.). Further afield

(1) J.T. Shelton. The Trade in Agricultural Seeds. AGRICULTURE, October, 1961.

Bells (of York) and Thompsons (of Prudhoe) also trade within the Hartlepools region. In addition most farmers contact firms scattered throughout the country if their attention has been drawn to special types of seeds in the farming press.

The chief types of cereal seed used in this district are Cappelle-Desprez for winter wheat, Rika for barley, and Blenda for oats. "Pedigree" seed is bought by farms every third year.

Rotations

While the Norfolk four-year rotation is widely practised in the Hartlepools region, with its roots-corn-corn-hay pattern, on the small farms (less than 100 acres) a three-year rotation is common, because there are not enough fields to accommodate both the stock and a second corn crop in the third year. On any farm the number of arable fields must be a multiple of four if the four-year rotation is not to produce an uneven crop sequence. The adoption of the long ley, whereby temporary grass is left for a number of years (usually three, the minimum period to qualify for the ploughing out subsidy) has upset the four-year rotation on many farms, which consequently have very flexible cropping sequences that may run for six to ten years. These longer term rotations are most common on the larger farms, with poorer soils having longer leys.

The use of modern chemical fertilizers has also made farmers more daring with their crop rotations. Corn can be grown with the help of nitrogenous fertilizers for many years in succession without apparent falls in yield or any other harmful effects. The advances made in rendering cereal seed resistant to disease have also helped this continuous cereal cultivation. Yet there is little evidence of such experiments in the Hartlepools region as corn crops are often regarded as of less importance than stock.

The reduction in the acreage of permanent grass has been largely due to the substitution of long leys, which on the bigger farms lie for five or six years.

Fertilizer practice

Since the Agriculture (Fertilizers) Act of 1952 farmers have been able to obtain Exchequer contributions towards the cost of nitrogenous and phosphatic fertilizers, with the result that the use of chemical manures has shot up compared with the pre-war years. In addition the Agricultural Lime Department pays 65% of the delivered cost of lime and a contribution towards the cost of spreading the lime.

Farms in the Hartlepools region buy fertilizers from a wide range of national manufacturers and distributors, although the two Teesside works of I.C.I. and Eaglescliffe (at Urlay Nook, 3 miles S.W. of Stockton) were mentioned most frequently on the farms visited. Supplies are ordered in bulk through local agricultural merchants, usually in September for use in spring (early orders secure a discount), and are delivered in multi-wall paper sacks. Dry storage space often sets a limit to the quantities that can be ordered, but the writer noted that during 1962 I.C.I. introduced a new damp-proof plastic transparent bag which can be stored safely out of doors.

Basic slag, obtained from the Dorman Long steelworks at Lackenby, and lime from quarries in the Magnesian Limestone plateau (e.g. near Shadforth) and from the I.C.I. works at Prudhoe, where it is a by-product, are also ordered through agricultural merchants. Spreading by the lorries which bring these is part of the service offered by the contractors, of whom the chief are Thompsons of Prudhoe, and Adam Lythgoe of Newcastle, Fulwell and Shadforth. Storage is therefore no problem. The basic slag is a rich source of phosphorus and is valued for grassland as the best response from nitrogenous fertilizers cannot be obtained without a balanced manuring. Magnesian Limestone usually contains a high proportion of magnesium carbonate, up to about 40%, and there is no objection to its use as a fertilizer, either burnt or ground (1) though it had

(1) The Use of Lime in Agriculture. H.W. Gardner and H.V. Garner. 1957.

a dubious reputation in the past (1).

The pellet form of most of the fertilizers enables them to be drilled mixed with grain seed, but some farmers are discarding the combine drill and using the chemical spinner to apply chemical fertilizer more quickly. This leaves them free to drill the grain without interruption whenever the soil and the weather are suitable, and saves time on the maintenance of the combine drill. Although more fertilizer may be used this way the saving in time at a vital period of the year may be worthwhile (2).

The amounts of fertilizer used vary from farm to farm, but the general rate of dosing is as follows:

Cereals	- 3 cwt. to the acre	of fertilizer containing 10% nitrogen, 10% phosphate, 15% potash.
Potatoes	- 5 to 10 cwt. to the acre	
Roots	- 5 cwt. to the acre	
Grass	- sown with 2 cwt. of nitro-chalk per acre, dressed with complete fertilizer (9% nitrogen, 9% phosphate, 15% potash) about mid-May, and with lime or basic slag once every three years, at the rate of 2 to 3 tons per acre for lime and 10 cwt. for basic slag.	

Much depends on the amount of farmyard manure which is available, and most farms are fortunate in that they keep cattle over the winter. Sheep also help to manure the grazing land, while the long leys themselves maintain the organic content of the soils which cereals tend to break down. It is estimated (3) that white clover in mixed swards will contribute a nitrogen equivalent of a

(1) The Rendzina Soils of the Magnesian Series in Durham M.E. Frisby. Unpublished M.Sc. thesis, University of Durham, May, 1961.

(2) C.J. Black. Spring Cereals and Farm Management. AGRICULTURE. Feb. 1962.

(3) M. McG. Cooper. More Food from Grassland. AGRICULTURE, May, 1961.

15-25 cwt. dressing of sulphate of ammonia per acre. Most of the temporary grass leys contain clover as well as rye grass, timothy and cocksfoot. Some farmers give a corn crop immediately following roots no fertilizer, on the grounds that there will be a residue from the previous year that will suffice.

Soils are tested on request by the fertilizer firms and by the National Agricultural Advisory Service, so that it is rare that any field is seriously deficient in plant foods, though the cost of fertilizer may still deter the smaller farms from using the optimum amount of chemicals required.

Weed control may be mentioned here since selective weed-killers are another type of expensive chemical which is fast becoming a necessity, though again many of the small farms in the Hartlepools region find them difficult to afford. About half of the farms possess chemical sprayers.

Average dates of sowing and harvesting

After the rains, snows, and low evaporation rates of winter the first cultivations in the Hartlepools region take place from late February, on the average, though during an "open" winter such as 1957 and 1964 with mild dry spells work can often be done in January and February. Cereals are usually sown in mid-April, followed by potatoes and roots in late April and May.

The first harvest is that of silage, often in May, followed by haytime, which may begin as early as mid-June but is more usually in late June and early July. Mid-August is the average date of the start of the cereal harvest but serious delays may be forced by cool cloudy summers, as the following actual records from Middle Field Farm at Greatham show:

	Started Harvest	Finished harvest
1955	13th August	21st September
1956	15th September	12th October
1957	13th August	28th September
1958	30th August	10th October
1959	4th August	22nd August
1960	11th August	15th September
1961	11th August	22nd September
1962	30th August	28th September
1963	11th September	19th October

On the farms on the higher land of the East Durham Plateau both sowing and harvest may be delayed up to a fortnight later than on the Tees lowland on account of cooler and wetter conditions, and in a late year like 1962 or 1963 the rush is so severe that cultivations for winter wheat cannot be carried out, late October being taken up by the potato harvest.

The potato harvest begins as soon as the cereals are safely in though in some years waiting may be necessary till the potatoes are properly ripe. Most farms are glad to wait till the school holidays in late October when a youthful labour squad may be assembled. The last sowing of the year comes between late October and late November, when wheat is drilled. In such a wet autumn as 1960 little wheat was sown - indeed hundreds of tons of potatoes were left unharvested - and most farms resorted to planting lower yielding spring wheat or even barley, in the following spring. The full benefits of mechanised harvesting are felt under such conditions when speed is the chief need, especially on the large farms where corn acreages are well over 100, and potato acreages 30-40.

In pre-war days when the bulk of the corn in the Hartlepools region was cut by binder and stooked for three weeks to allow the grain to dry and harden prior to stacking, harvesting could begin about a fortnight earlier than with the combine. Dates of harvesting from that period are therefore not comparable with dates after the war, now that nearly all cereals are "combined". To be ready for the combine the grain must be very ripe, almost falling from the ear, so it is given longer to ripen than was the case with corn cut by the binder.

Yields

Typical yields quoted by the farmers visited were as follows:

		Compare national and county yields (1951-60):	
Wheat	25-35 cwt. per acre	24.2 cwt.	23.4 cwt.
Barley	30-40 " " "	22.4 cwt.	23.5 cwt.
Oats	30-40 " " "	19.9 cwt.	21.1 cwt.
Potatoes	8-10 tons per acre	8.4 tons	7.6 tons.
Hay	1½-2½ " " "	29.9 cwt.	33.3 cwt.

These are big increases over pre-war figures when 20-30 cwt. per acre for cereals and 5-6 tons per acre for potatoes were considered good. In ideal weather and on good soils all the above figures are higher, while there are differences due to the degree of good management exerted from farm to farm within the region. It is impossible to apportion the credit for the higher yields between the increased use of fertilizer, the better yielding strains of seed, the use of weed control, the improvement of implements, and the drainage of heavier soils.

Marketing

The marketing of grain is carried on at two levels. The first stage is the negotiation between the farmer and the agricultural merchant who acts as the middleman between the farm and the giant milling firms like Ranks (Gateshead), Spillers (Newcastle), and the Co-operative Wholesale Society (Dunston) of Tyneside. These firms, and others even further afield at Hull and Liverpool, have completely replaced the small local mills at Newton Bewley, Greatham, Hart, and Elwick, and also the larger mills at Thornaby (Ranks) and Sunderland (Robsons), though for the smaller farms which still do not possess grinding mills of their own, Teesside Farmers Ltd., do a small amount of grinding at their West Hartlepool depot.

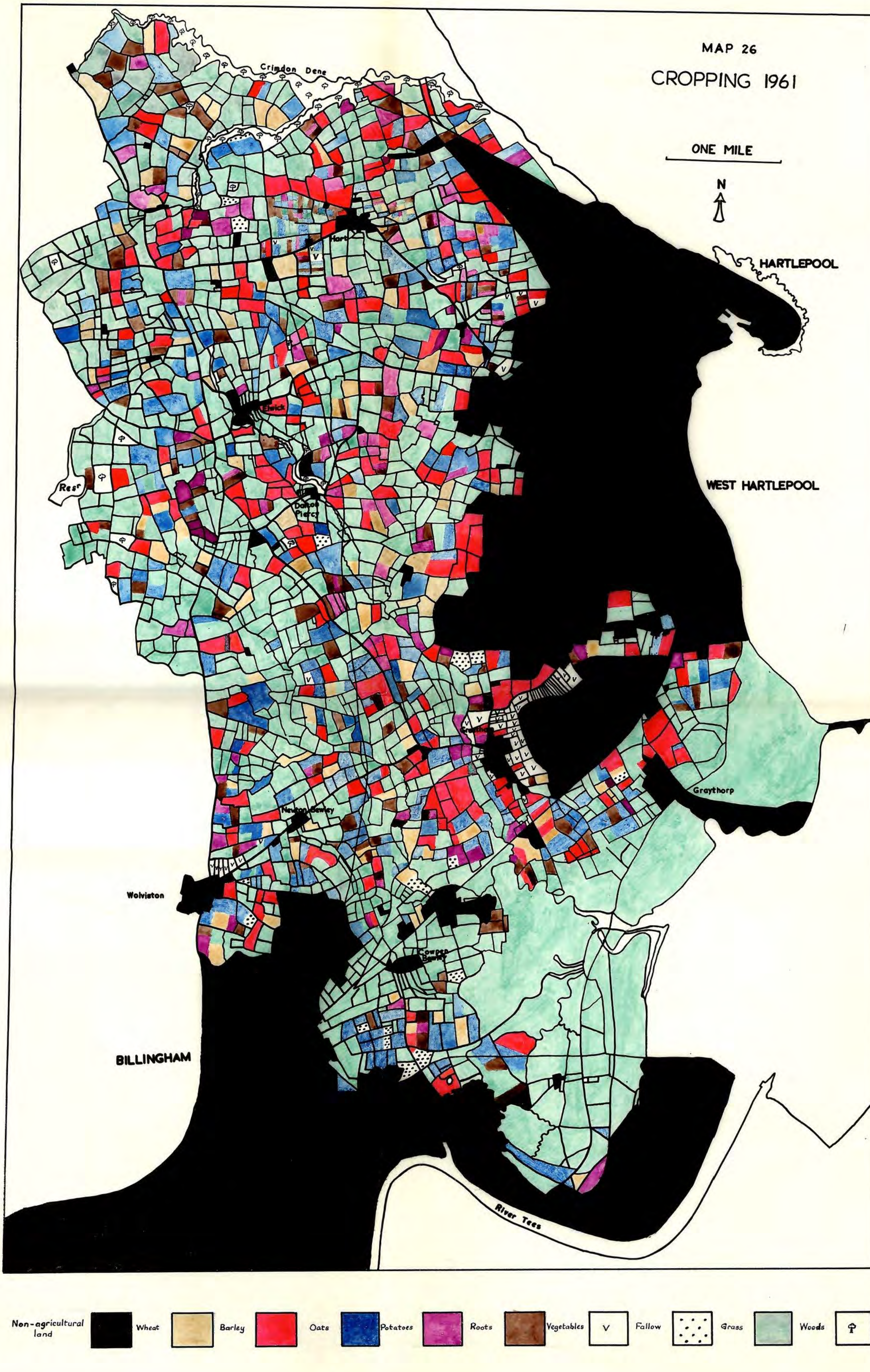
The second stage in the marketing, after the grain merchant has approved the sample (this usually takes place at one of the local markets) is the collection of the corn at the farm by the merchant's lorry which delivers straight to the distant mills. Few farms have the expensive bulk storage grain silos, but many make substitute holders from a polythene covered floor surrounded by bales of straw. From these containers grain is conveyed by augers or by suction hoses into the waiting lorry at the rate of about six tons per hour. From silos (fabricated in West Hartlepool from metal mesh) grain is even more quickly loaded by gravity feed down a chute. Nevertheless most grain is still transported in jute sacks.

Prices fluctuate according to the amount of imports from abroad and according to the season, rising from late autumn after the bulk of grain has been sold off the farms, till June. The Exchequer subsidy system emphasises this price pattern as the guaranteed price on wheat and barley jumps in steps so that it is several shillings per cwt. higher in June than in September. The farmer who can afford to wait to realise his grain harvest is in effect being paid a premium for storage. The prices for barley and oats also contain a subsidy for the acreage sown, while wheat receives only the subsidy on the amount sold, the reason being that the first two are often kept on the farm as feeding grain. Much of this fodder grain is milled and concentrated at the cake-mills at Piercebridge (Teesside Farmers Ltd.) and Bishop Auckland (Ferens) and returns to the farms.

Other minor markets for grain are the breweries which buy malting barley, though very little of this is produced in the Hartlepools region, and the big grain-growing farms which dry all their corn and need seed from other farms. A small group of farmers near Hart produce both malting barley (not every year) and seed grain, sold often to agricultural merchants as "once-used" seed.

In the marketing of potatoes the distribution of settlement is most important since this bulky heavy crop is expensive to harvest and transport. Potato growing orientates itself round the towns and larger villages and it is towards these that marketing is directed. Whereas grain goes out far beyond the limits of the region, potatoes are sold within a few miles of where they grow. West Hartlepool alone has six major wholesalers, Stockton has nine, Greatham two, and the colliery villages like Horden, Wingate and Fishburn have one or two each. The West Hartlepool market is served by a belt of farms within a three mile radius of the town perimeter. To the north of this potatoes are sent to the colliery villages, and to the south they are taken to the Stockton market, but few farms north of the River Tees supply Middlesbrough. Overlaps occur inevitably between the hinterlands of these town markets since various wholesalers serve the area and competition is strong. One important wholesaler from Wolviston deals with farms as far north as Castle Eden, as far west as Butterwick, and as far south as Easingwold in Yorkshire.

The pattern of cropping for 1961 is shown on Map 26.


MAP 26
CROPPING 1961
ONE MILE
N
HARTLEPOOL
WEST HARTLEPOOL
Crimdon Dene
Hart
Elwick
Dalton Piercy
Resr
Graythorp
Newton Bewley
Wolviston
Cowpen Bewley
BILLINGHAM
River Tees
Non-agricultural land
Wheat
Barley
Oats
Potatoes
Roots
Vegetables
Fallow
Grass
Woods

STOCK HUSBANDRY

Most of the farms in the Hartlepools region keep cattle, while with few exceptions farms away from the immediate urban fringe keep sheep, the town-edge farms making up for their lack of sheep by keeping pigs. Poultry, mainly for egg production, are kept on almost all farms, but the scale varies tremendously from the mere handful kept to supply the farm's own needs, to the occasional flock of 4,000. One new venture in 1961 at Dalton Field House was the installing of a broiler house for a flock of 6,000 day-old chicks which are replaced every three months, a contract for supply and marketing being arranged by a Bedlington firm (1).

MILK CATTLE

The main dichotomy in the herds of the Hartlepools region is between those kept for milk and those kept for beef. There has been a gradual but continuous change-over from milk production to beef in the past twenty-five years in this district for the following reasons:

1. Farms which turned to milk as a secure source of income in the depressed years from 1923 to 1939 no longer in these days of subsidy-security need such support.
2. The financial rewards of milk have decreased relative to those of cash cropping and beef production. The flat rate at which milk is bought by the Milk Marketing Board takes away advantages possessed by farms near the towns in the pre-motor age.
3. To be near the towns now is indeed a disadvantage for a milk farm in respect of labour. Alternative employment with more attractive hours of work and higher wages makes workers difficult to obtain. It is for this

(1) Mr. John Wright's company, "Tynedale" Accredited Hatchery, at Hartford Bridge near Bedlington, Northumberland.

reason that milk farms near the towns are very small and are worked by the farmer's family rather than by hired labour.

4. The tightening of the regulations governing the conditions under which milk is produced has made necessary certain improvements in farm buildings. Constant inspection by Milk Marketing Board officials of premises, equipment, cattle and the milk itself, has raised standards of cleanliness and health considerably, but many farms lacking the required facilities have gone out of milk production rather than face an expensive period of re-building and re-equipping their byres and milk-parlours.

5. Some farmers have inevitably turned away from the heavy labour associated with dairying as they have grown older. No farming system is light work, but milk production is the most tiring physically because of the indoor feeding, the twice daily milking, cleaning up afterwards, and the constant viligance and struggle against the disease to which dairy cattle are liable.

6. From October 1962 milk is being graded according to its butterfat and solids-not-fat content. Payment by the Milk Marketing Board will penalise milk with a low solids content. This has worried farmers, especially those with Friesian herds which do not always produce milk of even the second grade. One farm the writer visited is losing £25 a week compared with his returns before this scheme started. There is little doubt that this scheme precipitated the large number of switches from milk to beef production in the period 1962-63. The government White Papers during the 1950's and early 1960's have continually stressed that milk production was in excess of liquid consumption, with consequent depression of the pool price, so that this latest scheme is direct financial pressure on the less efficient producers to improve their milk quality or to quit milk production.

Forty-seven farms within ten miles of West Hartlepool have made the change from milk to beef production since 1937, including 20 between 1961-63, while only three have taken up milk production in the same period. Of the latter all three were new farmers, and one of these has gone out of milk after twenty years (in 1962). Milk cattle pay immediate cash and most new farmers do begin with dairy herds to cover their shortage of capital; the hard work is borne with equanimity.

SIZE OF MILK AND MIXED FARMS

Farms and dairy herds (classed on Page 171 as either milk farms or mixed farms, according to the size of the contribution towards net income made by milk) tend to be small or of medium size. Of the 79 milk farms visited 59 were of less than 100 acres, and of 106 mixed farms 15 were less than 100 acres, and 80 were between 100 and 250 acres. The biggest mixed farm (apart from Saltholme, 1,634 acres, where the small milk herd is very much a sideline) was Sheraton Hill, 365 acres, but a large proportion of cash crop acreage here ensures that this farm is not as specialised as most of the small milk farms; both pigs and sheep help to diversify production. On Horden Hall Farm, 360 acres, milk retailing and an absence of other than milking stock and followers make a more specialised farm, but even here 140 acres of corn and about 40 acres of potatoes lessen the dependence on milk. Wynyard Home Farm (900 acres) keeps milk cattle purely to supply the estate workers with milk in an area remote from retail delivery.

BREEDS OF MILK CATTLE

The predominant breed of cattle favoured by the milk producers in the Hartlepools region is the Friesian, popular on account of its high yields and the suitability of steer calves for beef. The work of the Moffitt brothers in Northumberland in producing record-breaking milkers has resulted in some fine

Friesian herds, for example at Sheraton Hill (J.O. Brewis & Son) and at Low Stotfield (C.C. Crozier) where pedigree cattle are kept.

The farmers with Ayrshire herds, however, contend stoutly that their choice gives milk with a higher butterfat content, eats less and handles better than the Friesian, though the beef from an Ayrshire is not esteemed, and the value of an Ayrshire bull calf is very low. During the 1950's Freisian herds increased at the expense of the Ayrshires, but since the 1962 premiums were introduced for quality milk there may be a swing in favour of the Ayrshire.

The Channel Island herds earn a premium for their high butterfat yields though their meat is fit for little other than the pie trade. Shorthorns are disappearing as a class though some of the older farmers still have them. Mixed herds of Friesians and Ayrshires on some farms are the result of changing from one breed to another, or on others merely the chance of a bargain at the sales.

The 1960 (June) figures for Northumberland and Durham collected by the Milk Marketing Board show Friesians with a third as many more than Ayrshires:

	Cows and heifers in milk and cows in calf					Dual purpose breeds		
Milk breeds	Ayrshires	Friesians	Guernseys	Jerseys	Total	Shorthorns	Others	Grand Total
	15,500	20,200	400	1,200	37,300	14,200	3,600	55,100

In the Hartlepools region, on the 51 farms with dairy herds in the inner belt of 116 farms the proportions were more heavily in favour of the Friesians:

	Friesians	Ayrshires	Jerseys	Guernseys	Shorthorns	Mixed
Herds	27	8	1	1	2	12

REMUNERATION

Remuneration of milk producers has been regulated since 1934 by the Milk Marketing Board who arrange the collection of milk from the farms and deliveries to the dairies at West Hartlepool (Co-operative Society), Wingate (East Durham Co-operative Society), Middlesbrough (Brunton's, Collier's, Donaldson's, and the Co-operative Society), Darlington (Walker's and Carrside's), and Stockton (Co-operative Society). The Milk Marketing Board's own dairy at Langley Bridge, near Durham, takes all Channel Island milk from the Hartlepools region and supplies bottled and cartonned milk to retailers, some of them farmers. Vicarage Dairies, who have a chain of seven milk-producing farms, process their own milk from their Guernsey herds, at Wellfield Farm, Wingate.

A flat-rate "pool-price" per gallon is paid to all producers regardless of the distance from the market. If a producer delivers his milk to the processing dairy then he retains a small premium otherwise paid to the Milk Marketing Board for haulage (1.3 pence per gallon in Northern England) but few farmers are able to do this.

Seasonal variations in the prices of milk are arranged by the Milk Marketing Board so that the summer flush of grass which corresponds with the highest level of production of milk brings the lowest price during May and June, while the highest price comes in January, other months being graded accordingly. The difference between highest and lowest may be as much as 1/1d per gallon (in 1963 3/- in January and 1/11d in May).

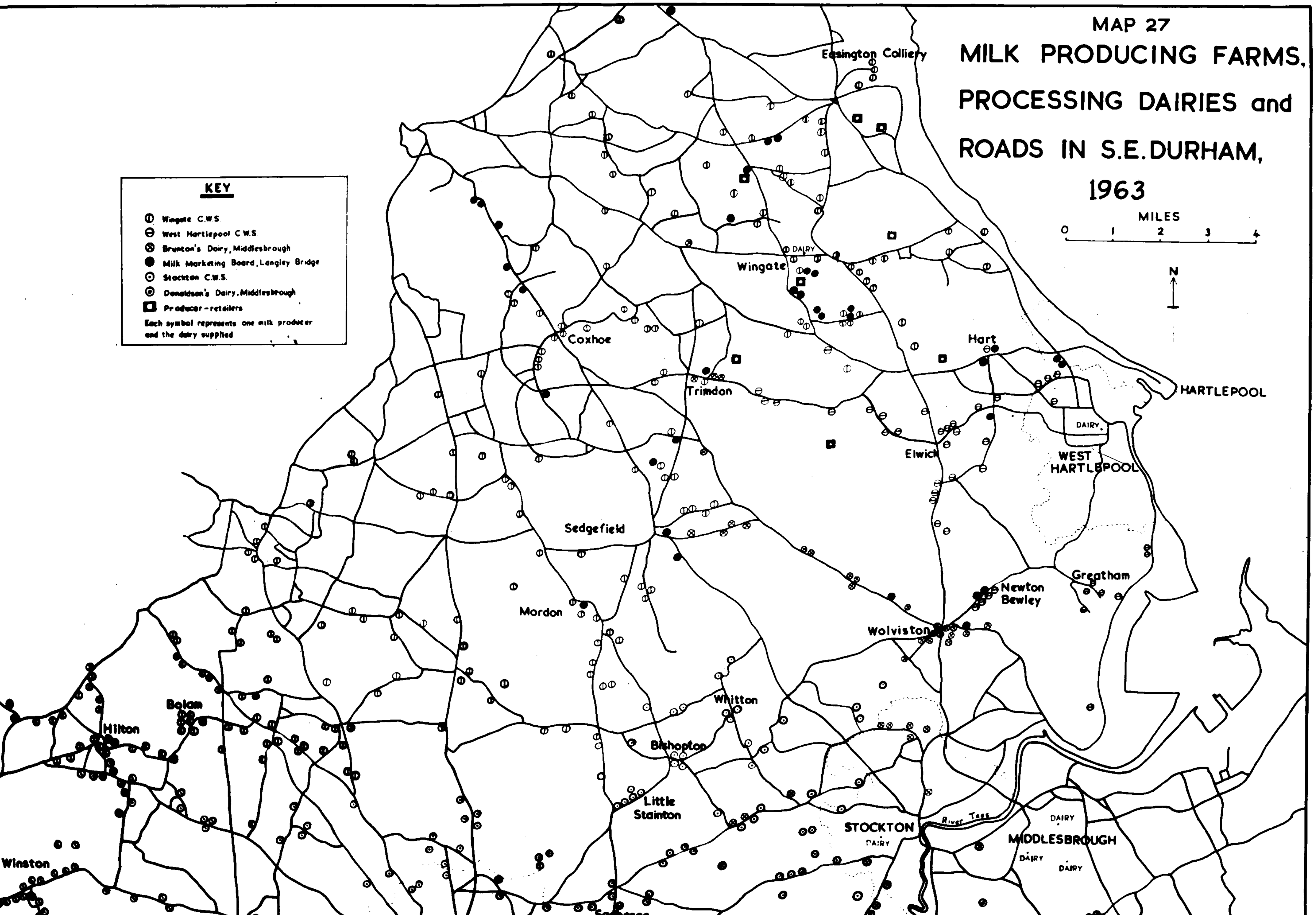
Guaranteed prices for milk are determined by the government under the Agriculture Acts, 1947 and 1957, together with similar producer price guarantees for other commodities. The guarantees are of two kinds. First there is an actual guaranteed price determined at the Annual Price Review in February for the year ahead, related to a specific quantity of milk (the "standard quantity") on which the full guaranteed price is paid. Supplies in excess realise a lower price approximating to the returns for milk used in manufacture. This form of price guarantee began in 1954-5, and has varied as follows:

Pence	1954-5	1955-6	1956-7	1957-8	1958-9	1959-60	1960-1	1961-2	1962-3
per gallon	37.25	38.00	38.50	38.75	37.75	37.75	37.50	38.30	37.90
"Standard" quantity"	1,651	1,651	1,651	1,654.1	1,654.5	1,661.5	1,678.8	1,698.2	1,721.1

Secondly. there are guarantees concerning the minimum levels of prices, and that for milk may not be reduced by more than 4% in any one year or by more than 9% over three years. This limits the reduction that can be made in the guaranteed price of milk in any one year to about 1½d per gallon.

In December 1961 the Minister of Agriculture in a written reply referred to the report of the Cook Committee on the compositional quality of milk in the United Kingdom, indicating that the government would consider paying the milk producer according to the compositional quality of his milk. In October, 1962 a scheme began whereby this compositional quality is sampled monthly and records kept, but a year's averages are necessary before payments are fixed. It is hoped in this way to halt the decline in the solids-not-fat (S.N.F.) content of milk over the past thirty years, and that the differential payments according to milk quality will improve the breeding of milk cattle. The standard figure for butterfat plus solids-not-fat content is 12.5%. Both the S.N.F. and fat content of milk are usually at the highest levels after calving as the change takes place from colestrum to normal milk. During the first week or two both decrease quickly and with even feeding are lowest just after peak milk yield, usually about one or two months after calving, but from then on rise slowly as lactation progresses. These differences within a single lactation may range as high as 1.5% total solids (1), but in the Hartlepools region they are masked for the herd's yield as a whole since calvings are arranged on a year-round basis. Where a series of calvings takes place over a short period, however, the new payment system will penalise only if the low solids content period that follows

(1) A.S. Foot. Total Solids in Milk. AGRICULTURE, March, 1962.


MAP 27
MILK PRODUCING FARMS, PROCESSING DAIRIES and ROADS IN S.E. DURHAM, 1963
MILES
0
1
2
3
4
N
KEY
Wingate C.W.S.
West Hartlepool C.W.S.
Brunton's Dairy, Middlesbrough
Milk Marketing Board, Langley Bridge
Stockton C.W.S.
Donaldson's Dairy, Middlesbrough
Producer-retailers
Each symbol represents one milk producer and the dairy supplied
Easington Colliery
HARTLEPOOL
DAIRY
WEST HARTLEPOOL
Wingate
DAIRY
Hart
Coxhoe
Trimdon
Elwick
Sedgefield
Greatham
Newton Bewley
Mordon
Wolviston
Whitton
Bolam
Hilton
Bishopton
Little Stainton
STOCKTON
DAIRY
River Tees
MIDDLESBROUGH
DAIRY
DAIRY
DAIRY
Winston

is heavily weighted by low-yielding cows that should be culled from the herd.

TRANSPORT

In the Hartlepools region the former benefits of lying near the Teesside towns have been obliterated by the Milk Marketing Board's flat rate payments since October, 1942, and the farms of S.E. Durham are now in competition with farms in the Pennine dales, the Vale of York, the Eden valley in Cumberland, and the North Riding of Yorkshire. West Hartlepool's only milk processing dairy (Co-operative Society) which deals with 25,000 gallons of milk a week (1962 figures) receives only about two-fifths of this from local farms, and the remainder from the Milk Marketing Board depot at Whitby, brought by road tanker. The deficit is caused by the gathering areas limits fixed by the Board; only 40 farms lie within the area supplying West Hartlepool with "ex-farm" milk. The Milk Marketing Board is continuously rationalising the collection routes, to make the most efficient use of the hauliers employed, and the rather isolated peninsula position of the Hartlepools, along with the close proximity of processing dairies at Wingate and Stockton, makes the balancing supply from Whitby inevitable. The accompanying may (Map 27) shows the Milk Marketing Board gathering areas and the processing depots in the Hartlepools region (1).

SIZE OF HERDS

The size of the herd varies with the size of the farm and with the number of other enterprises carried on. Hunter House (No. [illegible]) at Seaton Carew, with only 27 acres, carries eight milk cows (Friesian X Shorthorn), while at the other end of the scale Horden Hall (360 acres) has 170 Ayrshires, Hart Moor (170 acres), part of Mr. J.H. Thompson's chain of dairy farms, has 130 Guernseys, while Sheraton Hill Farm (365 acres) carries 130. The number of milk cattle (cows in milk and heifers following on) is also determined by the following factors:

(1) Drawn by the present writer from data supplied by the Milk Marketing Board.

1. The extent to which the farm practises a dual policy of milk and beef production. Even farms with very small herds have been encouraged by the recent improvement in the beef market and the deterioration of the milk market to rear some of their otherwise disposable young stock for either store cattle or fat beasts for slaughter. These beef cattle take up the space that might normally be occupied by milk cattle, both in the field and in the buildings.
2. Whether or not sheep are reared. Sheep need about one fifth of the grazing space required by mature cattle and can often follow the latter on the pastures which have not been eaten down too bare, but nevertheless they do impose limits on the amount of grazing available for cattle and on the extent of the grass that be turned into hay or silage.
3. The acreage given to cash crop production.
4. The number, and, even more important, the condition, of the farm buildings, which must conform with very strict regulations laid down by law when milk is to be produced.
5. The breed of cattle kept is important. The most popular type, the Friesian, eats more than its principal rivals, the Ayrshire and Channel Island breeds, which therefore can be kept in larger numbers if all other factors are equal.
6. The method of grazing adopted. Most cattle per acre can be kept by the zero-grazing method, whereby the grass is cut twice daily and fed to penned cattle, but this is expensive in labour requirements compared with either free-range or even strip-grazing (with an electric fence), and is not found in the Hartlepools region.

In general the milk farms can support about 8 cows in milk, 3 heifers and a calf for every 15 acres of grass, with slightly lower numbers if sheep or beef cattle are kept. These figures are based on averages for 48 farms producing milk in a belt immediately around West Hartlepool and Hartlepool, but the averages mask considerable differences in stocking intensity due to variations in the above factors and other individual circumstances.

HERD STRUCTURE

The normal structure of the milk herds in the region is roughly three times as many milk cows (including cows in milk, cows in calf, and heifers in calf) as heifers aged 1-2 years old, while the number of heifer calves under 1 year old can vary widely from farm to farm. The over-riding factor of eventually replacing old cows as they are culled from the herd may be solved either be rearing calves born on the farm itself, or by purchasing heifers or even mature cows. The dairy herd, by its own reproduction naturally tends to double in size every four years, allowing for freedom from disease and regular mating. To dispose of the excess animals the commonest practice is to sell off most of the calves, retaining only those from mothers with the best milking records in order to maintain the size and productivity of the herd. There is a ready market for calves in the Hartlepools region because of the numerous farms which fatten stock by the pail-feeding or multiple-suckling methods. The two types of farm, milk and beef, are thus complementary.

The 1961 survey discovered only two farms in the Hartlepools region (inner zone) where this normal herd structure was not followed. Pawton Hill, a small milk farm of 31 acres west of Elwick, maintains 24 milk cows on 29 acres of temporary grass and 2 acres of permanent grass, which also provide sufficient hay and silage to feed this herd through the winter. No calves are reared and replacements for the milk herd are purchased. Hunter House (No. 1) at Seaton Carew, with 130 acres, had 13 milk cows as well as about 30 store cattle being fattened; though calves were reared none went into the milk herd, replacements being purchased every four years. (Note: This farm has altered since 1961: the 57 acres rented from Durham County Council have been transferred to another tenant for a separate milk farm, while on the other 73 acres, rented from West Hartlepool Corporation, the cattle have been given up in favour of purely arable farming).

A variation of the self-contained herd system is one whereby instead of reducing the excess numbers at the lower end of the age range the selling is at the older end, milk cows being sent to the marts after bearing the third or fourth calf. Disease can be avoided in this way since the calves are inoculated at birth against contagious abortion and blackleg (tics) and their history is known before they pass into the milk herd. The structure of the herd therefore becomes less top-heavy, with fewer milk cows relative to heifers and calves. Three examples of actual herd structure may be quoted in illustration of these types:

Policy	Milk cows	Heifers (1-2 years)	Heifers under 1 year
1. Selling all calves and buying milk cows (e.g. Pawton Hill Farm)	24	-	-
2. Selling most calves and rearing replacements (e.g. Middlefield, Greatham)	23	12	5
3. Selling cows in mid-career (e.g. Beacon Farm, Sedgefield)	16	19	6

Note: Both the latter farms also rear bull calves for beef not mentioned in the above table.

FEEDING POLICY

Although in the Hartlepools region the grass starts growing usually at the beginning of April, and in some years even earlier, it is often early May before the milk herd is turned out permanently to graze, in order that there should be a fair growth. Interest in the exact diet of cattle is greater on milk farms than on beef farms since daily yields of milk are recorded and concentrates fed accordingly. Therefore the use of the electric fence to control grazing has widespread approval. The strip of grazing allowed by the fence may be several feet wide at the start of the season, but this is gradually narrowed as the grass grows higher at the far side of the pasture, till it may be advanced only two feet a day. The pressure on the grazing is greatest between May and July, before the hay is cut. After this the fields which have been reserved for hay become available for grazing, and, unless a second hay crop is anticipated, the cattle are virtually on free range. Some farms indeed buy in flocks of sheep in July or August to eat up all the surplus grass, while others make silage in May and hay in August. A ten acre field of grass, given sufficient rainfall, appropriate fertilizer, and managed with an electric fence strip-grazing system, should provide a herd of Friesians (the greatest eaters) with enough grazing up to about 25 head. Food values are not the same all the grazing season, however, since early spring grass 4 to 6 inches high will give enough digestible protein for maintenance and about 5 gallons of milk, but enough starch equivalent for maintenance and only 3½ gallons, so that starchy supplements like cereals must also be fed (1). As the season advances the feeding value of natural pasturage declines to such an extent that by August it provides no more than the daily maintenance needs of a dairy cow. Temporary grass, however, with a carefully balanced variety of grasses and clovers, and given nitrogen doses at the correct time, will be nutritious all the season. Even so cake and concentrate must supplement what is grazed, usually 3-4 lb. for every gallon produced.

(1) E.L. Smith. AGRICULTURE, July, 1953.

With free-range grazing it has been found that cattle of the dairy type consume far more than they require, and that restricted grazing, within limits, has no detrimental effect on the production of milk (1). Mixed stocking results frequently in a more evenly grazed pasture, and because the herbage is more fully utilised production can be intensified.

Some of the farms in the Hartlepools region are so large that the relative abundance of space and the lack of labour for moving electric fences combine to make free-grazing the rule. Between successive grazings in the period April to September a free-range pasture needs about a fortnight to recover, so that a field may give four or five grazings in this time, given a normal run of temperatures and rainfall.

Most milk farms give their cows in milk extra nourishment with ground corn and oilseed cake, plus vitamins and essential minerals, at milking time, the amount given being related to the milk yield of each individual cow, the highest yielders receiving most.

In late autumn, when the grass is exhausted, strip-grazing on kale is common practice, but after Christmas indoor feeding alone is available, and the diet is varied between hay, straw, swedes, mangolds, crushed oats and barley, and cattle cake. Cows approaching calving time, at any time of year, are "steamed up" on a high allocation of concentrated protein food.

The change from winter feeding to spring grazing is normally made very gradually, only short periods of grazing being allowed when the animals are first turned out. The writer came across several cases of cattle disorders in both the springs of 1962 and 1963, which were associated with overgrazing when the cattle's stomachs are not quite adapted to the change.

(1) J.D. Ivins. AGRICULTURE, March, 1954.

BREEDING

About one third of the farms which produce milk in the inner belt of farms visited prefer to keep their own bull (17 farms out of 51), but the others use the artificial insemination service maintained by the Milk Marketing Board, operating from a depot at Shincliffe, near Durham. While most of the Friesian herd farms prefer to make the first calving easier by using an Aberdeen-Angus bull, which gives a smaller calf, and then use the Friesian bull for subsequent calves, the Ayrshire herd use Ayrshire bulls from the start. Figures issued by the Milk Marketing Board in June 1960 show that in the Northern Region of England as a whole 13.3% of matings were by natural method only, 60.8% by artificial insemination only, and 15.8 by using both, the rest being unspecified.

MECHANIZATION

All the milk producing farms use electric milking machines of several types operated by vacuum pumps and coolers of the water-circulation type. Until a small and cheap storage tank comes on to the market most of these farms will continue to use churns for transport purposes, and no bulk collection by tanker has yet been necessary in the region, though several of the younger farmers have ambitions in this direction.

The milking equipment is sterilised by chemical means, and there are proprietary brands of chemicals supplied by the agricultural merchants for this purpose. Steam and boiling water methods of sterilisation are regarded as too expensive for the smaller farms and the chemical system is well established.

BEEF CATTLE

179 out of the 404 farms visited in the Hartlepools region kept beef herds. Of these 35 were classed as Fattening-with-cash-cropping farms, and 94 as Cash-cropping-with-fattening farms (i.e. farms where at least 30% of gross output

comes from cash crops). These numbers are tending to increase as some of the smaller milk producers switch from milk to beef production, in response to recent government changes in the Annual Review of Guarantees announced every March. Since 1955 these changes may be listed as follows:

1955 Calf subsidy increased from average of £5 to £7/10/- a head.
Average standard price for fat cattle up from 133/2d. a live cwt to 138/8d.

1956 Average standard price for fat cattle up to 151/- a live cwt.

1957 Average standard price for fat cattle up to 156/- a live cwt.
New system of weekly seasonal standard prices introduced.

1958 Calf subsidy up to £8/10/- a head.
Average standard price for fat cattle up to 157/- a live cwt.
Quality specification raised.

1959 Calf subsidy up to £9/5/- a head.
Hill cow subsidy increased from £10 to £12 a head.
Differential of 8/- per live cwt in favour of Grade 1 fat cattle reduced to 5/-, to encourage production of beef from dairy herds.

1960 Maximum weight for heifers qualifying as Grade 1 increased from 9 cwt to 9½ cwt liveweight.

1961 Average standard price for fat cattle increased from 157/- to 167/- a live cwt.

The relative positions of beef and milk production have changed as shown in the following indices of prices (1).

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960 (1927-29 = 100)
Fat Cattle	231	155	169	277	314	297	329	335	334	327
Milk	278	293	298	295	301	298	278	283	290	274

Few agricultural products have experienced this rapid increase in

(1) Agricultural Statistics 1960-61 (Ministry of Agriculture).

prosperity, only hops, geese, store cattle and store pigs having a higher index by 1960. The steady progress of beef and the gradual decline of milk prices, brought about by deliberate government policy, can clearly be seen from these figures. The capital required for beef production exceeds that for milk, however, because when animals must be kept sometimes more than two years before any cash returns are forthcoming sufficient money must be available to meet expenses for feeding stuffs, wages, fertilizers, and other fixed costs. Nevertheless, many smaller farms in the Hartlepools region have made the change to beef production since these government policies made themselves felt - thirty-four in the last nine years (1955-63). The quickest way of rearing beef cattle to secure capital gains is the finishing of beef store cattle, aged about 18 months to two years, but as these store animals cost about £60 the amount of ready capital required to begin is considerable.

SIZE OF FATTENING FARMS

In contrast with the milk and mixed farms the fattening farms tend to be larger holdings, falling mainly in the medium (100-250 acres), large (250-350 acres), and very large (over 350 acres) categories. The sole example of a very small fattening farm is Tilery Farm, near Hart, where 12 beef cattle are reared by a part-time farmer who works for I.C.I. at Billingham as his main employment. At the other extreme are Hulam, which is worked with Sheraton Hall Farm to form a 900 acre beef-producing unit, and Wynyard Home Farm, also of 900 acres.

The effect of size on the policy of the farm may be considerable since on the larger farms the extent of heavier soils which are considered marginal for arable cultivation is larger, and may be therefore left under grass with stock-fattening a natural economic consequence. Most of the beef farms except near the towns also carry sheep as a secondary enterprise. The chief practical benefit of large size is that herds of cattle and flocks of sheep can be big enough to guarantee butchers a regular supply of meat, monthly or even weekly. Standardized quality, moreover, is also more likely to be guaranteed from a large farm, while buying policy benefits from the discounts to be secured by large orders.

BREEDS OF BEEF CATTLE

Because many of the beef farms rely on local supplies of calves surplus to the requirements of milk and mixed farms, the beef breeds reflect the local predominance of Friesian cows, which have been mated with Aberdeen-Angus bulls, and to a lesser extent Shorthorns crossed with these bulls. Single-suckling farms tend to keep cows which are a cross between the Shorthorn and a Hereford bull, using a bull of the Angus breed; in this way is produced a beef calf which matures quickly, and has the benefit of milk from a cow of dairy-type quality.

The Angus bull cross with a Friesian cow gives its calves good beef qualities - an all black, hornless calf, quick to mature, and usually reaching Grade 1 at the marts. Most of the calves fattened in the Hartlepools region are of this type. Crossed with the Shorthorn, especially of the Dairy Shorthorn type, the Angus bull gives a calf which is apt to produce fat instead of lean meat.

The Hereford bull is also popular for crossing with the dairy breeds, giving a somewhat larger calf than the Angus bull, possessing the Hereford's white face, and being quicker to mature than the Angus calf, though yielding a coarser meat.

Pure Friesian calves are usually classed as Grade 2 at the marts, though they are large beasts and butchers may often give higher prices for them than for calves with a beef-breed sire.

Ayrshire cows, crossed with any sort of bull, give calves whose faults as beef cattle are numerous - fat in the wrong places, narrow across the shoulders, poor thighs, big belly, and poor killing-out percentages (i.e. deadweight minus weight of offals). The introduction from France of the Charollais bull is intended to produce good quality beef from such dairy breeds as the Ayrshire and the Dairy Shorthorn, but in the early 1960's it is too soon to say how well this experiment has fared. A few Charollais calves have appeared in the Hartlepools region but first reports are not too favourable.

Highland cows, with their long horns and shaggy coats, have been introduced at Crimdon House Farm, near Blackhall Rocks, for the sake of their suitability to poor pastures and their hardiness in face of cliff-top winds, but their calves are slow to mature, even with a Herefore sire.

Those farms which do not rear their own calves buy in store cattle, both home-bred, which are mainly Friesians, and Irish, which are mainly pure beef breeds, Herefords and Aberdeen-Angus. These come from marts at Darlington, Alnwick and Hexham.

TYPES OF BEEF FARM

Some analysis of the types of beef farm is necessary at this point because the variations in the methods of fattening are not apparent on a ground survey and only appear when the farmer is interviewed. Some beef farms, for example, possess a milk herd for rearing purposes, and are difficult to distinguish from a mixed farm simply by looking at what is in the fields.

There are four methods of fattening which are traditional in the Hartlepools region, though many farms combine one of them on a major scale with one or two of the other methods on a minor scale.

1. Single - suckling

A herd of cows is kept for breeding and each cow suckles her own calf, replacement calves being bought in if there are abortions or calf fatalities.

This method gives a better food conversion ratio, weight increasing more (1½-3 lb. a day) than with other methods, so that the animals reach earlier the weight at which they are sent for slaughter. Annual calvings are arranged to take place from early December to February after which the calves are suckled by their dams up to 8-9 months of age, though they may graze in summer a little. They are finished indoors on concentrates after September and sold as "baby-beef" in the second spring at 14-16 months old, weighing 7-7½ cwt. (heifers) or 8-8½ cwt. (bullocks). At this time of year the prices are at their highest and timing is most important, especially on the farms with no butchers' contracts to honour. For big farms like Wynyard Home Farm which wish to maintain a steady supply of butchers all the year, replacements may be bought at such an age that marketing can be continuous.

Cows are out-wintered on this system, grazing a little if the autumn growth of grass warrants it, but largely hand-fed on hay, silage, and roots - as cheap a diet as can be arranged. If bad conditions of weather enforce it the herd may be given shelter but generally they spend even the nights in the open. The system saves appreciable quantities of dry fodder and bedding straw, but its biggest advantage is the saving on labour. Since it takes more cows than the intensive methods described below it must ensure high prices for its products and low costs. It is best suited to farms where soils determine that arable is not advisable and where there is an abundance of grass.

The breeds of cattle favoured for this method are Aberdeen-Angus X Shorthorn cows, mated with an Angus bull (as at Wynyard Home Farm) or Hereford X Shorthorn cows, mated with an Angus bull (as at Home Farm, Hart). The cows are quiet and milk well, lasting normally over ten years, and occasionally for fifteen, so that replacement is cheap.

The single-suckling method of beef production is found on only 20 of the

404 farms visited, out of 179 farms producing beef. While the product is of high quality and is cheap and safe from most diseases, it may not be the most profitable method, and is certainly not the most intensive.

2. Multiple-suckling

This method involves the purchase of extra calves so that each cow in milk can suckle several at once, usually two or three, but sometimes four. Liveweight gain is therefore slower than in the case of single-suckling, while sleekness of coat and amount of fleshing are not developed to the same degree. Many calves are bought in autumn or early winter when they are born on local dairy farms and when they are at their cheapest. Though fattening may take up to two years some are finished to quicken the turn-over even though this may mean taking only £65 instead of £80 per beast. The calf subsidy, whereby a calf of beef type earns a government rearing grant, has undoubtedly increased the incentive to this earlier finishing and more rapid turn-over.

Though the introduction of fresh calves can be pursued all through the year, selling the fatstock is most often confined to that period between February and June when the prices are highest, so that liveweight gain has to be carefully managed, and intensive feeding on concentrates may be required towards the end in order to finish the beasts for sale by the beginning of summer when lower prices prevail. Thus grass plays a smaller part than in the case of single-suckling.

3. Pail-feeding

On farms which keep no milk cattle artificial feeding of calves can be practised, using dried milk powder mixed in the pail. Weaning comes early at about eight weeks. Concentrates are offered at one week of age - crushed barley, flaked maize, mollasine meal, linseed cake, fish meal and vitamins - and hay is given ad lib. Some farms put the winter-born calves out to grass in the first summer, but it is more general to leave this till the second summer. It is always two years before these calves are ready for the butcher.

This method is the most expensive since for the whole of the first year purchased feeding-stuffs have to be used, but it suits small farms with very limited amounts of grazing. Electric fences are not used because strip-grazing is not regarded as suitable for beef cattle since they are not being given supplementary rations of concentrates, and because the shifting of fences would make too much work. Instead grass is forced by the application of heavy doses of fertilizer until hay-making releases fresh pasture.

It is this type of farm which is taking most interest in new methods of intensive feeding of barley from troughs in the buildings to produce what has been termed "broiler-beef" from calves in as little as a year. This rapid turn-over method is operating in some parts of the country but as yet no farm in the Hartlepools region has adopted it.

4. Store cattle fattening

Cattle of 1½-2 years of age are purchased and fattened till they weigh not more than 11½ cwt. in the case of a steer, or 9 cwt. in the case of a heifer, these being the weights covered by the government-guaranteed prices. Many of these beasts are bred in Ireland and must be retained before slaughter for at least thirteen weeks after the last day of the period of importation, which is a fortnight ending on a Sunday as indicated by import tattoo marks on the animal's ear.

This is the simplest fattening system, since most of the work has already been done, and because only grass feeding is involved. It tends to be found on the larger farms where labour is fully occupied by other enterprises, and yet where there is grass to be eaten up. The cash rewards are small, stores costing about £60 and selling at only £70 after three months keep, but there is a rapid turn-over, since at least three batches can be handled in a year. They are usually bought in "wagon-loads" of 16 from the three north-east marts that handle store cattle, at Alnwick, Hexham, and Darlington. Irish store cattle are imported by a farmer-dealer, Mr. John Hall, of Manor Farm, Cowpen Bewley, whose family have handled this trade for several generations. Leaving Dublin on Thursdays, the stores reach Holyhead, from where they are sent by rail on the Friday night to arrive at Darlington on Sunday mornings, ready for the auction sales on Mondays. Batches of 300 are common, but the trade fluctuates with the season, being heaviest in spring and autumn, when farmers are buying for the summer grass feeding or for winter indoor feeding allied to the high spring prices. The trade is slackest in May, June and July, when only a few farms are purchasing replacement stock.

More English stores are sold than Irish, however, in the proportion of three to one. The source of these stores is the large number of dairy farms which cannot fatten all their own calves but rear them to 1½ years old; west of Darlington the dales farms provide such beasts and together with the lowland dairy farms send several hundreds of them to Darlington every week.

There are many farms which mix these four types of livestock farming. The smaller farms may combine multiple-suckling for as many calves as possible with pail-feeding, while the purchase of stores to eat up any spare grass is common on many beef farms. Wynyard Home Farm combines the single-suckling method (140 Aberdeen-Angus x Shorthorn cows giving 140 calves between January and February) with the buying of Angus stores (200 each autumn) of the same age as the home-bred calves, but of different sizes, to maintain a regular weekly supply to butchers at Stockton. It must not be forgotten that most milk-producing farms also retain as many calves for beef as they can support, while on mixed farms beef animals may actually form a majority (e.g. on Haisberry Farm, near

Elwick, out of 100 head of cattle between 60 and 70 are reared for their beef).

MARKETING

There are three ways of marketing beef in the Hartlepools region - at auction marts, by private treaty, or by selling to the Fatstock Marketing Corporation who have a depot at West Hartlepool.

The marts are by far the most common for several reasons. Private sales to butchering firms are difficult to arrange unless regular deliveries can be maintained, and the mart with its competitive buying is the next best. In addition to selling his fatstock the farmer is able to improve his knowledge of the kind of beast most in current demand by notihg the prices fetched by the best cattle at the auction. He can use the same occasion to buy replacement calves or stores, to contact the agricultural merchants who need to sample any grain he may wish to sell, and to inspect the latest implements and machinery. The mart means more than just a business deal; it is a social round for the farmer.

In the Hartlepools region an unusually large number of marts are used:

Mart	Day	Trade			
Darlington	Monday	Weekly throughput (1st April 1962 to 31st March 1963)			
		Dairy cattle	Average 65	Minimum 40	Maximum 100
		Fat cattle	280	150	400
		English store cattle	320	150	600
		Irish store cattle	200	100	400
		Calves	140	100	180
		Fat sheep	1,200	600	2,200
		Store sheep		50	600
		Fat pigs	400	200	750
	Thursday	Store pigs	600	450	750
		Annual totals CATTLE - Dairy 3,537, Fat 13,633, English Store 14,902, Irish Store 8,763, Calves 6,520			
		SHEEP - Fat 55,758, Stores 3,103			
		PIGS - Fat 18,047, Stores 21,046 (1)			
Sedgefield	Tuesday	Fatstock, 150 cattle, 200-300 sheep, and 50-80 pigs weekly.			
Stockton	Wednesday	Fatstock, 120 cattle, 450-500 sheep, and 200 pigs			
Castle Eden & Haswell	Alternate Mondays	Fatstock, 70-80 cattle, 300 sheep, 40-50 pigs.			

While the above are the marts most frequently used by farmers in the Hartlepools region, the following are also visited at less frequent intervals:

Alnwick	Friday	Store cattle - up to 400 Irish (weekly).
	Monday	Fatstock (small trade - 40 cattle, 50 sheep, 30 pigs).
Hexham	Tuesday	Irish store cattle (700) and dairy cows (150).
	Wednesday	Fatstock (small trade).
	Friday	English store cattle (1,000) and sheep (200).
Newcastle	Monday	Fatstock - 270 cattle, 800 sheep, and 100 pigs.
Gateshead	Friday	Fatstock of poorer grades, especially fat cows (200) and stores, 300 sheep and 150 pigs.
Fencehouses	Monday	Fatstock - 70 cattle, 110 sheep, 50 pigs.
Bishop Auckland	Tuesday	Fatstock - 160 cattle, 140 sheep, 50 pigs.

Darlington is by far the most important livestock market in the north-east of England, Newcastle having declined since a new bus-station was created over

(1) Figures supplied by The Darlington Farmers' Auction Mart Co. Ltd.

a substantial part of its market during the war. The area served by Darlington's mart stretches well down the Vale of York, up into the Pennines, on to the coalfield, and to the coasts of Durham and the North Riding of Yorkshire, thus overlapping considerably the hinterlands of the smaller neighbouring markets. While the smaller marts handle only a fraction of Darlington's trade they are very valuable to both local farmers and butchers in saving long journeys when only small numbers of animals are involved. The small fatstock producer also has a better chance of becoming recognized at the smaller sales.

Very few beef farms sell direct to private butchers, partly because so few of them can guarantee regular weekly supplies, and partly because they wish to visit the mart in any case. One farm, Tofts, near Seaton Carew, is run by a butcher, Mr. B. Jobson, who retails his own beasts in a West Hartlepool shop.

The third avenue for sales of beef cattle is the Fatstock Marketing Corporation who have a depot next to the West Hartlepool municipal abattoir. Approximately 30% of the slaughterings carried out here are on behalf of the F.M.C., who draw their stock from a very wide area including South Durham, the Cleveland Hills, the Vale of York, and, less frequently, from N.W. Durham and Northumberland. Annual slaughterings at the West Hartlepool abattoir in recent years are as follows:

Year	Beasts	Sheep	Calves	Pigs	Totals
1951	4,026	10,521	329	931	15,807
1952	4,094	14,278	486	1,830	20,688
1953	3,754	15,651	387	4,594	24,386
1954	5,713	16,858	189	12,724	35,484
1955	3,812	10,783	281	11,573	26,449
1956	3,947	12,220	329	9,910	26,406
1957	4,764	13,995	353	11,116	30,228
1958	5,116	12,107	133	10,562	27,918
1959	4,631	18,718	53	10,998	34,000
1960	4,801	15,402	74	9,847	30,124
1961	5,037	21,190	59	8,431	34,717
1962	5,548	27,137	66	9,407	42,158

80-90% of these killings are on behalf of the Fatstock Marketing Corporation, the remainder being animals sent in by individual butchers from marts or farms. The above figures show the upward leap in the demand for meat when rationing was abolished in July 1954, the subsequent lapse as plentiful meat supplies became customary, and the gradual rise in killings as the standard of living rose during the 1950's. The increasing tendency for butchers to buy from the Fatstock Marketing Corporation rather than buy at the marts and profit from hides and offals is perhaps a tribute to the efficiency of the Corporation's service. The risk of buying a diseased animal and losing money on the flesh or offals was a contributory factor in dissuading butchers from buying at marts before the 1939 war, but disease is rare now and the risk is no longer there.

About 40% of the F.M.C's killings are marketed in and around West Hartlepool, but 60% is "exported" to Newcastle, Middlesbrough, and even London, to which a daily wagon-load is delivered (82 sides of beef, i.e. 41 cattle, or 10 tons) most of which originates at the West Hartlepool or Sunderland abattoirs. This unusual marketing pattern arises from the higher costs of transport and slaughtering in the London area, and partly from the much higher prices fetched by meat in London.

The busiest marketing periods discovered by an examination of West Hartlepool abattoirs records are from October to December for beef, when grass-fattened cattle are sold off the farms, a less busy time from January to April when store cattle wintered indoors and "baby beef" (young cattle of 14 months from single-suckled herds) are marketed, and from June to September for fat lambs. Pigs are traditionally cool weather killings and few are slaughtered in the summer months. The busiest week of the year is usually immediately before Christmas. The slaughterings in this week in 1962 were as follows:

	Cows	Bullocks and heifers	Sheep	Pigs
December 14	-	26	112	15
" 15	3	16	43	56
" 16	-	-	49	142
" 17	-	18	100	146
" 18	3	3	168	175
" 19	2	2	66	172
" 20	1	4	12	109

(N.B: This was an unusually slack Christmas)

SHEEP

219 out of the 404 farms visited kept sheep, mostly as a subsidiary enterprise. These were distributed amongst the various types of farm as follows:

Milk farms	Mixed farms	Cash cropping/ fattening	Fattening/ cropping	Miscellaneous
18	72	59	66	4
out of 79	out of 106	out of 94	out of 85	out of 40

The two factors which militate most against the keeping of sheep are proximity to large housing areas where dogs may be free to chase and worry sheep, and sheer lack of space on the small farms.

Sheep have been an attractive enterprise ever since the war and, encouraged by the progressive increase in government supported prices, numbers have climbed to surpass pre-war totals by the early 1960's. The Annual Reviews since 1955, after a whole year of free marketing, have made the following changes in the price per lb. of lamb:

1955	2/10½ per lb. to 3/-
1956	Up to 3/2d per lb.
1957	Up to 3/3½d per lb.
1958	3/3½d maintained.
1959	3/3½d maintained.
1960	Down by ½d per lb. to 3/3d.
1961	3/3d maintained.
1962	Down by 1d per lb. to 3/2d.

In 1960 a warning note was sounded in the Annual Review of prices when it was stated that "for mutton and lamb the need is to check expansion and to discourage production of animals less acceptable to the market".

Prices are varied according to season, the guaranteed standard price ranging from 3/1¾d in the period May-August to 3/8d per lb. in January (1962 prices), while the market prices reach their peak in the period from mid-March to mid-April, and after June stay fairly constant, but are lowest from October to November.

In the Hartlepools region while the numbers of sheep kept on individual farms have certainly risen, several farms which formerly kept flocks have discontinued them, in favour of extra beef cattle. In general, however, farms which have traditionally reared sheep still do so, and with the help of vaccines and chemical dipping solutions have cut their losses from disease and pests. Pulpy kidney disease and blow-fly maggot have become things of the past, and lambing losses are the worst worry. Nevertheless sheep take more looking after than cattle, since shearing as well as lambing have to be managed carefully, and the lambs, unlike calves, come in a concentrated spell in March-April.

While two-thirds of the farms which keep sheep in this district are beef farms (i.e. Cash cropping with Fattening, or Fattening with Cash Cropping Farms) it is surprising to find how many milk-producing farms maintain a flock in view of the extra work involved. There is little difference between the numbers of sheep on beef farms and those on dairy farms, some of the latter increasing their stocking density by using the strip-grazing system. Flock sizes vary from the 10 breeding ewes on the 27 acre Hunter House (No. 3) at Seaton Carew to 658 on Saltholme, 1,000 on Hulam with Sheraton Hall, and 1,000 on White Hurworth near Trimdon. More typical is the 50-strong flock of ewes on the 200 acre farm, though there are examples of much higher stocking densities, for example on High Springwell Farm near Hart, where 50 ewes are kept on a 90 acre holding, or Thorpe Bulmer with 130 ewes on 230 acres.

Systems of sheep husbandry

Six systems exist in the Hartlepools region:

1. The permanent breeding flock is the traditional method of rearing sheep in this district. Mating in mid-October is followed by lambing in March, and the lambs are sent for slaughter at a weight of about 40 lb. from

June to August. When the hill farms flood the market with their fat lambs about August the remaining lowland lambs are held back till prices recover in October. Weaklings may still remain on the breeding farm as late as Christmas but it is rare for any lamb to see its first birthday under this system.

2. Some farms buy store lambs in August from the hill districts of the Border and Pennines, fatten them in about eight weeks, and use up the grass remaining after haytime. Farms in the first system also adopt this policy.

3. Store lambs may be purchased in October when very little grass remains and these are fattened on hay fed to them in field-racks, on turnips led out on to the pasture, or more rarely on mustard or rape, crops which have almost disappeared from the Hartlepools region (Hulam still grows them). Selling in February-March is a profitable business.

4. Some breeding farms keep their lambs until the New Year when prices have improved. The slower-maturing Masham sheep are more liable to be kept under this system (e.g. on Whelly Hill Farm and Middle Stotfold)..

5. Dry flocks are bought in October and fed over the winter. After they have been sheared in June they are sold in August at almost double the price paid for them. This practice is found more in Yorkshire and few farms in the Hartlepools region use it.

6. In the Bradbury Carrs area, where wet poor land predominates, cast ewes are bought after their best lambing days are over. They are used once ar at most twice, for breeding, and then sold fat.

While all these systems can be found in S.E. Durham, the first three are traditional and are still most common, many farms using all three in conjunction as the year goes on, store lambs following home-bred animals. It is the small milk farms which specialise in winter flocks which eat up foggage grasses while the dairy herds are indoors. Lean hill lambs can be bought for about £4 and fattened for sale when the prices are highest in March-April.

BREEDS OF SHEEP

S.E. Durham is transitional in its breeds of sheep between Scotland and Yorkshire, first crosses from both areas being kept. Breeding ewes are obtained from the Scottish border towns especially at the September sales, and the Scottish Halfbred is the most common animal here, being the product of the Cheviot X Border Leicester ram. Tow Law market specialises in the Greyface (or Mule) which is the cross between the Blackface and the Border Leicester. Hawes, Barnard Castle and Richmond markets are noted for the Masham, a cross between the Swaledale ewe and various rams such as the Blue-faced Leicester, or the Wensleydale, or the Border Leicester. All these breeds of mountain sheep are remarkable for their fecundity, mothering instincts, and their milking capacity (1). By mating such ewes with rams of the Suffolk or Oxford breeds (the most common in the Hartlepools region) the lowland farms produce a rapid-maturing lamb, weighing almost as much as the dam just prior to weaning.

Occasional farms keep breeds which are not commonly met with, such as the Dorset Horn, giving two crops of lambs a year, on College Farm at Dalton Piercy, and the Clun, a good scavenging sheep which the butchers like because of its good cutting carcase properties, on Woodside Farm near Wolviston. At Cowpen Bewley, Mr. John Hall breeds pure Suffolk lambs for the sale of breeding rams, while at Hulam, Mr. J.H. Murray has a pure-bred Border Leicester flock in addition to his Halfbred fat lambs.

EWE REPLACEMENTS

Because most farms which keep sheep sell all the lambs they produce and

(1) Competitive Farming. H. McG. Cooper. Crosby Lockwood, 1956.

because these lambs would in any case be unsuitable for breeding ewes, ewe replacements must be bought in. Hill-bred ewes are sought at a number of traditional markets in the Northumberland-Scottish Border region and in the Pennines. Of the farmers in the inner zone (defined on Page 166) who visited these markets the following numbers for each market were obtained, and may be taken as typical of S.E. Durham as a whole:

St. Boswells	11	Rothbury	6	Carlisle	2	Alnwick	2	Richmond	1
Tow Law	9	Scots Gap	4	Masham	2	Berwick	1	Northallerton	1
Hawick	8	Bellingham	2	Morpeth	1	Kelso	1		
Hawes	7	Leyburn	2	Wooler	1	Hexham	1		

These 61 "mentions" were obtained from only 37 farmers, most of whom patronise more than one market. Several sheep-rearing farms, however, buy their breeding ewes through dealers who use these same markets, and information supplied by dealers confirms the proportionate use of the same markets.

The animals purchased are shearling ewes (gimmers) about 1½ years of age, costing (at 1963 prices) £12 to £14 each. The size of the batch a farmer will buy is usually about 25% of the number of breeding ewes his farm carries, to replace older animals and those which die as a result of lambing or disease, the latter two factors accounting for about 5% of the ewes. On a bigger scale, where there is a deliberate policy of turning off the ewes of medium age to smaller local farms, a higher proportion of the flock may be replaced. For example on Wynyard Home Farm which keeps 300 breeding ewes 100 are sold off each year to other farmers and replaced by ewe lambs, a policy few smaller farms can afford. The draught ewes from this farm, usually three-crop ewes, are sold at about £7 - £8 each, and serve the new owner three or four years longer.

Of the farms visited that with the most sheep was White Hurworth, near

Wingate. Here 1,000 breeding ewes are kept by Mr. J.D. Sanderson, who has been steadily increasing the size of his flock since he took the farm in 1957. 100 of these ewes are Scotch Half-breds, and the rest are Mashams, Dorset Horn Crosses, Mules (or Grey-faced Cross), and Suffolk Crosses. The 17 rams include Dorset Horn, (used experimentally on all breeds of ewe), Suffolk (mated with the Half-breds and Mules), and Suffolk Cross (mated with the Masham ewes). A Teeswater ram (an old breed native to Teesdale, but now rarely found) is used on the Half-breds to give a black and white faced Masham lamb. Replacements are bought at Hexham, Penrith, Lazenby, Troutbeck, and Scots Gap, usually about September and October - about 100, while 50-60 are reared as replacement ewes.

WOOL

A by-product of some value is the wool fleece, which, although not taken from lambs, can be obtained from all sheep from their second year onwards. The value of a fleece in the early 1960's was 30-35 shillings. Arrangements for the collection of the wool are made by a Bradford firm, most being sent to Bradford by rail, though up to 1961 a firm of merchants from Yarm (Herds) handled the trade but have since reverted to the skin and hide trade alone.

The wool of the Masham sheep is reckoned as the best for the weight of an individual fleece, with the Half-bred next, though there is twice as much wool on a Half-bred out of a North Country Cheviot (Caithness district) as on a Half-bred out of a South Country Cheviot (Border district).

At White Hurworth hoggs and rams are sheared in early May, and ewes in late May and early June, with three shearers and two catchers shearing 65-70 sheep in an eight-hour day, the work taking over a week to complete. In 1962 1½ tons of wool were shipped away to Bradford, containing at least fifteen different grades of wool, each meriting a separate price per pound, from the hogg's wool at 4/- to the coarse Swaledale cotty ends at a few pence.

MARKETING

Since the chief object of sheep rearing in the Hartlepools region is the production of fat lamb for the butcher, marketing is similar to that for beef. The bigger sheep producers tend to sell by private treaty direct to butchers in the towns, while the rest use the marts and the Fatstock Marketing Corporation depot at West Hartlepool. The slaughterings of sheep at the West Hartlepool abattoir have almost trebled between the years 1951 and 1962, from 10,521 in 1951 to 27,137 in 1962, though this is partly the result of Fatstock Marketing Corporation policy in directing animals to West Hartlepool from areas remote from the district. At this abattoir the vast majority of sheep are slaughtered in the months from June to September.

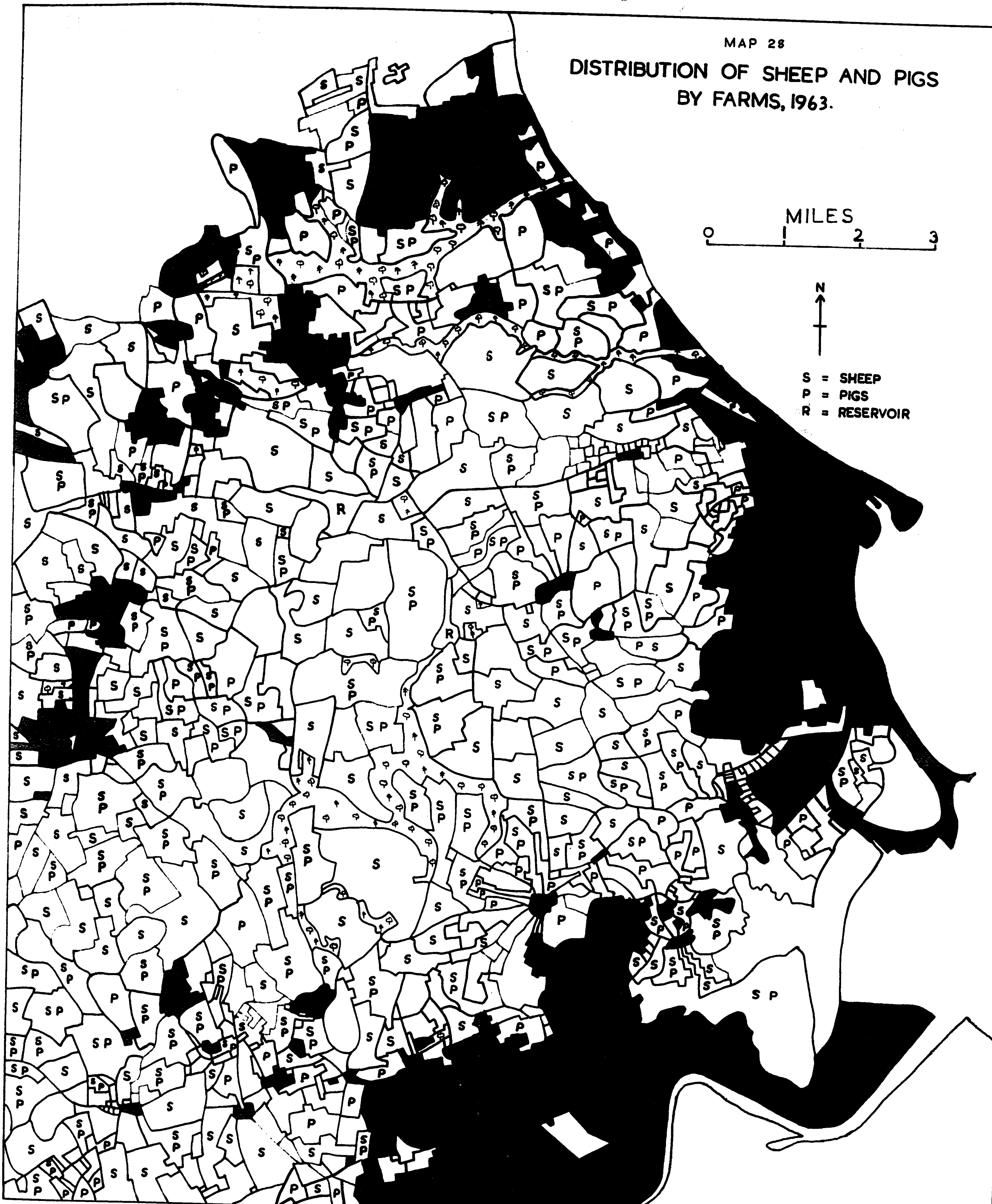
The distribution of sheep is shown on Maps 13 and 28.

PIGS

Pigs are not as important in the economy of farms in S.E. Durham as sheep. Herd numbers are smaller largely because pigs must be housed and take up time which many farmers need for their other enterprises. On most farms therefore pigs tend to be the Cinderellas, since they stay for a relatively short time compared with cattle and sheep, while variations in litter size and losses from disease and accidents are such that the small producer finds it difficult to fulfil delivery contracts.

185 of the farms visited kept pigs, rather less than half. These were accounted for by type of farm as follows:

Milk farms	Mixed farms	Cash cropping/ fattening	Fattening/ cropping	Miscellaneous
32	61	46	40	6
out of 79	out of 106	out of 94	out of 85	out of 40


MAP 28
DISTRIBUTION OF SHEEP AND PIGS
BY FARMS, 1963.
MILES
0
1
2
3
N
S = SHEEP
P = PIGS
R = RESERVOIR

In some cases where farms near built-up areas were unable to keep sheep on account of the danger from dogs, pigs were kept instead, but there were many farms which kept both sheep and pigs, as the following figures show:

Milk farms	Mixed farms	Cash cropping/ fattening	Fattening/ cropping	Miscellaneous
10	37	27	31	1

The size of herd kept varied on the farms in the inner zone immediately next to West Hartlepool as follows: (Number of farms).

Breeding sows

1	2	3	4	5	6	7	8	9	10	Over 10
6	6	6	3	1	2	2	1	1	2	7

Stores only

15 (with herds varying in number from only one up to 60, 80 and 100).

There are four systems of keeping pigs in the district:

1. Breeding and rearing up to pork weight (100-120 lb. live weight) which takes about four months. These animals are marketed by the same channels as fat cattle and sheep.
2. Breeding and rearing up to bacon weight (200-210 lb. live weight) which may take about six months. These animals are marketed through the bacon factories that lie rather remotely at Leeming Bar and at Malton in Yorkshire. Newcastle and Carlisle are also used by some Hartlepools region farmers because of individual preferences based on higher gradings at these distant bacon factories.
3. Breeding and rearing to sell as weaners at eight weeks old. The marts are used to sell this type of pig which is usually in demand after the winter when fattening farms have empty yards when their cattle go out on to grass.

4. Purchasing and fattening weaners, for either pork or bacon.

Home-grown barley is becoming increasingly the main food for pigs with supplemental mineral meal to balance the ration from the national scale mills. Not every farm has its own meal mixer or even the more humble grinding mill, but floor-mixing with shovels is satisfactory and not too time-consuming for a few pigs. Where ready-mixed rations are purchased, however, and this is all too common where only a few animals are kept, high costs are involved, up to £6 - £7 a ton over the cost of home-mixed foods.

The breeds of pigs most common in the region are the Large White, and the Large White X Landrace. The pure Landrace is not so common,

Government guaranteed prices have been a stimulus to greater pig production than before the war, though the better financial position of the mining community has led to a decrease in the number of piggeries on allotments near the colliery villages. The increase has largely been found on farms and on small-holdings. The price changes per score (20 lb.) deadweight have been as follows:

1956	49/7d.	Feed	price	31/2d.	per	cwt. (Guarantee related to feed price).
1957	51/11d.	"	"	33/6d.	"	"
1958	44/9d.	"	"	26/3d.	"	"
1959	46/9d.	"	"	28/3d.	"	"
1960	45/10d.	"	"	27/1d.	"	"
1961	43/7d.	"	"	24/7d.	"	"
1962	46/9d.	"	"	27/9d.	"	"

Policy was directed at a reduction in pigmeat production from 1956 to 1958, but in 1959 the breeding herds had been so reduced that the emphasis was placed on lower production costs, and in 1960 an increase of 3d. per score was made in the guaranteed price to stimulate more breeding, followed by a similar increase in 1961. Due to the linking of the price of the national feed mixture (a standard product) to the guaranteed price for pigs there was thus no real change in the prices from 1956 to 1959 inclusive.

In 1963 store pigs of eight weeks of age fetched about 90/-, porkers at 7 score (140 lb.) £11, baconers at six months old £15. These prices, along with the higher turnover (two litters a year) make pigs a more profitable line than sheep, but there is much work involved, and warm draught-free buildings are required. At the time the survey was made most farms were only just recovering from a widespread attack of swine fever in the period 1959-60. While some of the largest pig enterprises are carried on under smallholding conditions - indeed one pig breeder at Sedgefield with about 15 sows runs them in a single yard - there are some farms where pigs are the main enterprise. At Stockton the Co-operative Society has two farms, Summerville and Norton Hardwick, devoted to barley for the pig herd. Out of 140 acres there are 100 of barley, the rest being given over to hay, potatoes, wheat, oats and fallow. A pedigree herd of Large Whites is bred from 80 sows and three boars, the product being baconers which are now sent by road to Nottingham, the weekly consignment varying from 6 to 25, and-about 1,000 a year in all. Condensed whey is supplied in barrels from Cheshire, 1½ lb. being added to a gallon of water to reconstitute it for feeding the pigs.

Large pig enterprises at Thorpe Leazes Farm and Town Farm, Thorpe Thewles, have recently been discontinued due to changes of ownership, but changes on a small scale may occur all the time where farms with suitable accommodation take in weaners bought cheaply for a few weeks only in the hope of a quick profit. This speculative aspect makes pig farming more than usually insecure as a type of farming, and the contract system (with the Fatstock Marketing Corporation) employed by Summerville Farm and others is a means of stabilising prices. Another problem faced by the pig breeders is the competition of Danish bacon and ham, the answer to which seems to lie in higher quality.

The distribution of pigs is shown on Maps 13 and 28.

POULTRY

Although poultry are kept on almost every farm in the Hartlepools region the range in numbers is tremendous. On a small scale a few hens may be kept simply to supply the farm household with eggs, and on the larger scale up to 4,000 was found, where a regular contract with an egg-packing station was maintained.

Chicks are obtained from a wide variety of sources such as Birtley (Oats Bros.), Pickering (Robinsons), Sedgefield, Darlington (Stirlings), Stokesley (M. Seymour). Great Ayton (Harbottles), Thirsk (Willis), Easingwold (Spinks), Bishop Auckland (R. Hall), Yarm (Moore), Driffield, Bedale (Wittons), Skipton (Sharpes), Crawcrook (Pattisons), Bedlington (Fairbairns), Northallerton (Harrisons), Piercebridge (Hollands), Carlisle, and many more. The chicks are advertised in the farming press and many farms change their source of supply annually.

Free-range feeding is the rule though odd cases of battery feeding were found, and where poultry were kept on a larger scale deep-litter houses were popular. Small chicks are kept in heated sheds to six weeks of age but point-of-lay chicks do not need this special treatment and are therefore more commonly bought.

Eggs are sold wholesale to egg-packing stations at Darlington (Ross Lea Poultry Packers), at Merrybent (Meepak Ltd.), at Great Ayton (Richpak Ltd.), at Whitby (Eggpak Ltd.), to West Cumberland Farmers (Newcastle and Hexham), and to Northern Farmers Trading Association (Newcastle). These organizations pick up the eggs at the farms with their own transport. Some farmers possess

'B' licences to sell their eggs direct to shops in the towns, such eggs being stamped prior to sale.

Hens are culled from the laying flock at the end of their careers (normally at two years) for sale to butchers and fishmongers, but one farm, Mr. G. Sanderson's Dalton Field House near Dalton Piercy, installed a broiler house in 1961 for the production of cooking chickens of 12 weeks of age. 6,000 birds are fattened at a time, the chicks being supplied and marketed by a Bedlington firm (Tynedale Accredited Hatching). Inside a well-heated shed fueled by propane gas the chicks never see daylight, and consume 27 tons of feeding stuffs, mainly grain, in the short period they are kept.

The popular breeds of hen are Sussex, Rhode Island Reds, Leghorns, and various hybrids resulting from crossing these strains. 20% of the hens are hybrids because of the rapid progress made in selective breeding, aimed at increased productivity. The hybrid lays more eggs so that its food cost per bird is less than that for the pure breeds and their crosses. On the other hand the adult hybrids weigh about 2 lb. carcase weight less, so that the depreciation per bird is about 2s. 6d. more than for pure breeds and crosses (1).

Of the 91 farms for which actual flock numbers were obtainable the following figures for flock sizes were recorded:

	Less than 50	50-100	100-200	200-300	300-500	500-1,000	Over 1,000
Number of farms	23	17	18	13	9	7	4

Of the 116 farms in the inner belt of the survey area only 8 kept turkeys, and 9 kept geese, mainly for fattening for the Christmas trade. Cock chickens were more popular but even so only 14 farms were concerned.

(1) W.D. Jones. AGRICULTURE, October, 1960.

APPENDIX 1 Questionnaire used for farms in inner zone (see text P. 166

1. Where are your farm boundaries on the Six Inch map?
2. What is your farm's acreage?
3. Is more than one farm worked?
4. Are you owner or tenant? If you are the tenant who is the owner?
5. How long have you worked this farm? Can you give any information as to the length of tenure of the previous occupiers?
6. How many workers are employed apart from the occupier and his wife? What ages are the workers? Where do they live? How do they travel to work? What is the rate of turnover in labour?
7. What machines are used? What was the date when the first of each type of machine was used? How long do you keep each type of machine?
8. Has the use of machines had any significant effect on the economy of your farm?
9. When was your last working horse used?
10. How has the land-use or the farm economy changed since 1930?
11. Which agencies supply (a) machines, (b) fuel, (c) spares and maintenance?
12. What crops are grown? Which are kept and which are sold? Who buys the cash crops? Do you process the crops in any way?
13. Who supplies your seed?
14. What are the average dates for sowing and harvesting the various crops?
15. What rotation is used ?
16. What fertilizers are used and who supplies them?
17. What yields are achieved by your crops?
18. How many cattle have you? Into which age groups do they fall? For what purpose (milk or beef or stores) are they kept?
19. Of which breed are your cattle?
20. To where is the product (milk, beef, or stores) sent?

21. What proportion of the farm is grassland? Have you any special grazing system?

22. What are the average dates on which the cattle are brought in at nights and taken out again in autumn and spring?

23. What are the cattle fed on in winter?

24. From where do the cattle foods come?

25. Do you raise your own calves? If not, from where do you obtain herd replacements? How old are the replacements?

26. Do you use the artificial insemination service?

27. How many sheep have you? Into which group (breeding ewes, rams, lambs) do they fall? For what purpose are they reared? What breed are they?

28. Where do you buy sheep? How long are they kept? Where are they sold? To where does the wool go?

29. How many pigs have you? Into what groups can they be classified? What breed are they? For what purpose are they reared (pork, bacon or stores)?

30. Where do you buy pigs? How long are they kept? Where are they sold? On what do they feed? Where are the foods bought?

31. How many poultry have you? Of which breeds are they? For what purpose (eggs or meat) are they kept? Where are they bought? Where is the product sold? Where is the food bought?

32. Do you collaborate with any other farmer?

33. What is the composition of your output in percentages as far as income is concerned?

APPENDIX 2

Procedure for the mechanical analysis of the soil samples

The mechanical analysis of the soil samples was carried out using a Bouyoucos hydrometer, which is calibrated to read in grammes of soil per litre of suspension at a temperature of 20°C. The method is similar to that used by T.J. Marshall at Adelaide University (1). It should be noted that calcium carbonate and other soluble salts were not removed from the soil before the mechanical analysis took place.

50 grammes of soil were weighed into a shaking bottle and 200 cc. of water added together with 25 cc. of 5 per cent sodium hexametaphosphate (50 gm. of sodium hexametaphosphate, 5.724 gm. of sodium carbonate per litre, buffered to a pH of 9). The suspension was shaken continuously in a mechanical shaker for 10 hours, and then washed into a litre measuring cylinder. Water was added to the litre mark. The cylinder was shaken end over end for one minute and then placed on the bench to allow the suspended material to settle. After exactly 4 minutes 30 seconds the hydrometer was carefully placed into the cylinder, and after exactly 5 minutes the hydrometer reading and the temperature of the suspension were noted. Similar readings were recorded after exactly 5 hours.

The hydrometer is calibrated at 20°C. and therefore a temperature correction must be made to the readings taken. 0.3 unit was added for every degree Centigrade above 20°C. of the temperature of the suspension, and 0.3 subtracted for every degree below 20°C. The first reading gave the weight of clay plus silt particles held in suspension, the coarse and fine sand having fallen below the level of the hydrometer in five minutes. The second reading gave the weight of clay in the sample since after five hours all the other fractions of the soil had settled.

(1) C.S. Piper, 1950. Soil and Plant Analysis. Adelaide.

The clay fraction was then discarded and the silt and sand fractions were washed into a 0.2 mm. sieve, placed over a 400 cc. beaker. The silt and fine sand fractions were washed through the sieve into the beaker. The coarse sand still retained in the sieve was transferred to a filter paper, oven-dried at 105°C., and then weighed.

The silt and fine sand fractions were separated by decantation. Water was added until it reached the 10cm. mark on the beaker. The soil suspension was then allowed to settle for about five minutes, the exact time being determined according to the temperature of the suspension as follows:

The time of sedimentation at different temperatures (International System)

Temperature   Fine sand decanation depth 10 cm.

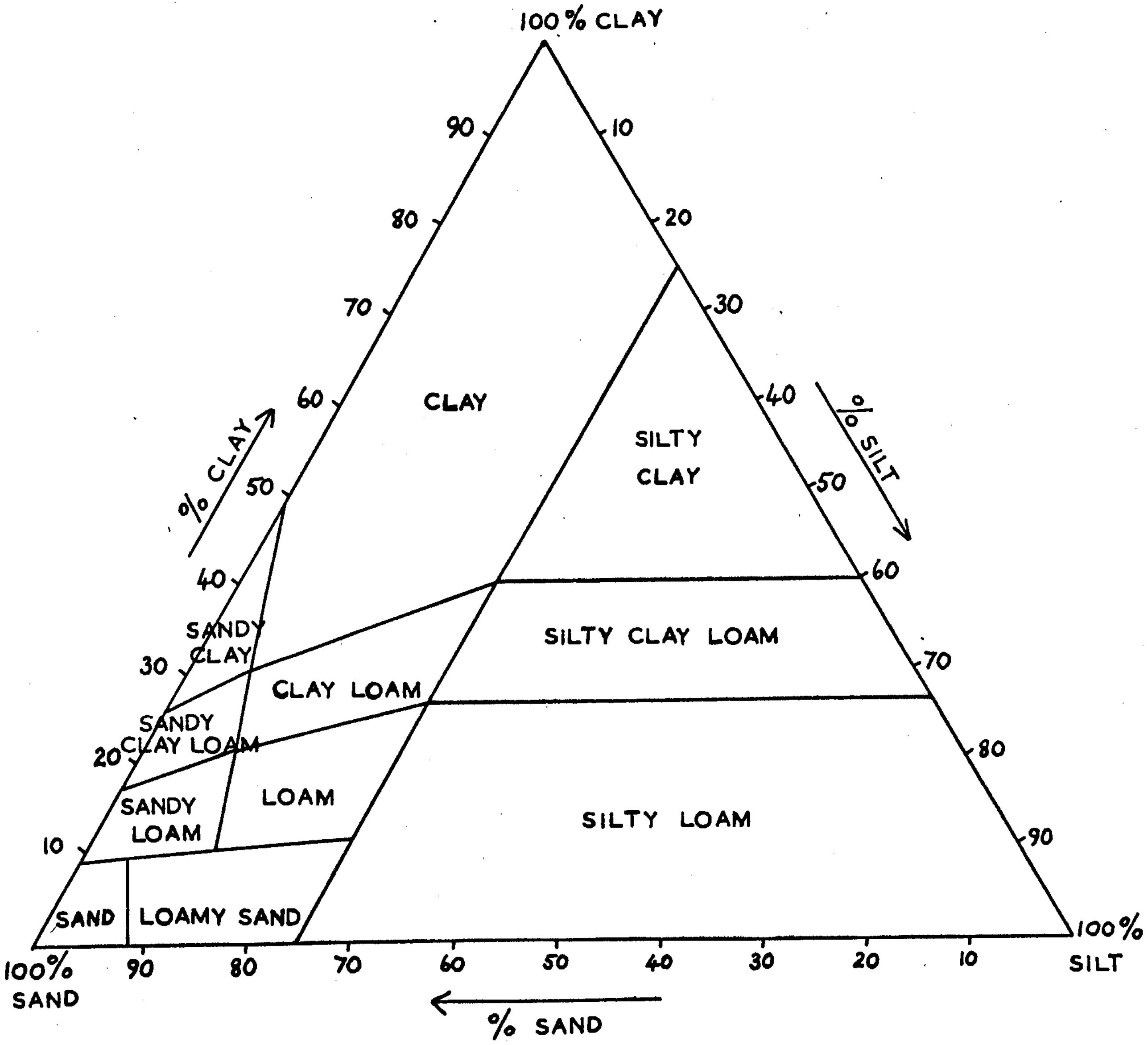
Deg. C.	Min.	Sec.	Deg. C.	Min.	Sec.	Deg. C.	Min.	Sec.
8	6	40	16	5	20	24	4	20
9	6	30	17	5	10	25	4	15
10	6	20	18	5	0	26	4	10
11	6	10	19	5	0	27	4	5
12	6	0	20	4	48	28	4	0
13	5	50	21	4	40	29	3	55
14	5	40	22	4	30	30	3	50
15	5	30	23	4	30	31	3	45

After this time the fine sand fraction had reached the bottom of the beaker and the water with silt held in suspension was poured away. The process of sieving and decanting was repeated until the water was clear after being allowed to stand for the sedimentation period.

The fine sand fraction was then washed from the beaker on to a filter paper, oven-dried at 105°C. for 12 hours and weighed.

The four fractions, coarse sand, fine sand, silt and clay, were then calculated as percentages of the weight of the original 50 grammes of soil used.

TRIANGULAR DIAGRAM FOR DETERMINATION OF TEXTURAL CLASSES



The percentages were then plotted on the triangular diagram shown below, and the corresponding textural class of each soil was thus determined. In general the soil texture determined from the mechanical analysis was in agreement with the field assessment.

Samples subjected to mechanical analysis and results

Sample number	% sand	% silt	% clay	Textural class	Field assessment
21 (subsoil)	11.3	35.7	53.0	Silty clay	Clay loam
29	66.3	15.1	18.6	Loam	Fine sandy loam
34	11.9	29.5	58.6	Silty clay	Clay loam
45	29.2	48.4	22.4	Silty loam	Loam
46	60.0	15.0	25.0	Clay loam	Loam
50	58.0	19.0	23.0	Loam	Loam
73	62.0	18.0	20.0	Loam	Loam
78	59.0	17.0	24.0	Loam	Loam

All the above soil samples were taken on the traverse from Sedgefield to Graythorp during the weeks 19th June - 2nd August, 1963, a warm dry spell, especially during the last week of July. The dryness of the soil therefore may have accentuated the sandy feel of many of the loams at the surface.

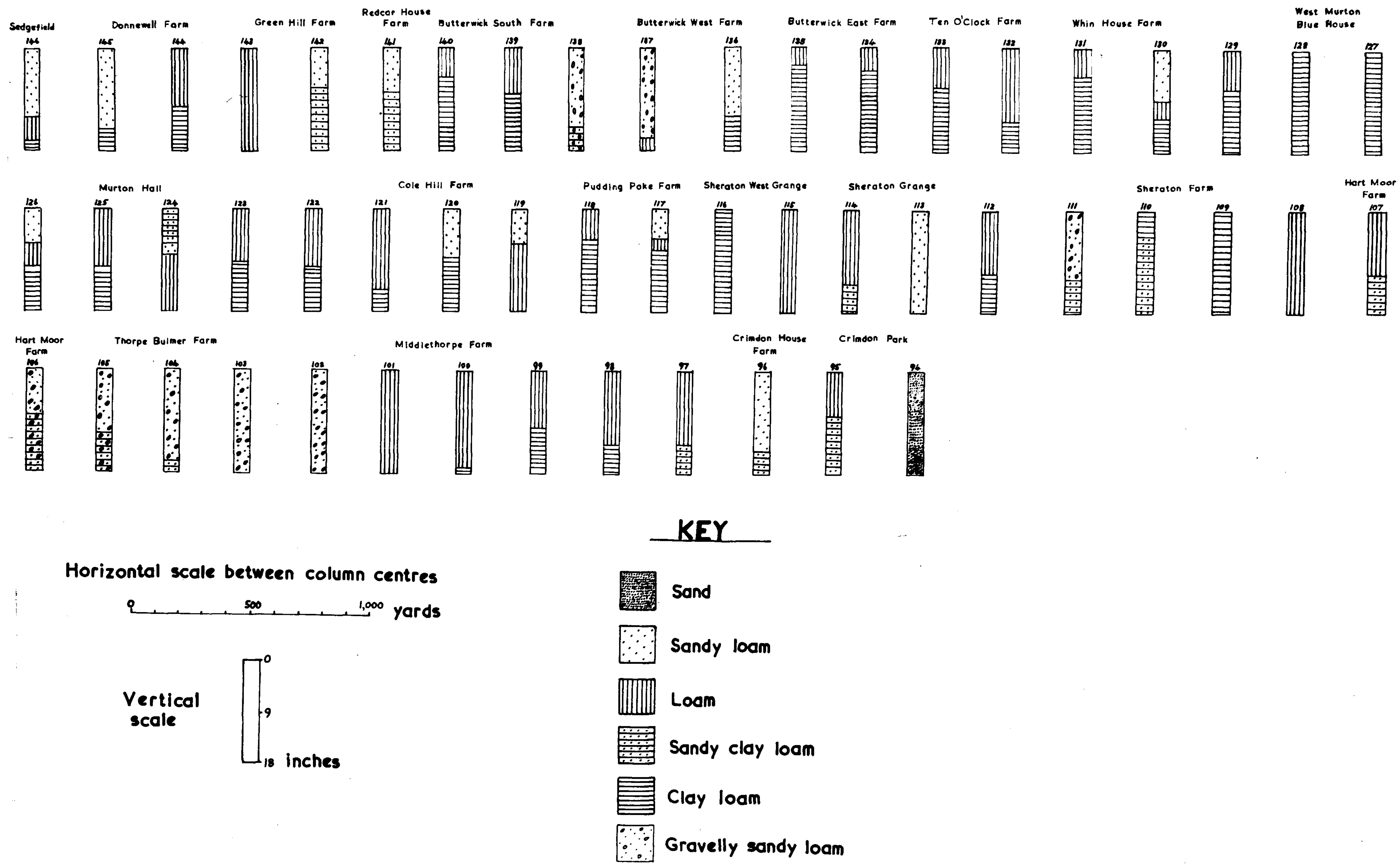
Sample number	% sand	% silt	% clay	Textural class	Field assessment
Elwick 1	78.9	13.4	7.7	Loamy sand	Sandy loam
" 3	78.0	11.0	11.0	Sandy loam	Sandy loam
" 4	81.4	9.8	8.8	Loamy sand	Sandy loam
" 19	69.2	14.1	16.7	Loam	Loam
" 44	66.5	14.9	18.6	Loam	Loam
" 53	68.4	14.1	17.5	Loam	Loam
" 60	67.1	15.3	17.6	Loam	Loam
" 64	71.2	15.5	13.3	Loam	Loam
" 65 (surface)	81.4	9.5	9.1	Loamy sand	Sandy loam
" 65 (subsoil)	72.9	13.8	13.3	Loam	Loam
" 66	72.3	14.3	13.4	Loam	Loam
" 76	68.5	15.1	16.4	Loam	Loam
" 79	72.5	15.3	12.2	Loam	Loam

Sample number	% sand	% silt	% clay	Textural class	Field assessment
Elwick 87	59.5	17.9	22.8	Loam	Clay loam
" 94(surface)	76.9	11.2	11.9	Loam	Sandy loam
" 94(subsoil)	66.0	12.2	21.8	Loam	Loam
" 98	69.8	5.4	24.8	Sandy clay loam	Loam
" 99	60.9	20.8	18.3	Loam	Loam

All the Elwick samples were taken from Home Farm, Elwick, in the summer of 1961 (100 in all).

FIG. 3

SOIL TRAVERSE FROM SEDGEFIELD TO BLACKHALL ROCKS



APPENDIX 3

Soil Traverse from Sedgefield to Graythorp (holes 1 - 93)

Grid Reference and from Blackhall to Sedgefield (holes 94 - 146)

1. 363287 7" dark brown sandy loam over light brown fine sandy loam.

Clover Cote Nook Farm

2. 364287 8" dark brown loam over light brown clay loam.

Barley

3. 365287 16" dark brown loam over dark brown clay loam.

Barley

4. 367287 10" dark brown gritty loam.

Potatoes

5. 369287 6" fine sandy dark brown loam over light brown loam.

Permanent grass (pasture)

6. 371287 9" dark brown sandy loam over light brown/orange loam.

7. 373287 6" dark brown sandy loam over 6" dark brown loam over greyish, yellow clay loam. Permanent grass (pasture)

8. 373287 6" dark brown loam over greyish yellow clay loam.

Turnips Green Hill

9. 374287 12" dark brown loam over yellow clay loam.

Barley

10. 375286 6" dark brown loam over orange clay loam.

Barley

11. 376286 7" dark brown loam over light brown sandy loam.

Hay

12. 377286 8" dark brown loam over light brown clay loam becoming grey at 17"

Hay and clover

13. 378286 14" dark brown loam over light brown clay loam.

Hay and clover Beacon Hill

14. 379286 6" dark brown sandy loam.

over 6" dark brown fine sandy loam.

over 6" light brown fine sandy loam.

Clover

15. 381286 18" dark brown loam.

Barley

16. 382286 8" dark brown loam over yellowish clay loam.

Temporary grass (pasture)

17. 383286 6" clay loam (dark brown) over mottled grey-brown clay loam.

Temporary grass (pasture)

18. 385286 11" fine sandy loam - light brownish grey over clay loam.

Temporary grass (pasture)

19. 385286 12" dark brown loam over medium brown clay loam.

Barley Oldacres Hall

20. 387286 19" dark brown loam.

Barley

21. 388285 7" dark brown loam over yellow brown clay loam.

Barley

22. 390285 14" reddish fine sandy loam over reddish loam.

Permanent grass paddock

23. 393285 9" dark brown fine sandy loam over 2" loam over light brown clay loam and gravel.

Permanent grass (pasture)

24. 394285 11" dark brown loam over greyish clay loam.

Turnips

25. 395285 8" dark brown loam over grey brown clay loam.

Temporary grass (hay)

26. 396285 12" dark brown loam over orange clay loam.

Oats Newlands

27. 398285 12" dark brown loam over orange clay loam.

Barley

28. 399285 8" dark brown loam over orange sandy clay loam.

Hay High Swainston Farm

29. 401285 18" fine sandy grey brown loam.

Permanent grass (hay) Tilery Cottage

30. 402285 Drainage impeded 16" wet dark brown loam over greyish-orange clay loam (or clay) Woodland

31. 403285 Drainage impeded (moss) 6" wet dark brown loam over mottled greyish-orange clay loam (or clay)

Woodland

32. 404285 9" dark brown loam over orange sandy clay loam.

Oats

33. 405284 17" dark brown loam over dark brown clay loam (reddish).

Oats Middle Swainston

34. 408284 18" reddish-brown clay loam (Top stripped) (Old Plantation)

Newly felled and ploughed

35. 410284 15" dark brown loam over orange-grey mottled clay loam

Scrubland and rough grass

36. 411284 12" dark brown loam over dark brown clay loam. Cold and wet (auger sank quickly) Buttercups and rough grass

37. 413284 15" dark brown loam over dark brown clay loam.

Wheat

38. 415184 14" dark brown loam (changing to light brown at 9") over light brown clay loam. Wheat

39.	416283	15" orange loam (wet and cold, over reddish sandy clay loam. <u>Silver birch plantation</u>
40.	418283	12" dark brown loam (wet and cold) over dark brown clay loam. <u>Oak and silver birch wood</u>.
41.	419283	18" grey-brown clay loam. <u>Oak and elm wood</u>
42.	421283	10" dark brown loam over reddish clay loam. <u>Oats</u> <u>Newton Hanzard</u>
43.	423283	9" dark brown sandy loam over gravelly reddish loam. <u>Hay</u>
44.	424282	2" humus and twigs. 6" dark brown wet loam (or clay loam) over grey mottled clay loam or clay <u>Woodland</u> (Flat)
45.	427282	16" red-brown loam over red-brown clay loam (Slope) <u>Woodland</u>
46.	428282	12" dark brown loam over reddish brown clay loam <u>Barley</u> <u>Low Newton Hanzard</u>
47.	429282	7" dark brown loam over 2" reddish brown loam over red-brown clay loam. <u>Barley</u>
48.	430281	2" leaf mould and twigs. 18" soft wet cold red-brown clay loam. Steel slope. <u>Beech wood</u> <u>Close Wood</u>
49.	432281	2" humus and twigs. 18" medium brown loam. Steep slope. <u>Bracken, nettles, thistles</u>
50.	434281	2" dark brown loam over gritty light brown sandy loam. <u>Beech wood</u> <u>Close Wood</u>
51.	435281	9" dark brown sandy loam over 7" dark brown loam over dark brown clay loam. <u>Permanent grass</u> <u>Red Gap Farm</u>

52.	437281	9" light brown loam over light brown clay loam.		
			Tall grass among scrub	
53.	439281	9" light brown sandy loam over 3" light brown loam over light brown clay loam.	Permanent grass with cattle	
54.	441280	18" dark brown clay loam.		Close Wood
			Hawthorn bushes and rough grass on steep slope near stream	
55.	442280	15" dark brown loam over reddish brown clay loam.		
			Hawthorn bushes and rough grass on steep slope next to stream	
56.	443280	12" dark brown loam over dark brown clay loam.		
			Hay	High Burn Toft Farm
57.	445280	9" dark brown loam over clay loam.		
			Permanent grass with cattle,	Pond nearby
58.	447479	14" dark brown loam over dark brown clay loam.		
			Hay	
59.	448279	12" dark brown loam over dark brown clay loam.		
			Clover	
60.	450279	18" dark brown clay loam.		
			Bare fallow	
61.	451279	18" dark brown clay loam.		
			Bare fallow	
62.	452279	18" dark brown clay loam.		
			Bare fallow	
63.	454279	18" dark brown clay loam.		
			Barley	Middle Burn Toft Farm
64.	455278	11" light brown loam over light brown clay loam.		
			Turnips	

65. 457278 10" very dark brown loam over light brown clay loam.

Temporary grass for silage

66. 458278 8" dark brown loam over light brown clay loam.

Temporary grass for silage

67. 459278 4" dark brown loam over dark brown clay loam.

Permanent grass

68. 461278 4" dark brown loam over dark brown clay loam.

Permanent grass

69. 463278 18" dark brown clay loam.

Silage grass

70. 464277 14" gravelly dark brown gritty loam over dark brown clay loam.

Permanent grass   Low Burn Toft Farm

71. 467277 5" coarse sandy loam over light brown clay loam.

Hay

72. 469277 18" dark brown loam.

Barley

73. 471277 18" light brown loam.

Oats   Claxton House Farm

74. 473277 12" light brown loam over light brown clay loam.

Barley

75. 475277 6" dark brown loam over dark brown clay loam.

Turnips

76. 476277 10" dark brown loam over dark brown clay loam.   Claxton Grange Farm

Permanent grass with beef cattle

77. 479277 11" coarse sandy brown loam over reddish-brown fine sandy loam.

Wheat

78. 481276 12" dark brown loam over dark brown clay loam.

Barley and wheat   Town Farm, Greatham

79. 483276 12" dark brown loam over dark brown clay loam.

Hay

80. 484276 13" dark brown loam over dark brown clay loam.

Potatoes

81. 487275 18" dark brown clay loam.

Barley and Potatoes

82. 489275 12" black sandy clay loam over gravelly sandy clay loam with orange sand. Barley Hall Farm, Greatham

83. 491275 12" dark brown loamy sand over dark brown sandy loam.

Permanent grass Greatham Hospital

84. 494275 12" dark brown loam over dark brown sandy clay loam.

Potatoes Strike's market gardens

85. 496275 10" dark brown loam over 5" dark brown clay loam over orange sandy clay loam. Cabbages Thompson's market gardens

86. 498275 12" dark brown loam over dark brown clay loam.

Potatoes Prospect Farm

87. 499274 4" dark brown loam over dark brown sandy clay loam.

Potatoes

88. 501274 12" dark brown loam over dark brown clay loam.

Rough Grass South Durham Steel & Iron Company

89. 505274 12" dark brown loam over dark brown clay loam.

Hay Middlefield Farm, Greatham

90. 506274 11" dark brown loam over dark brown clay loam.

Hay

91. 510273 9" dark brown loam over 6" light brown loam over light brown sandy clay loam. Clover Greenabella Farm

92. 513273 12" dark brown loam 5" light brown clay loam over mottled orange-grey clay loam. Oats

93. 515272 13" medium brown loam over medium brown sandy clay loam.

Permanent grass — Graythorp village

94. 483372 18" coarse sand — Picnic park grass — Crimdon Park, Blackhall

95. 480370 8" dark brown loam over light brown sandy clay loam.

Gorse and rough grass — Crimdon Dene

96. 477368 14" dark brown sandy loam over light brown coarse sandy clay loam.

Permanent grass with beef cattle — Crimdon House Farm

97. 475366 13" dark brown loam over dark brown sandy clay loam.

Barley — Middlethorpe Farm

98. 473365 13" dark brown loam over light brown clay loam.

Barley

99. 471363 10" dark brown loam over mottled orange-grey clay loam.

Oats

100. 468362 17" dark brown loam over dark brown clay loam.

Wheat

101. 466360 18" dark brown loam.

Hay with sheep grazing on aftermath

102. 464358 18" reddish-brown sandy loam and gravel (Loamy sand on field edge)

Barley — Thorpe Bulmer Farm

103. 462356 18" dark brown sandy loam, with gravel.

Permanent grass with beef cattle

104. 459355 16" medium brown gravelly sandy loam over orange-brown sandy clay loam. Permanent grass with sheep

105. 457354 11" medium brown gravelly sandy loam over orange-brown gravelly sandy clay loam. Permanent grass with sheep

106. 455352 8" medium brown gravelly sandy loam over orange-brown gravelly sandy clay loam. Permanent grass — Hart Moor Farm

107. 453350 11" dark brown loam over mottled orange-grey sandy clay loam.

Hay

108. 448346 18" dark brown loam.

Hay Sheraton Farm

109. 445344 18" dark brown clay loam.

Barley

110. 443343 4" dark brown clay loam over light brown sandy clay loam.

111. 441341 12" medium brown gravelly sandy loam over medium brown sandy clay loam. Permanent grass with milk cattle Sheraton Grange Farm

112. 438339 11" dark brown loam over mottled orange-grey clay loam.

Permanent grass and old coniferous plantation (Shangdon Hill)

113. 436337 18" medium brown sandy loam.

Barley

114. 434336 13" dark brown loam over orange-brown sandy clay loam.

Permanent grass

115. 432335 18" dark brown loam.

Wheat Sheraton West Grange

116. 430333 18" dark brown clay loam.

Barley

117. 428332 5" dark brown sandy loam over 2" dark brown loam over mottled orange-grey clay loam. Permanent grass Pudding Poke Farm

118. 426330 5" dark brown loam over mottled orange-grey clay loam.

Hay

119. 424328 6" medium brown fine sandy loam over medium brown loam.

Woodland Cole Hill Farm

120. 422327 8" dark brown fine sandy loam over mottled orange-grey clay loam.

Permanent grass

121. 419326 8" dark brown loam over 6" light brown loam over mottled orange-grey clay loam. Permanent grass

122. 417324 10" dark brown loam over mottled orange-grey clay loam. Marshy depression in same field Barley Murton Hall Farm

123. 416322 9" dark brown loam over mottled orange-grey clay loam. Potatoes

124. 414321 6" rusty brown sandy clay loam over 2" rusty coarse sandy loam over rusty brown loam. Potatoes

125. 411319 10" dark brown loam over mottled orange-grey clay loam. Barley

126. 409317 6" dark brown sandy loam over 4" dark brown loam over mottled orange-grey clay loam. Temporary grass for silage

127. 407316 7" dark brown clay loam over mottled orange-grey clay loam. Permanent grass with sheep West Murton Blue House Farm

128. 405314 7" dark brown clay loam over mottled orange-grey clay loam. Gorse and rough grass (Fox covert)

129. 403313 7" dark brown loam over mottled orange-grey clay loam. Poor permanent grass with heifers and sheep Whin House Farm

130. 400311 9" medium brown sandy loam over 3" medium brown loam over mottled orange-grey clay loam. Permanent grass with heifers and sheep

131. 398310 5" dark brown loam over mottled orange-grey clay loam. Barley, infested with thistles

132. 396307 13" dark brown loam over dark brown clay loam. Hay Ten O'Clock Farm

133. 394306 7" dark brown loam over mottled orange-grey clay loam. Hay

134. 392304 4" dark brown loam over 5" dark brown clay loam over mottled orange-grey clay loam. Barley Butterwick East Farm

135. 390303 3" dark brown loam over mottled orange-grey clay loam.

Barley

136. 388301 12" dark brown sandy loam over grey clay loam.

Clover Butterwick West Farm

137. 386299 16" dark brown gravelly sandy loam over dark brown loam.

Permanent grass

138. 384298 14" dark brown gravelly sandy loam over orange-brown gravelly coarse sandy clay loam. Permanent grass Butterwick South Farm

139. 381297 8" dark brown loam over mottled orange-grey clay loam.

Oats

140. 379296 5" dark brown loam over dark brown clay loam.

Hay

141. 376295 5" dark brown sandy loam over 3" orange coarse sandy loam over mottled orange-grey sandy clay loam. Rough grazing Redcar House Farm

142. 374294 7" dark brown sandy loam over mottled orange-grey sandy clay loam over mottled orange-grey clay loam. Permanent grass Green Hill Farm

143. 372292 18" dark brown loam.

Hay

144. 369291 10" dark brown loam over grey clay loam.

Oats Donnewell Farm, Sedgefield

145. 367289 14" dark brown sandy loam over mottled orange-grey clay loam.

Permanent grass

146. 365288 12" dark brown sandy loam over 4" dark brown loam over dark brown clay loam. Oats Eastwell Farm, Sedgefield

APPENDIX 4 Details of soil profiles from pits

1. Preston-le-Skerne (Darlington Series of Dougall)

Altitude 265' above sea level. Gentle concave slope. Drainage inadequate. Gleying at 11". Water table 3' but fluctuating. Drainage could be imporved.

Parent material - mixed drift over, and mixed with, alluvial material.

Vegetation - sown grasses, not well maintained, and deteriorating into tufted species.

Profile - (i) 0-7" grey-brown medium-working clay loam with a few stones up to 2" x 2". Large granular structure with tendency to clod. Porosity varied but generally very fine aggregate. Mellow compactness. Breaks under pressure into granules but rolls easily into wire. Not sticky. Medium organic matter. No mottling. Worms numerous. Boundary with (ii) sharp.

(ii) 7-11" lighter brown (chocolate) medium-working clay loam with some sand. Similar to (i) except for colour change, and less organic matter. Flecks of humus and occasional flecks of mica. Boundary sharp.

(iii) 11-19½" red-brown, yellow-brown, red and grey heavy clay, mottled with bright yellow streaks of weathered sandstone. Cloddy structure. Very little porosity except down root channels. Compact. Sticky. Highly mottled including MnO_2. Flecks of humus and mica, more frequent than in (ii). Boundary over 3".

(iv) 19½-48"+ red-brown (with grey mottlings) heavy clay. Compact. Almost impermeable. Few stones. Sticky. Cloddy.

2. North-west of Haswell (45/375436) Improved Haswell Series of Dougall

Altitude 460'. Fairly level ground. Free drainage.

Parent material - Lower Drift, with some influence on profile form from Magnesian Limestone from underneath.

Vegetation - permanent grass

Profile - (i) 0-1½" dark brown loamy sand. Gritty feel. Small coal and other gragments. Weak crumb structure. Mottled plant roots.

(ii) 1½-9½" dark grey-brown sandy loam. Gritty feel. Small coal and other fragments. Strong crumb structure. Good ubiquitous porosity. Earthworms throughout. Boundary irregular.

(iii) 9½-21½" yellow-brown silty loam, with a few coal fragments. Strong crumb and granular structure. Boundary irregular.

(iv) 21½-31½" pale yellow weathered Magnesian Limestone forming fine sandy horizon.

(v) 31½-48"+ very pale yellow bedded dolomite. Streaks of Fe_2O_3 concentrations.

3. East of Haswell (High Ling Close) Haswell Series of Dougall

Altitude 520'. Platform-like unit. Drainage fair.

Parent material - drift over soft Magnesian Limestone.

Vegetation - ley grass (second year). Large boulders interfere with ploughing. Good second class land.

Profile - (i) 0-6" dark grey-brown medium-working clay loam. Frequent stones from large gravel to boulder size, mainly rounded sandstone with angular dolerites up to 1' x 1'. Sod crumb structure, tending to granular and clod. Porosity varied. Very fine to porous aggregate. Inter-aggregate good along root channels. Slightly compact. Rolls to wire. Sticky when saturated. Organic matter status high. Sod roots throughout horizon. Drainage adequate - no mottling. Worms numerous. Boundary clear.

(ii) 6-25" light yellow-brown heavier clay with some sand. Many large sandstones up to 7-8". Cloddy but friable. Porosity restricted to root channels and cracks. Compact. Sticky. Easily wires. Only occasional fibrous roots at top. Drainage impeded with ferrous and MnO_2 mottling. Mottles of peaty humus add to excessively mottled appearance. Still occasional worms at top.

(iii) 25"+ soft weathered Magnesian Limestone (bedded dolomite).

4. South-east of Hart (High Throston Farm, 45/479339) Easington Series of Dougall

Altitude 225'. Flat-topped hill. Free drainage.

Parent material - drift over hard Magnesian Limestone.

Vegetation - barley stubble. Plough reaches solid rock over much of field which is aptly named Hanging Stones.

Profile - (i) 0-7" dark brown medium clay loam, with small pebbles. Strong crumb structure, Porosity varied but generally fine aggregate. Mellow compactness. Breaks under pressure in granules. Not sticky. Corn roots throughout horizon. No mottling. Mechanical analysis: 33.91% clay, 17,75% silt, 48.34% sand.

(ii) 7"+ brown stained shattered fragments of Magnesian Limestone up to 12" long.

5. South-east of Hart (High Throston Farm, 45/483336) Ryhope Series of Dougall

Altitude 150'. Gentle concave slope. Drainage adequate although only 30' from a spring on same level.

Parent material - glacial drift.

Vegetation - permanent grass.

Profile - (i) 0-20" dark brown medium loam, with small coal fragments. Weak crumb structure. Good ubiquitous porosity. Mellow compactness. Will not wire. Not sticky. Sod roots throughout horizon. Drainage adequate - no mottling. Boundary with (ii) not clear. Mechanical analysis: 20.34% clay, 18.54% silt, 61.13% sand.

(ii) 20"+ reddish-brown medium-working clay loam with stones up to 11" long. Blocky structure. Slightly compact but small fragments of rock (mainly Magnesian Limestone) throughout. Breaks under pressure into crumbs. Will not wire. Not sticky. Medium porosity with no mottling.

Mechanical analysis: 38.36% clay, 23.40% silt, 38.22% sand.

6. East-south-east of Hart (Reservoir Farm) 45/488345. Improved Haswell Series

Altitude 120'. Brow of short abrupt slope of small valley. Drainage free.

Parent material - glacial drift.

Vegetation - permanent grass

Profile - (i) 0-7" dark brown medium loam, containing very few stones. Crumb structure with tendency to clod. Good porosity. Friable. Forms wire only with difficulty. No mottling. Worms numerous. Not sticky. Boundary with (ii) sharp.

(ii) 7-43"+ lighter brown clay loam with pea-sized gravel of Magnesian Limestone. Crumb structure with tendency to clod. Fine aggregate. Compact. Not sticky. Friable. Gleying only along root channels.

Mechanical analysis: 33.69% clay, 19.88% silt, 46.42% sand.

7. East-south-east of Hart (Reservoir Farm, 45/487345) Easington Series

Altitude 160'. Top of low rounded hill - rather flat. Impeded drainage.

Parent material - heavy glacial clay.

Vegetation - corn stubble.

Profile - (i) 0-5" dark brown heavy loam with smooth stones up to 2". Porous, with high humus content. Coal fragments. Friable. Crumb structure, with tendency to clod. Forms wire only with difficulty. Sharp boundary with (ii).

(ii) 5-58"+ mottled grey-yellowish-brown clay. Coal fragments. Earthworms numerous. Compact. Slightly sticky. Blocky structure with vertical cracks causing columns of varying thickness. Cloddy but friable. Fine aggregate, low porosity, but drainage aided by cracks.

Mechanical analysis: 47.41% clay, 20.64% silt, 31.93% sand.

8. North-west of Greatham (Claxton Farm, 45/486283) Carlton Series of Dougall

Altitude 50'. Flat field above slope down to south-west side of Greatham Beck. Free drainage.

Parent material - glacial drift.

Vegetation - corn stubble.

Profile - (i) 0-8" dark brown loam with coal fragments, but few stones. Crumb structure. High humus content. Porous. Mellow. Sharp boundary with (ii).

(ii) 0-40" lighter brown heavier loam. Crumb structure with tendency to clod. Compact. Friable. Free-draining with gleying only along earth-worm channels from about 24" downwards. Very few stones. Earth-worms down to 40". Fine aggregate.

<u>Description of soils examined in a trench between Hart Moor Farm (455350) and Glebe Farm at Hart (466339).</u> HART SERIES named by B.M. Dougall.

1. 0-12" dark brown loam. (Grid Reference 455350).

   12-18" grey silty loam (increasing in thickness northwards).

   18-24" mottled orange-grey silty loam.

   24-60" mottled orange-grey gravelly silty loam.

2. 0-7" dark brown loam (456349)

   7-18" mottled yellow-grey sandy loam.

   18-60" mottled yellow-grey sandy loam (with small patches of grey silty loam up to 12" thick).

3. 0-10" heavy dark brown loam (456349)

   10-18" mottled orange-grey silty clay loam.

   18-60" mottled orange-grey loamy sand.

4. 0-10" heavy dark brown loam (457348)

   10-60" orange loamy sand with coal smuts and fragments of Magnesian Limestone and sandstone.

5. 0-10" dark brown loam (457348)

   10-60" yellow-brown loamy sand without gravel.

   60-70" yellow-brown silty loam.

6. 11" dark brown loam (458348)

   11-35" rusty brown loamy sand.

   35-71" rusty brown gravelly sandy clay loam.

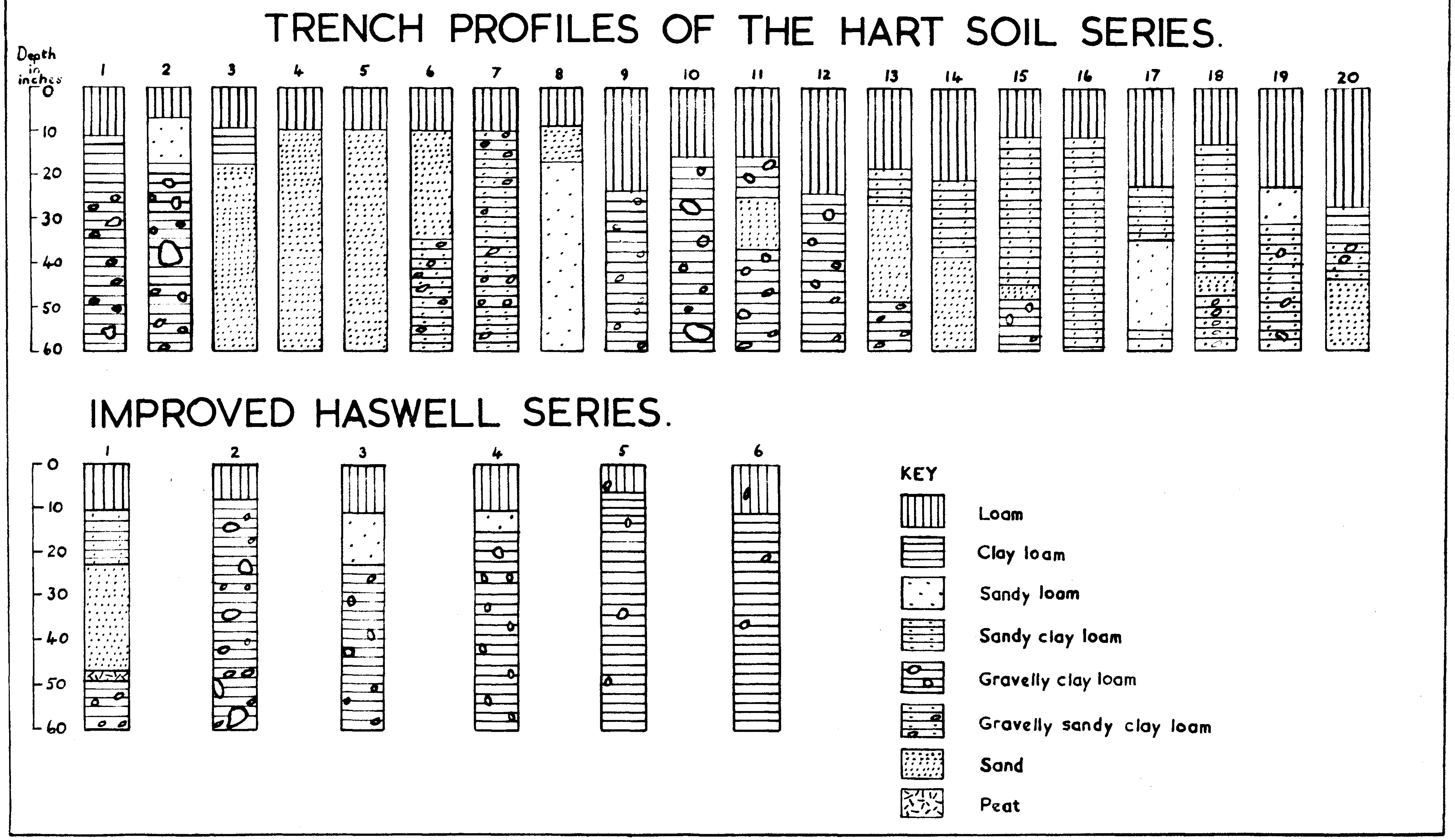
   71-75" reddish-brown clay loam.

7. 0-11" heavy dark brown loam (460347)

   11-35" medium brown sandy clay loam.

   35-55" mottled reddish brown-grey silty clay loam with gravel throughout.

FIG. 4


TRENCH PROFILES OF THE HART SOIL SERIES.
Depth in inches
0
10
20
30
40
50
60
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
IMPROVED HASWELL SERIES.
1 2 3 4 5 6
KEY
Loam
Clay loam
Sandy loam
Sandy clay loam
Gravelly clay loam
Gravelly sandy clay loam
Sand
Peat

8. 0-9" grey brown loam (460347)

9-17" medium brown loamy sand.

17-55" reddish brown gravelly sandy loam.

9. 0-11" dark brown loam (461346)

11-24" reddish brown loam.

24-55" reddish brown clay loam with scattered fragments of sandstone, Magnesian Limestone, and igneous rock up to 24" long.

10. 0-16" dark brown loam (462345)

16-60" yellow-brown silty loam becoming mottled orange-grey lower down.

11. 0-16" dark brown loam. (462345) Ten yards south of No.10.

16-24" yellow-brown silty loam.

24-36" yellow sand.

36-60" yellow-brown silty loam, with smoothed fragments of sandstone, igneous rock, and Magnesian Limestone up to 12" long.

12. 0-24" dark brown loam (463345)

24-60" mottled orange-grey silty loam.

13. 0-18" dark brown loam (464343)

18-26" mottled orange-grey sandy clay loam.

26-48" mottled orange-grey loamy sand.

48-62" reddish-brown silty loam with gravel.

14. 0-21" dark brown loam (464343) Adjacent to No.13.

21-38" mottled orange-grey sandy clay loam.

38-62" mottled orange-grey loamy sand.

15. 0-11" dark brown loam (465342)

11-44" medium brown gravelly sandy clay loam.

44-47" orange sand.

47-50" medium brown gravelly sandy clay loam.

16. 0-11" dark brown loam (465342)

11-50" medium brown gravelly sandy clay loam.

17. 0-22" dark brown loam (465341)

22-34" medium brown sandy clay loam.

34-54" medium brown sandy loam with smoothed sandstone fragments.

54-57" medium brown sandy clay loam.

18. 0-12" dark brown loam (465341)

12-42" medium brown sandy clay loam with coal smuts.

42-47" medium brown loamy sand with sandstone and Magnesian Limestone fragments.

47-57" medium brown sandy clay loam with pea-sized Magnesian Limestone fragments.

19. 0-22" medium dark brown loam. A few stones up to 6" long (465340)

22-31" grey-brown sandy loam. Coal fragments.

31-57" yellow-brown sandy clay loam with coal smuts and large pieces of sandstone and Magnesian Limestone. Lenses of gravel (mainly ¼" Magnesian Limestone) and sandy loam about 12" thick appear within one foot of surface south of this point).

20. 0-26" dark brown loam (466339)

26-35" grey-brown sticky clay loam.

35-45" yellow-brown sandy clay loam with gravel.

45-57" reddish brown loamy sand.

Description of soils examined in a trench between Eden Vale and Hulam

IMPROVED HASWELL SERIES named by B.M. Dougall

0. 0-8" dark brown loam (428369)

8-60" mottled orange-grey clay loam with lenses of sticky grey clay and narrow concentrations of small fragments of Magnesian Limestone.

1. 0-12" yellow-grey sandy clay loam (430369)

   12-24" orange sand.

   24-36" grey-brown sand.

   36-38" lense of black peat.

   38-72" grey-brown clay loam.

2. 0-9" dark brown loam (433367)

   9-72" mottled orange-grey clay loam, with abundant pebbles of Magnesian Limestone, and boulders up to 24" long of sandstone and Magnesian Limestone.

3. 0-11" dark brown loam (438364)

   11-23" orange fine sandy loam.

   23-48" mottled orange-grey clay loam with coal smuts, and Magnesian Limestone gravel.

4. 0-11" dark brown loam. (438364) Adjacent to No. 3, to south.

   11-16" orange fine sandy loam.

   16-48" mottled orange-grey clay loam.

   (Profiles 5 and 6 shown on the diagram Figure 4 were described from pits dug at Reservoir Farm, High Throston, and at Four Winds, West Hartlepool, respectively).

5. 0-7" dark brown loam (438345)

   7-45" lighter brown silty loam with pea-sized gravel and coal fragments.

6. 0-12" grey-brown loam under woodland (487327)

   12-180" light brown silty clay loam.

APPENDIX 5.

FARMS MAPPED IN THE HARTLEPOOLS REGION.

1. Milk Farms.

Code no.	Holding.	Occupier.	O/T	Acreage.
1	Head's Hope	F. Barrone	O	100
2	Lamb's Close	"	O	31
3	Rodridge	R.W. Davison	O	100
4	Rodridge Cottage	W. Holliday	O	75
5	Fairfield	J. Proudlock	O	37
6	Claypool	A. Spedding	T	46
7	East Carr Side	R. Peacock	O	60
8	Blackhalls Fm.	G. Hornsby	O	75
9	Southfield House	J. Robinson	O	72
10	Oldacres Lodge	J.R. Heron	O	57
11	Butterwick House	L. Raw	O	70 (fragmented)
12	Brocks	S.D. Swinbank	O	100
13	Todd's New House	G. Edgoose	O	60
14	Beacon Hill	H. Watson	O	58
15	Dornewell	T.R. Race	O	75
16	Elwick Village F.	R. Walker	O	105
17	Martindale Fm.	G. Browell	T.	76
18	Potter's Fm.	E. Claughan	O	105
19	Seaview Farm	H. Asquith	T	60 (fragmented)
20	Throston Grange	W.G. Coverdale	T	59 (fragmented)
21	" "	L. Ogle	T	49
22	Low Throston	E.R. Wappat	O	30
23	Hart Glebe Fm.	E. Sanderson	O	66 (fragmented)

APPENDIX 5. continued.

Milk farms.

Code no.	Holding	Occupier	O/T.	Acreage.
24	Middle Warren	G. Ogle	T	82 (fragmented)
25	" "	A.E. Storey	T	93 (fragmented)
26	Red Lion Farm	D. Seymour	O	82
27	Stotfold Crest	A.Hutchinson	O	35
28	Low Stotfold	C.A. Crozier	O	202
29	Letch Farm	Mrs O. Parker	T	50
30	Northern Grange	J.R.Swinbank	O	60
31	Garth End	R.E. Scotson	O	63
32	Green Farm	J. Mann	T	91
33	Wolviston Manor	G.Ross	O	60
34	Thompson Close	L.Brackenborough	O	100 (fragmented)
35	Owington	F. Ward	O	37
36	Pawton Hill	J.G. Musgrave	O	31
37	Greenacres	R.A. Brown	O	40
38	Bog Hall	R. Brown	T	150
39	Whitton Three Gates	E. Halliday	T	120
40	Town End Farm	R. Mortimer	O	108 (fragmented)
41	White House	R. Atkinson	T	162 (fragmented)
42	Whitton House	J.R. Thurston	T	46 (fragmented)
43	Whitton Moor	R. Clark	O	76
44	Hill House	M. Porritt	O	70

APPENDIX 5. continued.

Milk farms.

Code no.	Holding.	Occupier.	O/T.	Acreage.
45	Poplar Farm	G. Thompson	T	124 (fragmented)
46	Cape House	D. Applegarth	O	92
47	Howden Hall	A. Duell	O	80
48	Brookdale	F.H. Haws	O	60
49	Hardwick Dene Fm.	W. Tarren	T	60 (fragmented)
50	Newstead Farm	T. Franklin	T	50
51	Ivy House	R. Barker	O	20
52	Hambleton View	A. Ward	O	30
53	Town House	F. Wright	O	76 (fragmented)
54	East Lea	J. Armstrong	O	33
55	Woogra	R. Blythman	O	130
56	Manor Farm	R. Blythman	O	100
57	Sundial Farm	J. Smith	O	30
58	Ainsty Farm	T. Horner	T	105
59	Rose House	F. Fawell	O	95
60	Sauf Hall	J.R. Gale	O	139
61	Weterton House 6	F.J. Young	T	56
62	" " 5	E. Henderson	T	53
63	Liz ards Fm. 4	F. Young	T	39 (fragmented)
64	" " 3	R. S. Raw	T	56
65	Greenside Farm	E. Elliott	T	131
66	Boyne Gardens	J. Alderson	T	26
67	Sedgefield Manor	W. Chrystal	O	40
68	Wolviston Hall Fm.	R.H. Wallace	O	60

APPENDIX 5. continued.

Milk farms.

Code no.	Holding.	Occupier	O/T	Acreage.
69	Wilmire House	G.R. Bell	O	100(fragmented)
70	White House	W. J. Elstob	O	140
71	Eastwell	W. Musgrave	O	88
72	Brackenhill Fm. 1	W. Searle	T	37
73	" " 2	T. R. Tyrell	T	70
74	Thorpe Moor Lodge	W. Ramsey	T	50(fragmented)
75	Shotton West Fm.	T. Wilson	T	45
76	Shotton Hall Fm.	G. R. Davison	T	127
77	Parklands Farm	H. Bird	T	35
78	Hunter House No. 3	C. Clark	T	57
79	Hunter House No. 1	A. Fishwick	T	57

II. Mixed Farms.

Code no.	Holding.	Occupier	O/T	Acreage.
80	Tweddle Black Halls	T. Oliver	T	163
81	High Hesleden	J. O. Brewis	T	271
82	Weems Farm	Mrs T. Oswald	O	130
83	Hardwick Blue House.	S. Lee	T	200(fragmented)
84	Hardwick Hall Farm.	P. Chrystal	O	250
85	Fleetshot Farm	R. Walton	T	200
86	Blakely Hill	W. Ramsey	O	100
87	Woodlands Close	H.G. Carter	O	157
88	Catchgate Farm	J. H. Shotton	T	200
89	Southfield Fm.	J. Cowan	T	140
90	Mill Hill Fm.	T. Clark	T	112

APPENDIX 5. continued.

Mixed Farms.

Code No.	Holding	Occupier	O/T	Acreage
91	Saltholme Farm	I.C.I.	O	1,634
92	Wood Close	J. W. Dobson	O	85
93	Black Hurworth	J. Spence	T	187
94	Low Swainston	C. Kirk	T	214
95	Low Newton Hanzard	S & D. Hutchinson	T	217
96	Woodside	R. Carter	T	250
97	Annigate House	W. Watson	T	90
98	Pudding Poke	D. Appleton	T	82
99	Dropswell	J.R. Marshall	T	219
100	East Holling Carr	C. Sanderson	O	127
101	Whyn House	"	O	203
102	Middle Swainston	E. H. Boland	T	209
103	Church Farm	E. Lightowler	O	73(fragmented)
104	West Carr Side	J. W. Redfern	T	126
105	Elderberry Hall	W. Tinkler	O	222
106	Butterwick East	R. Hall	T	168
107	Butterwick West	A. Weightman	O	230
108	Butterwick South	W. Hall	O	134
109	Redcar House	R. Swinbank	O	120
110	Beacon Hill Cottage	T. Hall	T	104(fragmented)
111	Ryal Farm	R. W. Shann	O	150(fragmented)
112	Howle Hope Farm	"	O	86
113	Hart-on-Hill Farm	G. Simpson	T	158
114	Mill House	H. E. Tinkler	T	253

APPENDIX 5. continued.

Mixed Farms.

Code No.	Holding.	Occupier.	O/T.	Acreage.
115	Bridge House	H.E. Tinkler	T	151
116	Amerston Hill Fm.	W.T. Hutchinson	T	73
117	High Stotfold South	"	T	209
118	High Stotfold North	H. Penk	T	237
119	Three Gates Farm	E. Herdman	O	107 (fragmented)
120	College Farm	H. Johnson	O	140
121	Dovecote Farm	F. Grieves	O	140 (fragmented)
122	Elwick Home Farm	F. Sturrock	O	239
123	Elwick North Farm	S. Bell	O	124
124	Lamb's House	N. Proud	O	110
125	North Urn Farm	T. Brown	O	100
126	Naisberry	A. Bird	O	235
127	Priory Farm	T. Brown	O	150
128	Nesbitt Hall	T.D. Bird	T	219
129	Sheraton Hill Fm.	J.O. Brewis & Son	O	365
130	Shera ton Grange	H. Musgrave	O	203
131	Cotsfold Close	Mrs D.A. Appleton	O	87
132	Middleton House	J.W. Jobson	O	121
133	Low Field Farm	H.S. Scotson	O	110
134	Sundial Fm. East	J. G. Scotson	T	37
135	" " West	W. J. Taylor	T	76
136	Middle Burn Toft	S. Linton	O	130
137	Newton Bewley Grange	R.B. Craggs	T	150
138	Marsh House	T.R. Crowden	T	62

APPENDIX 5. continued.

Mixed Farms.

Code no.	Holding	Occupier	O/T	Acreage
139	Fairfields	J.G. Scotson	T	122
140	Newton Bewley Manor	J. Thompson	T	142
141	Blue House	G. Atkinson	T	150
142	Greatham Marsh House	G. Dresser	T	202
143	Thorn Tree Farm	P. Dresser	T	128
144	Pudding Hook Farm	R. Dresser	T	75
145	Middle Field Farm	H. Corner	T	110(fragmented)
146	Hunter House No. 2	E. Lowson	T	56
147	Greenabella Farm	B. Bell	T	93
148	Brackon Hill	G. Swinbank	O	160
149	South Moor Farm	A. Swinbank	O	150
150	Foxton South Farm	W. Swinbank	O	125
151	Elstob Hall Farm	J. Tinkler	T	178
152	Elstob Hill Farm	J. J. Kemp	T	206
153	Stillington Town Fm.	J.T. Scurr	T	200
154	Stillington West Fm.	A. Bowes	T	261
155	Coalgarth House	R.M. Smith	O	119
156	Thorny Close	J. R. Kennedy	T	150
157	Station Farm	G. Stevenson	T	100
158	Crook Barns Farm	R. Barker	T	100
159	Viewly Hill Farm	R. W. Kennedy	O	220
160	Town Farm	W. D. Kitchen	T	180
161	Broad Lea Farm	C. Beatty	T	134
162	Southfields Farm	S. Thompson	T	170

APPENDIX 5. continued.

Mixed Farms.

Code No.	Holding.	Occupier	O/T.	Acreage.
163	Longpasture House	W. Barker	T	260
164	Rednarshall Mains Farm	J. P. de Harvard	O	260
165	Church Farm	"	O	115(fragmented)
166	Pitfield House	P. Hill	O	100
167	Fishburn West House	C. Morgan	O	260
168	Fishburn Town Farm	G.W. Robinson	O/T	132(fragmented)
169	Trimdon Hall Farm	J. M. Pattison	O	95(fragmented)
170	Southern Law Farm	B. Scurr	T	209
171	Carr House	C. B. Taylor	O	165
172	West Woodburn Farm	G. Cowan	O	104
173	Greenhills Farm	A. Johnson	T	214(fragmented)
174	Fleming Field Farm	F. B. Wreford	T	164 (fragmented)
175	Elder Acres Farm	R. D. Musgrave	T	176
176	Horden Hall Farm	A.F. Howard	O/T	360(fragmented)
177	Mordon Moor Farm	R. E. Wright	O	120
178	Kelloe Hall Farm	A. Wilson	T	220
179	Hole House	"	T	103
180	Low Raisby	A. F. Taylor	T	228
181	High Raisby	"	T	100
182	Shotton Village Farm	Mrs. Wappat	T	170
183	Thorpe Moor Farm	Mrs Hodgson	T	150
184	Low Hills Farm	R. W. Snowdon	O/T	120
185	Easington White House	"	O/T	80

APPENDIX 5. continued.

Cash cropping with fattening farms.

Code No.	Holding	Occupier	O/T	Acreage.
186	Cotsfold Grange	J. King	O	84
187	Brewery Farm	T. Seymour	O	113
188	Oakerside	H. Bird	T	154
189	Low Warren Farm	G. Ogle (Jnr)	T	62
190	Middlethorpe Farm	T. S. Brown	O	240
191	North Hart Farm	F. Brown	O	198
192	High Throston Farm	R. Bird	O	129
193	Reservoir Farm	"	T	37
194	Quarry Farm	D. H. Clapham	O	104
195	High Throston South	L. C. Clapham	O	64
196	High Tunstall Farm	S. Darling	O	210
197	Dalton Field House	G. Sanderson	O	94
198	Low Tunstall Farm	Craven Bros.	T	126
199	Brierton North Farm	G. Brown	O	200
200	Brierton East Farm	G.W.T. Brison	O	138
201	Owton Grange	L. Wood	T	105
202	Claxton Farm	G. Nichol	T	127
203	Claxton Grange	W. Dryden	O	186
204	Blue House	"	O	118
205	Owton Fence Farm	T. R. Teasdale	O	150
206	Golden Flatts Farm	W. Layton	T	108
207	Tofts Farm	B. Jobson	T	138
208	Greatham Hall Farm	R. F.A. Bell	T	365
209	West Meadows Farm	W. E. Wright	T	84(fragmented)

APPENDIX 5. continued.

Cash Cropping with fattening farms.

Code No.	Holding.	Occupier	O/T	Acreage
210	Field House	J. Hutchinson	T	81
211	Wolviston High Grange	Mrs I. Peacock	T	188
212	West Farm	W. Noddings	T	124
213	Halls Field Farm	"	T	65
214	Low Burn Toft Farm	"	T	215
215	Trimdon House	J. Hirst	O	130
216	Layton House	F. Hanley	O	342
217	Benknowle Farm	J. Jobson	O	100
218	Hart Home Farm	F. Darling.	O	254
219	Glower O'er Him Fm.	H. Craggs	T	208
220	Crimdon House	J. M. Collingwood	O	160
221	Sheraton Farm	M. Brown	T	165
222	Tunstall Hall Farm	H. Robson	O	56
223	Catcote Farm	"	T	147
224	Dalton Manor Farm	G. Jobson	O	178 (fragmented)
225	Whelly Hill Farm	J. Linton	O	236
226	West Layton Farm	R. Swinbank	T	190
227	Claxton House Farm	F. Elstob	O	106
228	Town Farm	C. Jackson	O	120
229	Cowley House	H. Allison	O	250
230	Brierton West Fm	G. Herbert	O	163
231	Hulam Farm	J. H. Murray	T	564
232	High Springwell Fm.	H. Darling	O	90

APPENDIX 5 continued.

Cash Cropping with fattening farms.

Code No.	Holding	Occupier	O/T	Acreage
233	Deaf Hill Farm	T. Hopper	T	283(fragmented)
234	North Moor Farm	T. Hopper	O	98
235	West Farm	T. E. Hopper	T	151(fragmented)
236	Shotton White House	R.V. Rutherford	O/T	112
237	Strawberry Hall Farm	"	O/T	95
238	Fillpoke Farm	M. Collingwood	O	160
239	Hart Farm	J. Barker	O	140
240	Knotty Hill Farm	F. Craggs	O	182(fragmented)
241	Sands Farm	G. Lawson	O	400
242	Low Shotton Farm	W. Craggs	O	300
243	West Shotton Farm	"	O	400
244	Foxton North Farm	A. Hart	O	150
245	Low Foxton Farm	"	O	200
246	Elstob North Farm	A. Wood	O	238
247	Merton Grange	R. Wood	O	242
248	Stillington North Farm	S. Thompson	O	174
249	Whitton Manor Farm	J. Hall	T	120(fragmented)
250	Thorntree Farm	L.W. Rhys	O	68
251	Norton Low Middlefield Farm	T. Elcoat	O	210
252	Norton Middlefield Fm.	J.S. Hall	O	200
253	Summerville Farm	Stockton Co-op.	O	60
254	Norton Hardwick Farm	" "	O	80
255	Tithe Barn Farm	A. G. Lockey	T	70
256	Northfields Farm	T.E. Watson	T	246

APPENDIX 5 continued.

Cash cropping with fattening farms.

Code no.	Holding	Occupier	O/T	Acreage
257	Lea Close Farm	E. Whitehead	O	152
258	Bishopton West House	O. Armstrong	O	200
259	Gilly Flat Farm	H.M. Bell	O	259
260	Town Farm	W. Twizell	O	157
261	East House	W.C. Dove	T	203
262	Trimdon West Farm	E. Tinkler	T	140 (fragmented)
263	Trimdon Grange Farm	T. Robinson	T	71
264	Trimdon East House	G.E. Carter	T	300
265	Garmondsway Middle Fm.	Rutter Bros.	T	490
266	Harpington Hill Farm	R. Lawson	O	200
267	Warren Farm	K. Wilson	T	247 (fragmented)
268	Bottle Hill Farm	J.R. Smith	T	250
269	Wingate Grange	A. Flowers	T	370
270	Grindon Grange	I. McLaren	O	285
271	Thorpe Leazes Farm	T. Allen	O	250
272	Thorpe Thewles Manor Fm.	P. G. McLaren	O	300
273	Orchard Farm	"	O	116
274	Sprucely Farm	J.C. Dove	T	60
275	Carlton Grange	W.H. Smith	O	159 (fragmented)
276	High Barns Farm	D.R. Wilson	T	265
277	Old Acres Hall Farm	T. E. Watson	O	296
278	East Close Farm	F. Craggs	O	240
279	Stob House	W. Darling	O	109

APPENDIX 5 continued.

IV. Fattening-with-cash cropping farms.

Code no.	Holding	Occupier	O/T	Acreage
280	North Blackhalls Farm	A. Wreford	T	94
281	West Holling Carr Farm	B.W. Sanderson	O	162
282	Blackhills Farm	J. Smallwood	T	34
283	Low Hesleden Farm	J. Brown	T	79
284	Hesleden Hall Farm	T. Swinburn	T	146
285	Top House	G. Mason	O	42
286	Hartbushes Hall Farm	C. H. Wreford	O	82
287	White Hurworth Farm	D. Sanderson	T	595
288	Catlaw Hall Farm	Miss E. Nichol	O	120
289	Pike Whin Farm	"	O	180
290	Red Barnes Farm	"	O	37
291	North Close	H. Hutchinson	T	85
292	Catley Hill Farm	A. Kirkpatrick	T	64
293	West Murton Blue House	D. Sanderson	O	171
294	Murton Farm	W. Allen	T	70
295	Embleton Old Hall Farm	J. Stonehouse	T	225
296	Cole Hill Farm	R. Nichol	O	486
297	Amerston Hall Farm	J. Sanderson	O	290
298	High Swainston Farm	J. T. Musgrave	T	218
299	Close House	W. Shepherd	T	283
300	Red Gap Farm	T. H. Hutchinson	T	337
301	Newton Hangard Farm	J. Thompson	T	135
302	High Burn Toft Farm	G. Boland	T	176

APPENDIX 5. continued.

IV. Fattening-with-cash cropping farms.

Code No.	Holding	Occupier	O/T	Acreage
303	Tofts Farm	F. Scotson	T	343
304	Wynyard Home Farm	Lord Londonderry	O	900 (fragmented)
305	Embleton Farm	W. Thompson	T	525
306	Beamley Carr Farm	F.L. Harrison	O	73 (fragmented)
307	Sunnyside Farm	R.A. Marshall	O	51
308	Humble Knowle Farm	W. & L. Etherington	O	173
309	Galley Law Farm	J. Etherington	O/T	201 (fragmented)
310	Butterwick Moor Fm.	R. Clifford	O	273
311	Ten O'Clock Farm	"	O	160
312	Hutton Henry Mill Farm.	R. Wood	T	50
313	Hely House	W. Johnson	T	212
314	Woodend Farm	C. Walker	T	170
315	Pilmore House	W. Stevenson	O	80
316	Old Vicarage Farm	W.M. Walsh	O	70
317	Green Hill Farm	T. Prest	O	110
318	Ox Close Farm	Bowes Bros.	T	59
319	Cote Nook Farm	" "	O	126
320	Diamond Hall Farm	F. R. Craggs	O	300
321	Measless	"	T	89
322	Cowburn Farm	G. Hay	T	114
323	Fulthorpe Farm	A. Hunter	T	337
324	Cowpen Bewley Manor Farm.	J. Hall	T	450 (fragmented)
325	Little Marsh Farm.	Miss Nightinggale	T	167 (fragmented)
326	Cowpen Village Farm	A. Farrow	T	90 (fragmented)

APPENDIX 5. continued.

IV. Fattening-with-cash cropping farms.

Code no.	Holding	Occupier	O/T	Acreage
327	Earl's Nook Farm	J. Waller	T	116
328	Lower Claxton Farm	G. Nichol	T	125
329	West Pasture Farm	J. Atkinson	O	97
330	Springwell House	"	O	110
331	Brierton Moor House	G. Nichol	O	168
332	Middle Stotfold Farm	"	O	262
333	Sheraton Hall Farm	J. H. Murray	T	336
334	Stotfold Moor Farm	H. Hutchinson	T	151
335	Sheraton West Grange	S. Hutchinson	O/T	203
336	Tilery Farm	J. Tiplady	O	22
337	Nelson Farm	H. I. Ford	O	53
338	Thorpe Bulmer Farm	W.F. Hall	O	280
339	South Layton Farm	W. Craggs	O	198
340	Brakes Farm	J. Barron	T	212
341	Crowdy Hall Farm	T. Brown	O	200
342	Stillington East Farm	G. Knox	T	130
343	High Middlefield Farm	C. Curry	O	160
344	Little Stainton Manor Fm.	B. Wise	O	203
345	Prospect House	H. Hutchinson	O	30
346	Northside Farm	J. Atkinson	T	110
347	Horse Close Farm	P. Duignan	O/T	45
348	Downland Dairy Farm	J. Hall	O	130
349	Bishopton Grange Farm	F. Elders	O	250
350	Fishburn Hall Farm	G. Danby	T	188 (fragmented)

APPENDIX 5. continued.

IV. Fattening-with-cash cropping farms.

Code no.	Holding	Occupier	O/T	Acreage.
351	Garmondsway East Fm.	E. Crisp	T	300
352	Green Knowles Farm	T.W.B. Walton	O	186
353	Town Farm	R. Brown	O	100 (fragmented)
354	High Farm	G.T. Thornton	O	300 (fragmented)
355	Lilac House	F.W. Hall	O	147 (fragmented)
356	Glese Farm	C.H. Hill	T	40
357	Newstead Farm	I. Parsons	O	90
358	Stony Flat Fam	T. H. Robson	T	300
359	Ox Eye Farm	T. East	O	172
360	High House	W. Ferguson	O	178
361	Two Mile House	M. Helmsley	T	100
362	California Farm	Mrs L. Umpleby	O/T	146
363	Bradley Farm	G. Stainthorp	O	72
364	Kelloe Laws Farm	J. Nicholson	T	168

V. Miscellaneous farms.

Code no.	Holding	Occupier	O/T	Acreage.	
365	Dene Leazes Farm	H. Thompson	O	300	Milkretailed from own production.
366	Hart Moor Farm	"	O	170	Potatoes.
367	Wellfield Farm	"	O	200	"
368	Park House	"	O	199	"
369	Red Hurworth Farm	"	O	171	"
370	Murton Hall Farm	"	O	233	"
371	Murton Blue House Farm	"	O	130	"

APPENDIX 5. continued.

V. Miscellaneous farms.

Code no.	Holding.	Occupier	O/T	Acreage	
372	Gunnersvale Farm	W. Forbes	O	160	Milk produced and retailed
373	Leechmire Farm	"	O	200	Milk produced and retailed
374	Town Farm	J.J. Brown	T	105	Arable
375	Gray's Land	R.Hutchinson.	T	43	Young stock grazed
376	Seaton Snook	F. Davison	T	450	Grazing of temporary stock
377	Hopper House	R. Brown	O	60	Young Stock grazed
378	Wolviston Mill Farm.	R. Forster	O	30	Young stock grazed
379	Morton White House	T.E. Watson	O	66	Arable
380	Grassy Nook Farm	W. Coupe	O	40	Market Gardens
381	Ouston Moor Fa rm	R. Forster	T	50	Young stock grazed
382	Elton Lane Farm	P.M. Staples	O	50	Grazing only
383	Gravel Hole Farm	E. Knaggs	O	30	Young stock grazed
384	Collinclose Farm	C.Thompson	O	250	Arable
385	Howden House	T.D. Firby	O	20	Accommodation grazing
386	Railway Land	T. Thornton	T	30	Young stock graz ed
387	The Bungalow	G.R. Skripka	O	30	Market Gardens
388	Bishopton Glebe Fm.	J. Lynas	O	40	Young stock grazed
389	Holme Lea	G. Fordy	O	30	Accommodation grazing
390	Brookside Farm	C. McCune	O	80	Young stock grazed
391	Rosedale Farm	E.B.Hopkinson	O/T	102	Accommodation Grazing
392	Townend Farm	G. Walker	T	90	Arable
393	Throston Grange	G. Armstrong	T	40	Market Gardens
394	Hardwick Grange	F.C. Heddle	T	52	Accommodation grazing
395	East Farm	Mrs S.J.Nunn	T	122	Stores reared
396	Home Glebe Farm	T. Dawson	T	41	Stores reared

APPENDIX 5 continued

V. Miscellaneous Farms

Code No.	Holding		O/T	Acreage	Type of farming
397	Wingate Low Grange	G. Bryson	T	92 (fragmented)	Market gardens and arable
398	Mill Farm	J.S. Hall	O	75	Accommodation grazing
399	Corner's Land	R. Corner	O	22	Arable with pigs
400	Newlands Farm	A.H.J. Pinch	T	34	Stores reared
401	Seaton Grange	B. Bell	T	78	Arable
402	Benbridge	H. Bird	O	74	Arable
403	Wingate Arms Holding	B. Ward	O	37	Arable
404	South Seaton Holding	D. Areford	T	73	Arable

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FIG. 2

SOIL TRAVERSE FROM SEDGEFIELD TO GRAYTHORP