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Spatial Adjustments in the  
Teesside Economy, 1851-81.

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A Thesis Submitted to the  
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## ABSTRACT.

This study is concerned with spatial change in a regional economy during a period of industrialization and rapid growth. It focuses on two main issues : the spatial pattern of economic growth, and the locational adjustments induced and required by that process in individual sectors of the economy. Conceptually, therefore, the thesis belongs to the category of economic development studies, but it also makes an empirical contribution to knowledge of Teesside in a crucial period of the region's history.

In the first place, it was deemed necessary to establish that economic growth did occur on Teesside between 1851 and 1881. To that end, use was made of a number of indirect indices of economic performance. These included population change, net migration, urbanization and changes in the employment structure of the region. It was found that these indicators provided evidence of economic growth, and evidence that growth was concentrated in and around existing urban centres and in those rural areas which had substantial mineral resources.

To facilitate the examination of locational change in individual sectors of the economy - in mining, agriculture, manufacturing and the tertiary industries -, the actual spatial patterns were compared with theoretical models based on the several branches of location theory. In general, the models proved to be useful tools for furthering understanding of the patterns of economic activity and for predicting

the types of change likely to be experienced during industrial revolution. Thus, the spatial development of mining and manufacturing on Teesside was governed by the cost factor and advantage was generally taken of any opportunity to reduce costs. Agriculture, however, was more responsive to national than regional conditions, and fitted the appropriate location model less closely. As would be expected, the central place system expanded in the economically buoyant urban areas, where population and economic growth were concentrated, and contracted in rural districts dependent on farming.

## ACKNOWLEDGEMENTS

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a former Secretary of the Cleveland Mine Owners' Association  
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CHAPTER ONE  
INTRODUCTION.

This is a study of the spatial aspects of economic growth rather than the economic geography of Teesside, and the region is regarded merely as a laboratory and is not itself the main object of the enquiry. As such, the study has two main and complementary aims : the examination of the spatial pattern of economic growth and the analysis of locational changes induced by that process in individual sectors of the economy. The theoretical sections of the thesis should not, therefore, be viewed as background material but as a conceptual framework for the study as a whole. The main value of the empirical sections lies in their capacity to illuminate the various theories examined.

In 1851 Teesside was still primarily a rural area, with farming its main economic base; in 1881 it was both essentially urban and one of the country's major industrial regions. Those two years have been selected as the terminal dates for the present study because they encompass the main period of urbanization, industrialization and rapid economic growth. At mid-century, Teesside was socially and economically a stable region, with little propensity for change. It was dominated by agriculture to such an extent that George Markham Tweddell, a local

writer, found himself regarded as an outcaste for publicly advocating the principle of free trade.<sup>1</sup> Three decades later Teesside had been changed almost beyond recognition by the development of a massive industrial complex and the influx of 100,000 migrants.

At the beginning of the period, Teesside had a population of approximately 120,000, two-thirds of which lived in small hamlets and villages and on scattered farmsteads. The largest settlements in the region were Darlington (11,228), Stockton (9,808), Hartlepool (9,503) and Middlesbrough (7,431). West Hartlepool, only four years of age in 1851, had fewer than 2,000 inhabitants. Although substantial for North East England at that time, none of the larger Teesside towns was comparable in size with either Newcastle (100,000) or Sunderland (64,000), the dominant urban centres in the immediate vicinity.

Darlington and Stockton were principally service centres, each having a well-established market as well as a wide range of other commercial functions, and each serving a large agricultural district. In addition, Darlington had woollen and linen mills, but it was not of note as a manufacturing centre. Stockton was involved on a small scale in shipbuilding and general engineering, and

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1. See George Markham Tweddell, The Bards and Authors of Cleveland and South Durham and the Vicinage, Stokesley, 1872, p.280.

it was also of some significance as a port, though to a lesser extent than had been the case before the development of Middlesbrough.

The other towns were very different in character, Middlesbrough and West Hartlepool owing their origin, and Hartlepool its recent recovery, to the development of coal mining in South Durham and the growth of coal shipments from the Tees. The development of the coal trade had depended, in turn, on the construction of a network of railways to link the Tees with the coalfield, a process begun in the early 1820's. The first railway to be completed was the Stockton and Darlington Railway Company's line from Witton Park, in south-west Durham, to Stockton, which was opened in 1825. This event was followed immediately by the beginning of coal shipping from Stockton.

It soon became apparent, however, that Stockton had severe limitations as a port, and little capacity for expansion. The main reason was that the channel of the Tees immediately below Stockton was both shallow and tortuous. This led to delays for shipping and created problems of congestion in the vicinity of the coal staithes. It also meant that vessels of more than 100 tons burden could not leave the quayside fully laden. Instead, they took on part of their cargo at Stockton and were supplied with the remainder by keel boats which followed



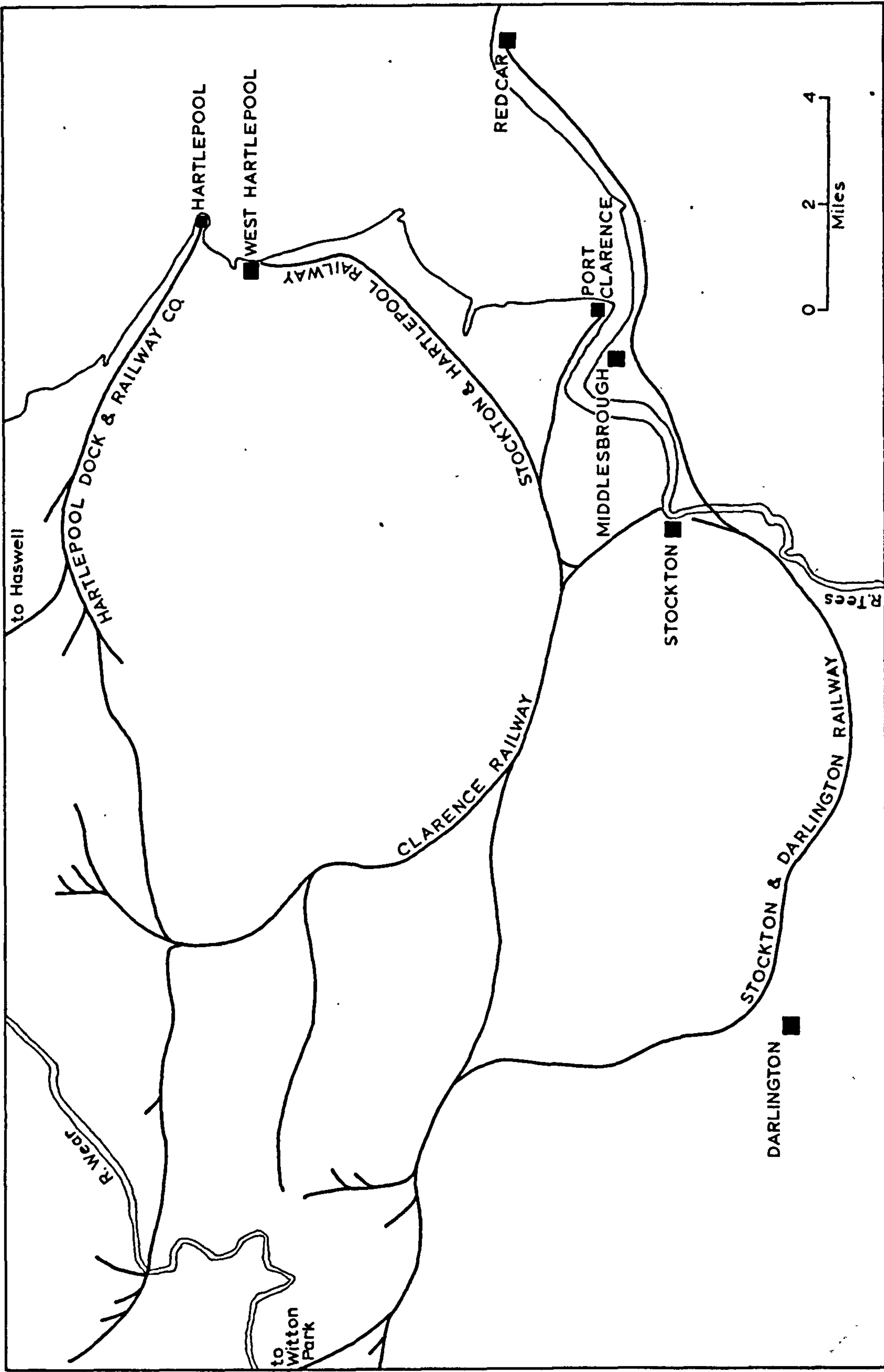
them downstream into deeper water.<sup>1</sup>

Because of these difficulties, the directors of the Stockton and Darlington Company began as early as 1826 to consider the feasibility of extending their main line to a point nearer the mouth of the Tees.<sup>2</sup> Haverton Hill, on the north bank of the river, was initially proposed as the new terminus, but the board eventually decided in favour of a site on the opposite shore, largely because the requisite extension to the railway would be shorter and hence cheaper to construct. Parliament sanctioned the scheme in 1828, and the line from Stockton to Port Darlington, as the new terminus was at first known, was opened two years later. In the meantime Joseph Pease, a director of the Stockton and Darlington Railway, and a number of other business men had formed a company named the 'Owners of the Middlesbrough Estate', purchased 527 acres of land in the vicinity of Port Darlington, and made plans for the building of a new town there.<sup>3</sup> Middlesbrough's first house was completed a few months before the opening of the railway from Stockton.

Coal shipments from the new port began to increase very quickly, though there are no detailed statistics for them in the early years. In the year 1830-31, the

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1. William Weaver Tomlinson, The North Eastern Railway : Its Rise and Development, Newcastle, (1914), p.165.
  2. Ibid, Chaps.2-4 for information on railways in Teesside area.
  3. William Lillie, The History of Middlesbrough, Middlesbrough, 1968, Chaps.5 and 6.

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Source: Wood, *op.cit.*, pp. 17 & 54.

Figure 1.1 The Early Coal Railways

first in which Middlesbrough was operational, the Stockton and Darlington Railway carried 229,487 tons of coal, including 151,263 tons for export, to Stockton and Middlesbrough.<sup>1</sup> The equivalent figures in the previous year, when Stockton was the only port available in the region, had been 147,570 and 79,434 tons. Shipments continued to rise steadily in subsequent years, and, as a result, Middlesbrough's population grew from 40 in 1829 to 154 in 1831 and 5,463 in 1841.<sup>2</sup>

In 1834 the first load of coal carried by the Clarence Railway Company, which had a more direct line than the Stockton and Darlington to the coalfield, arrived at Stockton for shipment. The main terminus of the Clarence Railway, however, was at Samphire Batts - later named Port Clarence - on the north bank of the Tees and immediately opposite Middlesbrough, and shipments soon began from there too. With the opening of coal staithes at Middlesbrough and Port Clarence, Stockton was superseded as a coal port and its share of the trade declined rapidly.

Not long afterwards, however, Middlesbrough and Port Clarence were themselves threatened by competition from Hartlepool, which was even more advantageously placed for coal shipping. Hartlepool, on the coast, was an

- 
1. J.S. Jeans, Jubilee Memorial of the Railway System, London, 1875, Chap.22.
  2. Asa Briggs, Victorian Cities, London, 1968, p.242.

ancient borough that had once been of considerable importance as a port, but in the early years of the nineteenth century it was merely a large fishing village, its harbour long in disuse.<sup>1.</sup> The town's fortunes changed with the development of mining in east Durham in the 1820's; for Hartlepool seemed the natural outlet for produce from that part of the coalfield. In 1831 the Hartlepool Dock and Railway Company was formed for the joint purpose of re-developing the harbour and building a railway north to the collieries which were being planned and opened in the Haswell area. Parliament assented to the project in 1832, work began soon afterwards and the first load of coal was shipped from Hartlepool in 1835.

With its harbour and coastal location, Hartlepool was in a more advantageous position than the river ports; it could offer ships a speedier turn-round, and it made the time-consuming and costly journey up and down the Tees unnecessary. To enhance Hartlepool's attractions still further, the Dock and Railway Company adhered to a policy of keeping port charges at a minimum - they were only half as high as those levied at Middlesbrough -, and subsidising its port operations from railway revenue. To ensure a larger supply of coal for the new harbour, plans were made in 1837 to divert traffic from Port Clarence by tapping the

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1. Robert Wood, West Hartlepool, West Hartlepool, 1967, Chaps.1-3.

Clarence Railway system. This was achieved by sponsoring a separate company for the purpose of building a short connecting branch railway, as a result of which Hartlepool became the nearest port for that part of the coalfield served by the Clarence Railway.

As a counter-measure, a group associated with the Clarence Company built a railway from Billingham to Hartlepool (the Stockton and Hartlepool Railway). The object of this scheme was to retain some coal traffic for the Clarence, and this was achieved by charging lower rates than the Hartlepool Dock and Railway Company, which meant that it was cheaper for many collieries sending coal to Hartlepool to use the Clarence system even though the route was longer. However, coal shipping from Port Clarence still had to be abandoned. To obtain their own shipping facilities, the initiators of the Stockton and Hartlepool Railway formulated plans in 1844 for the construction of a new dock complex, and this project - the first stage of which was completed in 1847 - subsequently became the nucleus of West Hartlepool. Later still, in 1853, the railway and dock companies were amalgamated - under the title of the 'West Hartlepool Harbour and Railway Company' - into an organisation similar to that based on the old town of Hartlepool.

The rather complex manoeuvrings of the rival railway companies in the region paved the way for a shift in the

centre of the coal-shipping trade from the river ports to the Hartlepoons. Stockton, of course, had played only a minor role after the establishment of Middlesbrough and Port Clarence. The coal staithes at Port Clarence had been abandoned by 1842,<sup>1</sup> if not earlier, but Middlesbrough held its own for rather longer, aided by the replacement of its staithes with a dock in 1842, and coal shipments from that port did not reach a peak until 1846. Due to the opening of the West Hartlepool dock, however, shipments from Middlesbrough fell from 742,521 tons in 1846 to 452,237 tons in 1850.<sup>2</sup> By mid-century, the Hartlepoons were responsible for three-quarters of the two million tons of coal despatched annually by sea from the region, and their share was still growing.

The implications of this trend were particularly ominous for Middlesbrough, which, unlike Stockton, did not have a traditional role as a regional service centre to sustain it and had been unable to develop a substantial manufacturing base. With the exceptions of a small forge and a pottery, Middlesbrough had virtually no basic functions unconnected with the coal trade. It seemed unlikely, therefore, that the town could survive if coal shipping were to decline further.

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1. Joseph Taylor, "Description of the River Tees, and of the Works upon it Connected with the Navigation", Proceedings of the Institution of Civil Engineers, Vol.24 (1864-65). p.65.

2. Loc.cit.

With the exception of a few mining villages in the north, on the southern edge of the Durham coalfield, most other settlements in the region were at mid-century essentially rural service centres. In size, they varied from hamlets with little more than a church and a few houses to small country market towns, such as Guisborough and Stokesley in North Yorkshire and Staindrop and Sedgfield in Durham. The larger settlements had a greater range of handicraft-type industries, as well as commercial functions, but they were primarily concerned with supplying goods to a local population largely dependent on agriculture and they were not involved in manufacturing on a significant scale.

In 1851, therefore, Teesside was basically a stable agricultural region, with a veneer of industrial development associated with the growth of coal shipping. It had potential for industrial expansion - in view of the proximity of large and known coal resources, the existence of a number of railways built to tap the coalfield, and the region's seaboard location -, but there were no indications that this was about to be realised. On the contrary, Middlesbrough seemed poised for decline rather than growth, and even for the Hartlepoons the future was not especially promising, or so it appears in retrospect; for the burgeoning national railway network was already beginning to undermine the coastwise trade in coal. The



turning-point came with the discovery of Cleveland's iron ore resources, an event which made possible the expansion of manufacturing and injected buoyancy into the regional economy.

The thesis is organised along lines suggested by the statement of intent at the opening of the present chapter. Chapter 2 examines the relevance of the regional concept to a study of this type, and defines Teesside for operational purposes. Chapters 3 to 5 are concerned, at theoretical and empirical levels, with economic growth as a spatial process. Chapters 6 to 9 treat locational changes in the mining, agricultural, manufacturing and tertiary sectors. The period covered by the study was chosen because it was then that Teesside gained its essential modern urban-industrial character. The specific terminal dates, 1851 and 1881, were selected for reason of statistical convenience; both were Census years.

## CHAPTER TWO

### THE TEESSIDE REGION

'Teesside' or 'Tees-side', the older version, is a well-known regional label that has recently been given the sanction of administrative usage with the creation of the Teesside County Borough.<sup>1</sup> Nevertheless, it is a label given to a region of apparently variable extent, and the new administrative unit is smaller than most definitions of Teesside would allow. For example, House and Fullerton included the County Borough and Rural District of Darlington, which are not part of the Teesside County Borough, in their survey of the region.<sup>2</sup> On the other hand, Hetherington specifically excluded those areas on the grounds of their "... closer association with the coalfield and ... relative remoteness from the [Tees] estuary"<sup>3</sup>.

Various indices, including physiographic, economic and administrative criteria as well as patterns of economic and political organisation, have been used to delimit the region.<sup>4</sup> In many cases, however, little importance

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1. The date of its coming into being was April 1, 1968.
  2. J.W. House and B. Fullerton, Tees-side at Mid-Century : An Industrial and Economic Survey, London, 1960, p.15.
  3. Joseph Hetherington, "A Physical and Economic Geography of Northern Tees-Side", unpublished Ph.D. Thesis, University of Durham, 1958, Vol.1, p.18.
  4. Hetherington (*ibid.*, Chap.1) used a series of such indices. A.E. Smailes employed the concept of urban fields : see his "The Analysis and Delimitation of Urban Fields," Geography, Vol.32 (1947), pp.150-61; and The Geography of Towns, London, 1953, Chap.7.

has been attached to the position of the regional boundary, which has been left unspecified or chosen quite arbitrarily. An overall impression remains that no single index is adequate, and that Teesside is the title not of one but of many regions, their only common characteristic being a location bordering the lower reaches of the Tees.

This view is one that can be comfortably reconciled with the conclusions emerging from the modern theoretical literature dealing with the subjects of regions and regionalization. It is usually accepted that the regional concept is an intellectual tool designed to aid understanding of the earth's surface, either by facilitating its division into constituent parts or by allowing the grouping of like places into areal units.<sup>1</sup> Regionalization is therefore essentially a taxonomic procedure<sup>2</sup> and the nature and extent of a particular region will depend upon the criterion, or criteria, used to distinguish it.

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1. See Richard Hartshorne, Perspective on the Nature of Geography, London, 1959, Chap.9; and Derwent Whittlesey, "The Regional Concept and the Regional Method," in American Geography : Inventory and Prospect, ed. Preston E. James and Clarence F. Jones, New York, 1954, pp.19-68.
  2. The relationship between regionalization and taxonomy has been closely examined in recent years. See : William Bunge, Theoretical Geography, Lund, 1962, pp.14-22; David B. Grigg, "The Logic of Regional Systems," Annals of the Association of American Geographers, Vol.55 (1965), pp.465-91, and "Regions, Models and Classes," in Models in Geography, ed. Richard J. Chorley and Peter Haggett, London, 1967, Chap.12.

Within this broad framework, there is an important difference between 'formal' and 'functional' regions.<sup>1</sup> The formal region, which is also referred to as being uniform or homogeneous, is characterised by the presence of some property, or group of properties, which differentiates its members from places outside the region. The definite feature or features may exist within the region and not without; alternatively, and more probably, the regional boundary may mark a significant quantitative change in the value of the selected attribute or attributes. Either case provides a legitimate basis for delimiting a formal region.<sup>2</sup>

The functional, or organizational, region, on the other hand, is distinguished by the linkages between its constituent parts rather than by their common features.<sup>3</sup> It is "... an area in which one or more selected phenomena of movement connect the localities within it into a fun-

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1. See G.W.S. Robinson, "The Geographical Region : Form and Function," Scottish Geographical Magazine, Vol.69 (1953), pp.49-58; and Whittlesey, op.cit.
  2. Hartshorne, op.cit., pp.112-22;  
Eunge, op.cit., pp.14-23;  
Leonard Zabler, "Statistical Testing of Regional Boundaries," Annals of the Association of American Geographers, Vol.47 (1957), pp.83-95;  
Brian J.L. Berry and Thomas D. Hankins, A Bibliographic Guide to the Economic Regions of the United States, Chicago, 1963, pp.ix-xviii.
  3. Hartshorne, op.cit., pp.129-43.  
Whittlesey, op.cit.  
Robinson, op.cit.

ctionally organized whole."<sup>1</sup> Thus, places within a drainage basin are linked, one with another, by the flow of water between them and the watershed is the regional boundary. In the cases of other types of functional regions, however, particularly those depending upon economic connectivity, the boundary is often more difficult to define. It may therefore be necessary to consider only the dominant flows between places, and disregard those which are in conflict with them but are of minor importance.<sup>2</sup>

Not all regions can be termed either formal or functional, and it has been suggested that a third type should be designated the 'general' region.<sup>3</sup> This is essentially a subjective construct, an area which is declared or implied to be sufficiently distinctive to warrant its being given a name. Its limits may be defined arbitrarily or, which is very common, left unspecified. In effect, therefore, the term 'region' is in this context used simply as a synonym for 'area', as in the case of a pre-determined study area. The general region therefore differs fundamentally from those defined on an objective basis, and it was thought to be inappropriate for the present study.

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1. Berry and Hankins, op.cit., p.x.

2. See John D. Nystuen and Michael F. Dacey, "A Graph Theory Interpretation of Nodal Regions," Papers and Proceedings of the Regional Science Association, Vol.7 (1961), pp.29-31.

3. This was proposed by Hartshorne and seconded by Berry and Hankins. See Richard Hartshorne, "What Do We Mean by 'Region'?", abstract in Annals of the Association of American Geographers, Vol.48 (1958), p.268; and Berry and Hankins, op.cit., p.x.

So far as formal and functional regions are concerned, it is a commonplace that regionalization should be designed to serve a specific purpose, and should not be conceived of as an abstract exercise capable of meeting all requirements.<sup>1.</sup> In practice, however, the most appropriate scheme of regionalization is not always obvious, and even when it is, there may be insuperable problems - notably a lack of suitable data - preventing its implementation, and favouring a less desirable alternative.

The purpose of the present study has already been defined as the examination of the spatial pattern of economic growth, and the concomitant locational adjustments, in an area centred on the towns of Middlesbrough, Darlington, Stockton and the Hartlepoons. This was an area transformed by industrialization in the third quarter of the nineteenth century. In one sense, at least, a regional framework for such a study may seem inappropriate; economic growth influences places and areas far distant from the initial point of development, and its effects are not confined to the immediate locality. However, just as the international economy may be regarded as being composed of national economies, so the latter may be conceived of as systems of regional economies. That being the case, the regional economy does provide a logical unit for the investigation

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1. See Grigg, "Regions, Models and Classes", op.cit, p.486.

of economic growth as a spatial process, even though it is not a closed compartment and events within it may have repercussions elsewhere.

Nevertheless, the problem still remains of how best to define a regional economy. In recent years, the whole subject of economic regionalization has attracted much interest, not least from economists.<sup>1</sup> One result has been a growing dissatisfaction with the use of administrative areas for the purposes of economic analysis. Lösch was an early critic of this and related practices, arguing that "geographical and cultural regions ..., are from an economic point of view, just as artificial units of reference as states are."<sup>2</sup> This view was later echoed by a number of other writers, including Vining.<sup>3</sup> Though there are theoretical and practical difficulties to overcome, it is generally accepted that the national economic system is

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1. Eg. Karl A. Fox and T. Krishna Kumar, "The Functional Economic Area : Delineation and Implications for Economic Analysis and Policy," Papers of the Regional Science Association, Vol.15 (1965), pp.57-85; John Friedmann, "The Concept of a Planning Region - the Evolution of an Idea in the United States", Chap. 25 in Regional Development and Planning : A Reader, ed. John Friedmann and William Alonso, Cambridge, Massachusetts, 1964, pp.497-518; Andrzej Wrobel, "Regional Analysis and the Geographic Concept of Region", Papers of the Regional Science Association, Vol.8 (1962), pp.37-41.
  2. August Lösch, "The Nature of Economic Regions", Southern Economic Journal, Vol.5 (1938), p.71.
  3. See : Rutledge Vining, "The Region as an Economic Entity and Certain Variations to be Observed in the Study of Systems of Regions", American Economic Review, Vol.39 (1949), pp.89-119; "The Region as a Concept in Business Cycle Analysis", Econometrica, Vol.14(1946)pp. 201-218; "Delimitation of Economic Areas : Statistical Conceptions in the Study of the Spatial Structure of an Economic System", Journal of the American Statistical Association, Vol.48 (1953), pp.44-64; "On Describing the Structure and Development of a Human Population System", Journal of Form Economics, Vol.41(1959), pp.922-42.

best disaggregated into sets of functional economic regions. There has also been much support for the belief that central place theory provides the most appropriate conception framework for doing this.<sup>1.</sup>

Settlements and their complementary areas form functional regions and these belong to a hierarchical system, in which the smallest settlements and their service areas constitute the lowest stratum and the national metropolis and economy the highest. Thus, each region, with the exception of one of the very lowest order, is composed of other regions, and the system as a whole embraces the entire national space-economy. Places within an individual region are bound together by linkages developed through the service industries, which rely on local support and cater for local demand, and thereby promote spatial organisation at a local level. The role of manufacturing industries and of agriculture is less important in this respect. While they employ local labour and some other local resources, they also draw capital and materials from distant places. Above all, they usually rely on non-local markets. Consequently, these activities may not foster regional organisation below the national level.

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1. Lösch, op.cit., pp.71-78;  
Allen K. Philbrick, "Principles of Areal Functional Organization in Regional Human Geography", Economic Geography, Vol.33 (1957), pp.299-36;  
Brian J.L. Berry, "Cities as Systems within Systems of Cities", Chap.6 in Friedmann and Alonso, op.cit. pp. 116-37, and "Research Frontiers in Urban Geography", Chap.11 in The Study of Urbanization, ed. Philip M. Hauser and Leo.F. Schnore, New York, 1965, pp.404-408.



In principle, then, the definition of Teesside that is most suitable for the present study includes the functional economic regions which had the main towns of the area as their respective centres. It is therefore an amalgam of the regions containing Middlesbrough, Darlington, Stockton and the Hartlepoons, which in turn embraced lower-order regions based on the hamlets and villages subordinate to the main towns. A further point worthy of mention is that regional boundaries change with time. As towns grow and decline in commercial stature, their tributary areas expand and contract. The Teesside region is therefore likely to cover a rather different area at one date than at another.

There are also operational problems to be overcome in defining functional regions, and in many cases these are sufficient to warrant the conclusion that theory is far in advance of what can be achieved in practice. The first requirement is an acceptable method of assigning places to their respective regions. Some studies have used information concerning shopping habits, collected through questionnaires, for this purpose,<sup>1</sup> but this is obviously impracticable in a historical context. In Britain, recourse has often been had to more indirect guides to regional

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1. Eg. see Brian J.L. Berry, H. Gardiner Barnum, and Robert J. Tennant, "Retail Location and Consumer Behaviour", Papers of the Regional Science Association, Vol.9 (1962), pp.65-106.

organisation, such as the provision of bus services.<sup>1</sup> For the present study it was decided, after consideration of various alternatives, that road carrier services offered the best indication available of the pattern of regional linkages in the mid-nineteenth century, though they are not without limitations.

A brief comment on the role of road carriers and their place in the transport system is appropriate at this point. One outstanding feature of the road transport industry as a whole on Teesside in the mid-nineteenth century was that it was essentially organised to cater for the demand for local transportation. Neither goods nor people moved long distances by road at that time, and very little of the road traffic generated in the area passed beyond the county boundaries of Durham and the North Riding of Yorkshire. This was largely a result of fierce competition from the railways and, to a lesser extent, coastal shipping, which had deeply undermined the traditional pattern of transportation. As late as 1840 coach journeys could be made from Darlington to London or Edinburgh<sup>2</sup>, but in 1851 this was no longer possible<sup>3</sup>. Similarly, the large and lumb-

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1. Eg. F.H.W. Green, "Community of Interest Areas : Notes on the Hierarchy of Central Places and Their Hinterlands", Economic Geography, Vol.34 (1958), pp.210-26, "Bus Services as an Index to Changing Urban Hinterlands", Town Planning Review, Vol.32 (1952), pp.345-56, "Urban Hinterlands in England and Wales : An Analysis of Bus Services", Geographical Journal, Vol.116 (1950), pp.64-81; R.J. Johnston, "An Index of Accessibility and its Use in the Study of Bus Services and Settlement Patterns", Tijdschrift voor Economische en Sociale Geografie, No.1 (1966), pp.33-38.

2. Charles G. Harper, The Great North Road : The Old Mail Road to Scotland, London, 1901, p.68.

3. Evidence from directories referred to below.

ering stage-waggons had by then ceased to be an important medium for carrying goods overland.<sup>1</sup> Nevertheless, the road transport industry was in a state of flux rather than decline; for there were new opportunities awaiting it in the field of local transportation.

In some areas, of course, there had been little change. Contemporary accounts indicate, for example, that trains of pack-animals were used in North Yorkshire until quite late in the nineteenth century. Canon Atkinson, who spent fifty years as the incumbent of Danby and was a local historian of some renown, recalled that panniermen, with their strings of horses and mules, were responsible for distributing Durham coal through much of Cleveland in 1852, as indeed they had been for at least four centuries.<sup>2</sup> Another contemporary observer noted that for a long time after the completion of the railway between Darlington and York, in 1841, droves of asses laden with coal from Durham could be seen regularly in the Northallerton area, wending their way into the moorland dales.<sup>3</sup> In Northallerton itself, it was normal to see thirty or forty carts standing in the market place every Wednesday and Saturday, their drivers selling the coal they had brought from Durham.<sup>4</sup> Later still, Sewell

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1. John W. Wardell, A Short History of Stockton-on-Tees, Yarm, 1962, p.17.
  2. Anon., "Ecclesiastical Middlesbrough in Medieval Times", Yorkshire Archaeological Journal, Vol.18 (1904-1905)p.70.
  3. J.L. Saywell, The History and Annals of Northallerton, Yorkshire, London, 1885, p.160.
  4. Loc.cit.

records that coal was brought to Helmsley by Durham panniermen even in 1869.<sup>1</sup>

The road carriers, however, were engaged in a different type of work. They had regular routes and schedules to keep, and they were concerned with the transportation of general merchandise and passengers. On Teesside, in the middle of the nineteenth century, the great majority of carriers operated within a fifteen-mile radius of Stockton and Darlington, then the largest towns, but a few had longer routes. The latter reached as far afield as Newcastle, Sunderland, Whitby, Richmond, Northallerton and Thirsk.<sup>2</sup> Over such comparatively long distances, competition from the railways, where they had been built, must have been quite intense. For survival, the road carriers may well have relied upon obtaining series of short-haul loads, collected from and delivered to places en route. This would have made them more able to withstand competition, but, even so, the long-distance routes were essentially a relic of the pre-railway era.

Most of the carriers operating in the Teesside area, as already remarked, used Stockton or Darlington as their base and had a relatively small area of activity. In 1851, for

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1. J.T. Sewell, Account of Some Medieval Roads Crossing the Moors South of Whitby, Whitby, 1923, p.18.
  2. Information relating to carrier schedules in 1851 has been taken from:  
Robert Ward, Ward's North of England Directory, Newcastle upon Tyne, 1851.

example, 36 carriers were scheduled to make a total of 76 journeys each week from Stockton, and 71 per cent of those trips terminated within 15 miles of their point of origin. Similarly, 83 per cent of the 24 weekly journeys made from Darlington were to places no more than 15 miles away. These figures give substance to the claim that the road carriers were essentially short-distance hauliers by that time. Most were able to make a return journey in one day.

In 1851, more than half the services from Stockton and from Darlington were scheduled to depart during the afternoons of market days, Wednesday and Saturday in the first case and Monday and Friday in the second. Thus, a substantial part of the outgoing carrier traffic was generated on market days, and can in fact be attributed to the holding of markets. It was normal for the carriers to collect people from the outlying districts and take them into the towns in the morning, and return them later in the day. Passengers were also carried during the remainder of the week, but goods and parcels were then more important.

Although railway development had undoubtedly undermined the road haulage industry at many points by 1851, the local carriers still provided a service of great importance to the economic life of Teesside. On the whole it is doubtful whether they had suffered lasting damage from the growth of railway competition, though they had been obliged to adjust their modes of operation. The railway system was neither

complete nor self-contained, and by concentrating on local routes the road carriers were able to find ample scope for supplementing the railways where lines had yet to be built, and for complementing them where 'feeder' services were required.<sup>1</sup> In general,

goods that had formerly moved by long-distance stage-waggon now went by rail, and road-carriers concentrated their activities on feeder services to the railways or on providing special local services for manufacturers or traders.<sup>2</sup>

Within the Teesside area, while there must have been carriers who augmented the railway system by collecting goods and taking them to or distributing them from railway depots, those working to fixed and publicised schedules were independent hauliers providing an alternative service. Some operated on routes through areas which were still unserved by rail, as in the moorland district of North Yorkshire, but there were others who were in direct competition with the railway companies. For example, two road carriers made daily return journeys between Stockton and Middlesbrough in 1851, despite the long-established rail connection between those two towns.

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1. See W.T. Jackman, The Development of Transportation in Modern England, 2nd. ed. (rev.), London, 1962, Chap.9.
  2. Christopher I. Savage, An Economic History of Transport, 2nd ed. (rev.), London, 1966, p.87.

Paradoxically, in view of their reliance upon animal as opposed to mechanical horse-power, the road carriers may well have been able, in favourable circumstances, to transport goods more speedily than the railway companies. This would partially account for their ability to withstand direct competition from the latter. In terms of their capacity to cover a given distance in a certain time, the carriers were obviously slow. The speed of road vehicles varied with surface conditions, length of journey, size and weight of load, as well as type of vehicle, but even the fastest - the special 'fly vans' designed to carry perishable commodities - do not appear to have been able to travel much more than 5 miles per hour on good roads.<sup>1</sup> The clumsy stage-waggon, drawn by teams of up to twelve horses, were appreciably slower and in rugged terrain, such as that between Manchester and Sheffield, 1 mile per hour was normal.<sup>2</sup> An estimate of 2½ miles per hour is therefore probably a good approximation to the average rate of progress of general goods vehicles in normal conditions.<sup>3</sup>

However, while goods could be moved faster by rail once they were in transit, they had first to be collected and later delivered by road, and these were time-consuming

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1. Jackman, op.cit., pp.346-47.

2. Loc. cit.

3. Loc. cit.

operations that broke the journey into three stages and were quite capable of doubling the total time involved. Road hauliers loaded and unloaded goods just once, since they were able to collect and deliver them directly. Particularly over short distances, this gave them an advantage over the railways.

The small scale of the carrier unit and the flexibility with which it could be used were further compensations for its low speed. The road carrier could thrive on loads too small to be viable for the railway companies, which obviously required large volumes of goods, and he could adjust his route to probe for gaps in the railway network.<sup>1</sup> To these economic factors favouring the survival of the road carrier should be added social considerations. He offered a more personal service than his rivals, and in rural districts often acted as a postman as well as a haulier. Especially in the remote moorland parishes, the carrier's visits were important events in people's daily lives, bringing news of places far enough away to be seldom frequented before the days of cheap travel.<sup>2</sup>

There are grounds, therefore, for arguing that the provision of carrier services in the nineteenth century

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1. G.C. Dickinson found that this was also true for coaching firms. See his "Stage-Coach Services in the West Riding of Yorkshire between 1830 and 1840", Journal of Transport History, Vol.4 (1959-60), p.3.
  2. See J. and R. Fairfax - Blakeborough, The Spirit of Yorkshire, London, 1954, p.57.



reflected the economic regionalization of comparatively small areas quite closely. By the middle of the century, on Teesside as well as in other parts of the country where railway development had virtually destroyed the traditional system of road transport, the carriers were of little importance as links between regional centres of higher than village or small-town status. Rather, they served to connect the larger settlements with their rural service areas, a task for which railways were not well suited, since they were widely spaced and of value in this context mainly to fairly narrow corridors adjacent to them.

In North East England, at least, railways were built to facilitate long-distance communication and the movement of heavy, bulky materials, such as coal and iron ore. The local transportation of general merchandise and people was a secondary consideration. Even in 1871, for example, the North Eastern Railway Company did not provide passenger trains on its line from Middlesbrough for the mining communities to the east of Guisborough<sup>1</sup>, despite the growth of population in that area. Nor was much thought given to the possibility of encouraging passenger traffic by reducing the higher cost of railway travel.<sup>2</sup> Most people consequently

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1. Information from : North Eastern Railway, Northern Division, "Working Time Table, January 1st, 1871" - in the Archives of the British Transport Commission at York.
  2. Railway fares were generally little lower than coach fares. See Dickinson, op.cit., p.5; and Jackman, op.cit., pp.608-609.

preferred, or were obliged, to either walk or use the carrier's cart on their local journeying.

To delimit the Teesside region, use was made of the timetables for local road carriers. Places visited by carriers from the main towns were included in the region, unless they were substantial enough to qualify as alternative regional centres of comparable stature to those on Teesside. The most distant of the places included were regarded as points marking the outer limit of the region, and between them the boundary was drawn by interpolation.<sup>1</sup> Parts of the peripheral zone were visited by carriers from, and thus shared with, other regional centres, such as Durham, but this type of overlapping appears to be a normal feature of regional organisation in the real world.<sup>2</sup>

The data used were drawn from local trade directories, publications which have certain limitations.<sup>3</sup> Standards of accuracy varied considerably between companies, some of which made exhaustive field surveys, while others were content to plagiarise their findings. The question of time also influenced the degree of accuracy. Directories were primarily commercial publications, and there was a good

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1. Rather than direct lines between places, parish boundaries were followed.
  2. Hence the concept of 'dominant flows' used by Nystuen and Dacey, op.cit.
  3. See Jane E. Norton, Guide to the National and Provincial Directories of England and Wales, Excluding London, Published Before 1856, London, 1950, pp.241.

deal of pressure on editors to be the first to publish and to have the most recent information. As a result, they usually attempted to forestall criticism by pleading haste in preparation as an excuse for inaccuracy. By 1850, however, there were fewer companies engaged in this field than had been the case earlier, and many of the survivors had earned national repute for the quality of their work. Directories published after that date are therefore considered to be comparatively reliable in general.<sup>1</sup> At least, the carrier schedules must be accurate; otherwise they would not have been of much value.<sup>2</sup>

Maps showing the regional boundary were constructed for 1851, 1861, 1873 and 1879, and they have been superimposed on each other in Figure 2.1.<sup>3</sup> From this, it can be seen that the boundary appears to have altered over time, and to have encompassed a larger area in the two later years. This is as would be expected, in view of the development of the main towns after 1851, but it does raise a conceptual

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1. Ibid, p.15.

2. Dickinson (op.cit., p.3) maintains that coaching timetables must have been accurate for the same reason.

3. The directories used were:  
Robert Ward, Ward's North of England Directory, Newcastle upon Tyne, 1851;  
Isaac Slater, Slater's Royal National Commercial Directory of the Northern Counties, Manchester, 1861;  
E.R. Kelly, The Post Office Directory of the County of Durham and the Principal Towns and Adjacent Places of Northumberland, London, 1873;  
E.R. Kelly, The Post Office Directory of Durham and Northumberland, London, 1879;  
E.R. Kelly, The Post Office Directory of the North and East Ridings of Yorkshire, London, 1879.

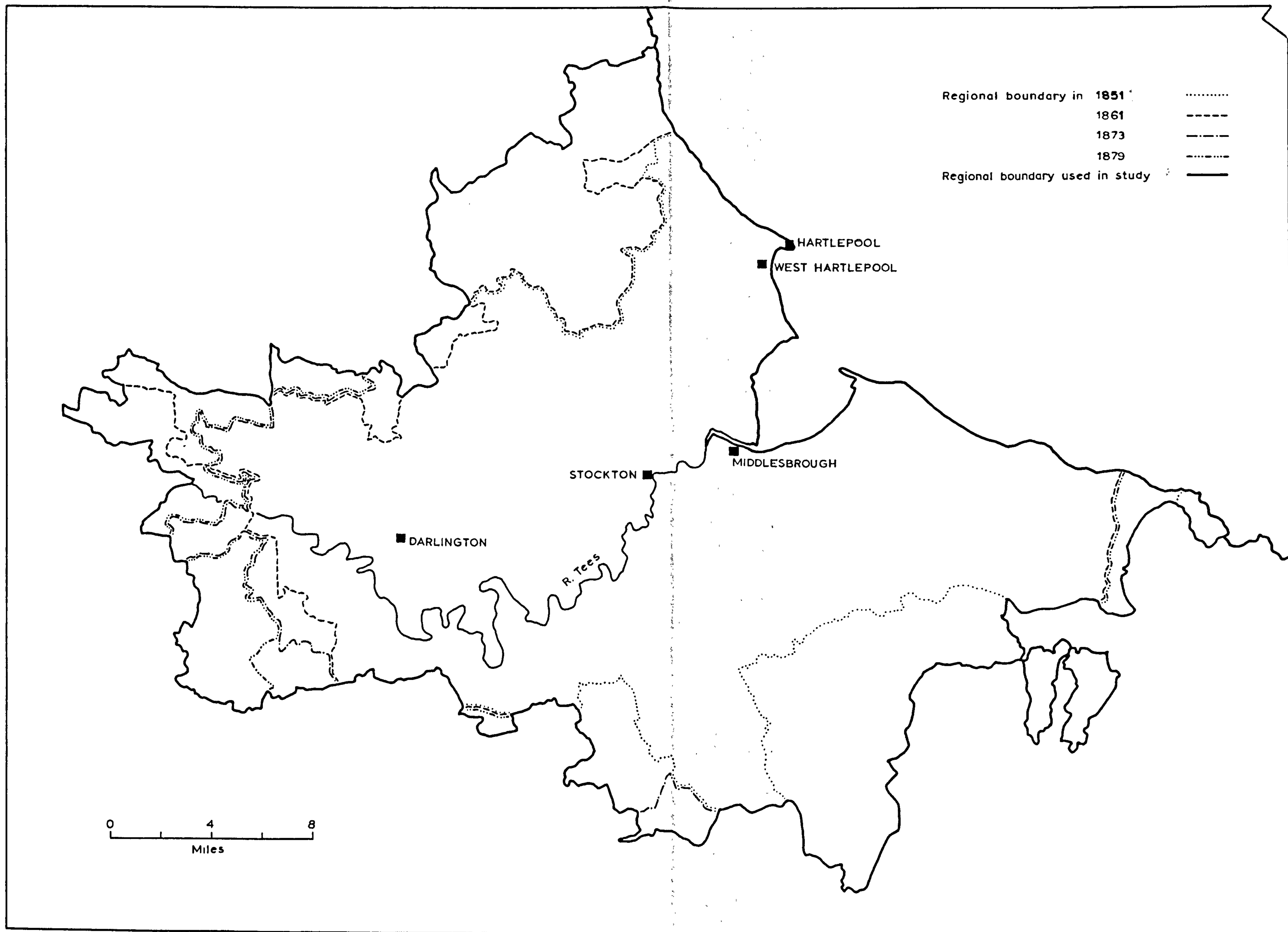


Figure 2.1 Boundary of the Teesside Region

problem. Since the study is concerned with spatial change over time, it is for many purposes necessary to have a constant base area. For this reason, the boundaries displayed in Figure 2.1 have been amalgamated, and all places that were within the region at any time between 1851 and 1879 have been included in the final definition of Teesside.

It is worth noting, however, that the boundary for 1851 is not very much different from that for 1879. This appears to be due to the nature of the index of regional organisation which was adopted. A town may act as a regional centre at more than one scale simultaneously, and while the provision of road carrier services probably reflected the maximum range of influence of the main Teesside towns very closely in 1851, it is unlikely that this was still the case in 1879. By then, the larger towns must have been operating as regional centres not only at their original levels, as indicated by the carrier traffic, but also at higher scales, dominating other and more distant places which had once been their equals in commercial status. The latter, however, would be revealed not by the road carrier schedules, but by the movement of goods and people by rail, and perhaps by less tangible linkages.

The matter has not been pursued, partly because adequate data could not be obtained but also because for most purposes of the present study it is necessary to have a constant area, in order that legitimate comparisons can be

made of various spatial distributions over time. Hence, a low-order definition of the region has been adopted for 1879 to maintain comparability with 1851. Similarly, to ensure a constant area, a composite boundary has been adopted. This is open to methodological objections, but in defence it is submitted that the practical effects are likely to be slight. The final definition of the region probably matches the economic organisation of the Teesside area, at a certain scale, fairly closely at both beginning and end of the period.

### CHAPTER THREE

#### THE THEORETICAL FRAMEWORK FOR SPATIAL ECONOMIC GROWTH

The study of economic growth has been much in vogue in recent years, partly, if not largely, as a result of the emergence and acceptance of economic planning, in one form or another, as part of the legitimate apparatus of government throughout much of the world. The promotion of economic growth is the main object of planning, and with the development of the latter, there has arisen a deeper interest in - and indeed a greater need to understand - the nature of the former. There has consequently been a proliferation of theoretical and empirical studies of economic development, but it is arguable that the spatial aspects of this process have been somewhat neglected.<sup>1</sup>

An economy has a spatial as well as a sectoral structure, and the role of places and areas is quite as significant as that of industries in the initiation and transmission of economic growth. Indeed, growth may justifiably be regarded as an areal process, and as such it is

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1. Eg. see D.E. Keeble, "Models of Economic Development", Chap. 8 in Models in Geography, ed. R.J. Chorley and P. Haggett, London, 1967; and Norton Ginsburg (ed.), Essays on Geography and Economic Development, "Department of Geography Research Papers", No.62 (1960), University of Chicago, Introduction.

capable of effecting profound changes in the spatial structure of an economy.<sup>1</sup> This is significant in a practical as well as a theoretical context. Economic inequalities between the regions of a country are today a pressing concern of central government. Where differences in living standards are bolstered by differential growth rates, they can be the cause of resentment and political disaffection, even to the point of encouraging the formation of separatist movements, in the less favoured regions. In many cases, the amelioration of economic inequalities between regions may be more crucial to national unity than the removal of gross discrepancies between social classes. On the other hand, governments cannot afford to alienate the richer regions by adopting equalization policies that impose too heavy a burden on them.

Despite the urgency of these issues, it is only comparatively recently - mainly within the past decade - that the spatial aspects of economic growth have attracted much interest. The reasons for the neglect of such an important topic are undoubtedly complex, but they appear to owe much to the traditional character and preoccupations of the academic disciplines most closely involved with it. Rather surprisingly, for members of a profession with an explicit

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1. See John Friedmann, The Spatial Structure of Economic Development in the Tennessee Valley : A Study in Regional Planning, Chicago, 1955, pp.1-4.



interest in spatial phenomena, economic geographers have contributed very little of conceptual value to the study of economic growth,<sup>1</sup> whether it is viewed as a spatial process or otherwise. Their frequent interest in particular industries or areas that happen to be expanding or declining economically cannot be equated with an interest in the growth process as such.

Keeble has suggested that the relative isolation of geographers, as a group, and their predominantly idiographic outlook have limited their concern with economic development. These factors have meant that geographers have not shared as fully as they might have done in the mounting tide of interest in the subject, and that they have tended to concentrate on the uniqueness of the experience of individual areas. It might also be argued that geography has traditionally been biased towards the study of pattern rather than process,<sup>3</sup> and that the effects of economic growth have consequently received more attention than the process itself. While pattern and process may well be dualistic, as Bunge maintains,<sup>4</sup> only a limited

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1. Ginsburg, op.cit., pp.vii-xx; and Keeble, op.cit.; p.243.
  2. Keeble, op.cit., pp.243-45.
  3. Edward A. Ackerman, Geography as a Fundamental Research Discipline, "Department of Geography Research Papers", University of Chicago, No.53, 1958, pp.18-20.
  4. William Bunge, Theoretical Geography, Lund, 1966, pp.18-20.

form of understanding can emerge from the study of one without the other.<sup>1.</sup>

Economists, on the other hand, are obviously more deeply committed to the analysis of economic growth, and, despite the recency of their interest in this aspect,<sup>2.</sup> they have contributed most of what is known of growth as a spatial process. Their increasing concern with the latter subject has coincided with a more general trend which has sought to admit the spatial dimension to economic theory as a whole.<sup>3.</sup> The emergence of regional science has been part symptom and part cause of this trend. Even so, the space-economy is seen by regional scientists mainly through static location theories, which leave much to be desired as media for the study of the dynamics of economic growth.<sup>4.</sup>

#### A Conceptual Framework.

In a very general sense, economic growth may be said to have occurred when the real total income or product of an economic system has risen over a period of years longer

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1. Ackerman, op.cit., p.18.
  2. Keeble, op.cit., pp.245-48.
  3. See Robert E. Kuenne, The Theory of General Economic Equilibrium, Princeton, New Jersey, 1963, Chap.7.
  4. See Walter Isard, Location and Space-Economy, Cambridge, Massachusetts, 1956, p.viii.

than the duration of a business cycle.<sup>1</sup> Cyclical variations are of secondary importance; it is the underlying long-term trend that is significant.<sup>2</sup> Usually, however, economic growth is given a more restricted definition, and per capita real income is substituted for total real income. Basically, this is because the concept of economic development, is associated with the ideal of 'human progress', and growth which leaves people without any improvement in their standard of living - which is possible if movements in total income are adopted as the measure<sup>3</sup> - does not correspond with the generally accepted interpretation of progress. In short, the notion of welfare is involved.

Per capita real income can itself be criticised in this context. While it may rise, whether or not such a movement is reflected in living standards depends upon the political and social structure of the economy concerned. It may be the case that the great bulk of the population is unaffected, either because capital investment takes precedence over consumer welfare or because a small part of the society is in a position to appropriate the additional wealth created. Again, the equation of individual

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1. This definition is used by Gerald M. Meier and Robert E. Baldwin in their Economic Development : Theory, History and Policy, New York, 1957, p.2.
  2. Thus it is the change in income between two or more cycles at the same stage, rather than within one cycle, which should be measured.
  3. Growth of total income may simply result from an increase in the size of the population and of the labour force.

welfare with the level of per capita income requires the exercise of value - judgements that may not be warranted. Hence, the level of per capita real income is not a reliable guide to either the standard of living or human welfare.<sup>1</sup>.

In many ways, real per capita output is the most satisfactory index to economic growth.<sup>2</sup> Use of it avoids the confusion over standards of living and welfare that bedevils the per capita income measure, and also obviates the assumption that the different strata of society share proportionately any increase in wealth. At the same time, however, it is an index that is not entirely unrelated to living standards, since any improvement in them must be based on a rise in per capita output. An increase in output per head provides the opportunity for an increase in the standard of living; whether or not the latter occurs is determined largely by political circumstances.

Another advantage of the per capita output index is that it eliminates the population variable, which is essentially fortuitous in an economic sense. Whereas an increase in total output may simply reflect population expansion, a rise in per capita output, or productivity, "... occurs only when men are more efficient in exploiting the resources at their command."<sup>3</sup> It is, therefore, the result of

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1. See Meier and Bandlwin, op.cit., pp.2-10; and Richard Hartshorne, "Geography and Economic Growth," chap.1 in Ginsburg, op.cit., pp.5-13.

2. R.M. Hartwell, "Introduction" to The Causes of the Industrial Revolution in England, ed. R.M. Hartwell, London, 1967, p.8.

3. Loc.cit.

fundamental economic change. Potentially, at least, rising productivity offers the key to a radical transformation of human society. Hence, it is to be preferred as the measure of economic growth.

The precise details of the mechanism responsible for economic growth in a particular area are a matter for empirical investigation. The major elements may however be classified into two groups; those affecting demand conditions and those affecting the supply of factors of production. The first category includes market expansion, rising incomes, changes in the social distribution of purchasing power, and matters of taste and fashion. Factor supplies are affected by innovations in technique and organisation, capital accumulation, resource discovery, and improvements in the skill and education of the labour force.<sup>1</sup>

In a static economy growth is usually stimulated by changes in, or affecting, one sector or even a single industry.<sup>2</sup> Clearly, there must be a rise in productivity and, if full employment at the outset is assumed, this requires improvements in production technology and, or, organisation. These could be prompted by an expansion of demand which made possible greater scale economies, by

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1. Meier and Baldwin, op.cit., pp.2-3.

2. According to W.W. Rostow, at least. His basic thesis is that conditions tend to favour one group of industries, the 'leading sector', at a given time. See his "Leading Sectors and the Take-off", Chap.1 in The Economics of Take-Off into Sustained Growth, ed. W.W. Rostow, London, 1963.

invention and innovation which lowered unit costs, or by changes in any of the other demand and supply conditions listed above. A necessary qualification is that for overall economic growth to take place, productivity increases should not be matched by growing unemployment resulting from them.

As well as favouring particular industries, or groups of industries, changes which stimulate economic growth also tend to favour certain places and areas within the space-economy. In the case of a manufacturing industry bound by locational considerations to the source of a raw material, rising productivity and expansion of output will secure economic growth in the area containing that material. Due to the differential quality of locations within the space-economy, initial growth is likely to occur in a relatively small area or at a small number of places, especially when it is attributable to the manufacturing sector. At an extreme, there may be but one initial growth point.

In favourable circumstances, the growth impulse may be transmitted quickly to other industries and areas. Those linked directly to the original growth point, as suppliers of materials and other inputs or as markets for its products, are likely to benefit first, if not most. Input suppliers will have the assistance of a larger market, and possibly greater scale economies. Output consumers will receive cheaper and larger supplies of the good in question. Both, in common with laterally - connected industries and

areas,<sup>1</sup> will benefit from the more general consequences of economic growth, such as the development of the infrastructure and the emergence of a more affluent and skilled population.

The speed and extent with which growth and its effects are diffused through the economy varies with the degree of integration present. At one extreme, it is possible for events affecting one industry or area to be without consequence elsewhere in the economy; at the other, the entire economy may be transformed as a result of development at one point. The first of these hypothetical cases is perhaps best exemplified by the 'colonial-type' economy, where plantation agriculture or mining projects exist as oases of modern development within a traditional and stagnant economic matrix. Capital, enterprise, equipment and even labour may all be of foreign origin, while the land has been obtained either through confiscation or the payment of a nominal sum of money. Such ventures rely entirely, or nearly so, on overseas markets, and both products and profits are exported. There is thus very little contact with either the indigenous society or economy, with the result that the development of these oases has slight significance for the economic systems in which they are embedded.<sup>2</sup>

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1. Rostow (ibid., pp.3-7) identifies three groups of "spreading effects" - backward, lateral and forward - which correspond with the stimuli to suppliers, industries offering general services and facilities, and consumers.

2. See J.N. Tattersall, "Exports and Economic Growth : The Pacific Northwest, 1880 to 1960", Papers and Proceedings of the Regional Science Association, Vol.9 (1962), pp.215-34.

On the other hand, there is the opposite extreme of a well-integrated modern economy, in which the slightest tremor of change reverberates throughout the entire system. Specialization is intense and characteristic, with each industry dependent on a host of others for its inputs, and possibly its markets too, and with each place or area holding direct and indirect links with a great many others.

In this case, few industries and locations will escape the effects of growth at some point within the economy. Even when growth is widespread, however, its speed varies spatially. Some areas contain industries which are slow to respond to new opportunities, or have little scope for expansion. In any given period, moreover, some industries are growth leaders, while others must await events outside their powers to influence. Spatially, these differences are reflected in the conventional contrasts drawn between rich and poor countries, growing and lagging regions, and urban prosperity and rural poverty, generalizations which serve as reminders that differentiation occurs at a variety of scales.

#### Spatial Equilibrium.

In an expanding economic system, the likely future prospects of individual regions, or of parts of one region, are a somewhat controversial subject. The debate has been waged at both theoretical and empirical levels, and there has been a general polarization of views into two schools of thought. In this section the arguments of proponents



of the spatial equilibrium or equalization model are examined. Regional inequality, it is held by this school, is a temporary state. Theoretically, at least, differences in per capita incomes - the usual measure employed - will eventually be removed through the workings of the free trade mechanism and the mobility of the factors of production. This case is based on the general equilibrium theory of world trade,<sup>1</sup> which was originally formulated to apply at the international level but is in principle equally suitable for analysis at the regional scale. Although ideal conditions are not obtained in the real world, there are degrees of free trade and factor mobility, and hence there should be a tendency for regional income levels to converge.<sup>2</sup> Some empirical support for this view has been adduced, but not enough to satisfy critics.<sup>3</sup>

Equilibrium, or equalization, is achieved through the operation of a process which is relatively simple in principle.<sup>4</sup> At the international scale, free trade encourages individual countries to specialize in the production of those goods for which they hold a comparative advantage.

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1. See Keeble, op.cit., p.257; and John Friedmann, Regional Development Policy ; A Case Study of Venezuela, Cambridge, Massachusetts, 1966, p.14.
  2. Keeble, op.cit., p.264.
  3. See Seymour E. Harris, International and Interregional Economics, New York, 1957, Part 1; and Richard E. Caves, Trade and Economic Structure : Models and Methods, Cambridge, Massachusetts, 1960, Chap.2.
  4. The following works have detailed presentations of spatial equilibrium theory:  
Caves, op.cit.; Harris, op.cit.; Paul A. Samuelson, "International Trade and the Equalization of Factor Prices," Economic Journal, Vol.58 (1948), pp.163-84.

As a result, an optimal pattern emerges in which each country can maximize its returns. The only goods produced locally are those which cannot be obtained more cheaply from elsewhere; the remainder are imported. Free trade, incidentally, ensures that the price of a commodity does not vary between countries, since consumers are prepared to pay no more than the lowest price at which it is offered.

Similarly, there will be no differences between countries in the prices paid to the factors of production. If one country has relatively large supplies of labour but scarce capital reserves, then labour will command a low price and capital a high one. This situation will encourage the production of goods which require large labour and small capital inputs. Hence, labour will become less plentiful and more costly, and ultimately it will receive the same payment as in other countries. Conversely, the demand for capital will decrease, as labour inputs are substituted for it, and its price too will reach a normal level.

Factor-price equalization is also attainable through the mobility of labour and capital, without free trade. Assuming that there is an absence of international barriers and restraints, factors will migrate between countries, in accordance with price gradients, to maximize their returns. Ultimately, the demand-supply mechanism will ensure international price parity, and the system will be

in equilibrium. Equilibrium can also be reached through some combination of trade and factor mobility, with the two processes working in parallel.

Obviously, this theoretical model is based upon certain assumed conditions which are very idealistic. Free trade and perfect factor mobility are two such conditions.<sup>1.</sup> Another is that factors are qualitatively homogeneous everywhere : that labour in one country, for example, is economically equivalent to labour in another.<sup>2.</sup> The more formal statements of the theory have in fact been accompanied by explicit statements of the limiting conditions assumed to obtain. Thus, Samuelson has provided a mathematical proof of the equalization theorem<sup>3.</sup> which assumes

... free trade, no transportation costs, pure competition in all markets, homogeneous production functions (no economies of scale), and the fact that all commodities are produced in ... [all] countries.<sup>4.</sup>

These are, indeed, "... very restrictive assumptions!"<sup>5.</sup>

In a paper concerned with the equalization of interest rates through trade, Samuelson went so far as to say : "... I have

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1. See Caves, op.cit., pp.93-101.

2. Loc.cit.

3. Paul A. Samuelson, "International Factor-Price Equalization Once Again," Economic Journal, Vol.59 (1949), pp.181-97.

4. Harris, op.cit., pp.53-54.

5. Loc.cit.

no desire to persuade anyone into believing that the following simple models leading to factor price equalization are realistic."<sup>1</sup>.

Nevertheless, the worth of a model lies not in the degree of abstraction necessary to its formulation, but in its capacity to further understanding by isolating and emphasising fundamental components and relationships of reality.<sup>2</sup> Objections to the spatial equilibrium model are generally based on the apparent lack of correspondence between its theoretical implications and observations that have been made empirically. Whereas the convergence of regional per capita income levels ought to be the norm, it has been noted that in many cases there is a marked tendency for international and inter-regional disparities to increase with time.<sup>3</sup>

This contradiction has been interpreted variously. One view is that while the model is fundamentally sound, it does not allow sufficiently for the capacity of disequilibrating forces to delay the convergence of income levels. Indeed, the model is not at all explicit on the subject of how long a period is necessary for equalization to occur.

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1. Paul A. Samuelson, "Equalization by Trade of the Interest Rate Along With the Real Wage", in Growth and the Balance of Payments : Essays in Honor of Gottfried Haberler, ed. Robert E. Baldwin et.al. Chicago, 1965, p.36.
  2. See P. Haggett and R.J. Chorley, "Models, Paradigms and the New Geography", chap.1 in Models in Geography, op.cit., pp.19-41.
  3. Keeble, op.cit., pp.257-58.

There may also be some justification for the view that conditions are now much less conducive to equalization than they were in the nineteenth century, when there were fewer political barriers to international trade and to movements of labour and capital.<sup>1</sup> While conceding that equilibrium is a long-term possibility, some economists hold that the model has little practical significance. The problems associated with income inequality are so immediate and pressing, it is argued, that to counsel underdeveloped areas to await patiently long-term, and largely hypothetical, compensatory adjustments is akin to advocating the fatalism and lethargy of which they are often accused in the first place.<sup>2</sup>

#### Spatial Disequilibrium.

Some critics have concluded that the spatial equilibrium model is inadequate even in theory, because of its idealized conditions and the exclusion of dynamic elements.<sup>3</sup> In its stead, a number of conceptual models have been proposed which assume that regional inequality is actually the norm under free market conditions. The terminology used varies, but the fundamental concept that is common to most of the models is that of the dualistic 'centre-periphery'

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1. Harris, op.cit., part 4.

2. Friedmann, Regional Development Policy . . . . .  
op.cit., pp.13-19.

3. Loc.cit.

structure.<sup>1</sup> Growth is recognised to be spatially uneven, and a developing economy typically includes a centre of rapid, intensive growth and a periphery which is stagnant or declining. Empirical support for this simple descriptive thesis is impressive :

World, continent, nation, and city - the centre-periphery hypothesis appears on all the relevant scales of explanation simultaneously as cause and as effect of economic transformation.<sup>2</sup>

However, the concept is not only a descriptive device; for it does offer some explanation of unequal spatial growth. A centre, once established, possesses considerable advantages over the periphery and is therefore likely to retain its leading position. The periphery lies in the economic shadow of the centre, and may consequently be at a permanent disadvantage. Regional inequality therefore tends to be self-perpetuating rather than a temporary state of maladjustment.<sup>3</sup>

The spatial disequilibrium model developed by Myrdal was one of the earlier examples of its type.<sup>4</sup> It has occupied a place of great importance in the literature on the

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1. Ibid., pp.10-13; and D.F. Darwent, "Growth Poles and Growth Centres in Regional Planning - A Review", Environment and Planning, Vol.1 (1969), pp.16-19.
  2. Friedmann, Regional Policy ..., op.cit., p.12.
  3. Keeble, op.cit., p.271.
  4. Gunnar Myrdal, Economic Theory and Under-Developed Regions, London, 1957, 168 pp.

subject and therefore has been selected for examination here. Myrdal states quite categorically that the income disparities between regions will increase, not decrease, if left to the free play of market forces. Equalization, he argues, can only occur through government intervention.

In a relatively free economy, according to this view, changes favouring the development of one region breed additional supporting, not counteracting, changes. This process of amplification is termed 'cumulative causation' by Myrdal.<sup>1</sup> The advantages derived from cumulative causation are largely the product of agglomeration economies, those internal and external economies of scale that result from growth at a particular point within the economic system. To these, however, should be added extra-economic factors.<sup>2</sup> For example, expanding regions can afford to invest more capital and other resources in social provisions, including health and educational services, which increase their initial advantages and contribute to further improvements in economic performance. There are also less tangible benefits resulting from success itself, such as a high repute for local products and the bolstering of entrepreneurial confidence. All these, and other, factors tend to favour sustained growth.

Myrdal maintains that cumulative causation, as a cause

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1. Ibid., p.13.

2. Albert O. Hirschman provides a good description of what might be termed the 'psychology of growth'. See his The Strategy of Economic Development, New Haven, 1958, chap.10.

of differential spatial growth, is supported by trade and by factor mobility, the mechanisms to which the neoclassical model looks for the correction of any imbalance. In his view, capital migration to the growth centre, for example, does not necessarily lead to the lowering of the price of capital at that point. If growth is sufficiently vigorous, even very large inflows of capital may leave demand and price at a high level. Moreover, the price of capital in the periphery will only rise if there is sufficient demand there for it, and the concentration of development projects in the centre makes this unlikely. There is, therefore, no inherent reason why the flow of capital to the centre should be reversed.

Similarly, labour movements may also leave the price differentials between growing and lagging regions intact. Economic growth at the centre may well lead to the creation of extra employment capacity at a higher rate than can be met by immigration. Thus, the demand for labour will continue to rise, and the price differentials between the centre and the periphery will remain. Migration will also tend to benefit the centre at the expense of the periphery, since it is a selective process which involves the young, the ambitious, the better educated, and the more skilled members of a community. Large-scale emigration from a lagging region will consequently add to the latter's difficulties.



Finally, it is maintained, free trade is positively harmful to backward areas. They find it difficult to compete with the modern, sophisticated and efficient industries of advanced areas. Production in the periphery therefore tends to be suppressed by competition from the centre. Only in respect of raw materials are underdeveloped regions normally assured of an opportunity to expand, these being commodities that cannot be produced anywhere. However, movements in the terms of trade are notoriously unfavourable to areas producing primary goods, and it is unlikely that equalization will result from the expansion of primary production.

To some extent, the periphery may be assisted by what Myrdal terms 'spread effects'. These are growth stimuli emanating from the centre, which is unlikely to be able to produce all the commodities it requires itself, and therefore needs to draw upon the periphery. Because of this, it is possible that some initially peripheral areas will overcome their handicaps and develop into new growth centres. However, 'spread effects' are highly selective; they are most in evidence in relatively advanced and well-integrated economies, and even then they affect comparatively small parts of the periphery, leaving the remainder largely untouched.

#### Evaluation of the Equilibrium and Disequilibrium Models.

At this stage it is desirable that the value of the existing theories and models pertaining to spatial economic

growth should be assessed in relation to the study of a single region constituting part of a national space-economy. It should be apparent, despite the selective and cursory nature of the summaries in the earlier sections,<sup>1</sup> that theoretical knowledge of the spatial aspects of economic growth is limited, imprecise and rather contradictory. A great many hypotheses, concepts and models have been prepared and adopted, but there has been a polarization rather than a consolidation of views on the subject, which fall into either the equilibrium or disequilibrium categories. Empirical tests have not provided convincing support for any particular model.

The growth impulse emanates from one industry or sector, and hence one or more locations, and is subsequently transmitted to other parts of the economic system through the linkages between industries and areas. This generalized overview of the mechanics of spatial development, which embodies the 'growth-pole' concept<sup>2</sup>; is unexceptionable. It merely involves admitting the spatial dimension to the economist's conventional sectoral analysis of growth, so that places and areas as well as industries are incorporated. More controversial is the question of how the different parts of the space-economy are likely to fare in the longer run. It is this problem that the regional equilibrium and

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1. For a fuller review see : Keeble, op.cit., pp.243-302; and Harry W. Richardson, Regional Economics : Location Theory, Urban Structure and Regional Change, London, 1969, Chap.13.

2. This term is widely used but Darwent (op.cit., pp.5-31) shows that the concept has very little value.

and disequilibrium models address.

Models in both these categories have generally been formulated to apply at the international or inter-regional levels of enquiry, but there is no inherent reason why they should not also be extended to the intra-regional scale, as in the present study. Indeed, there are strong grounds for believing that the equilibrium model, at least, is more appropriate the lower the scale of the study. At the level of the city region, for example, the ideal conditions of the spatial equilibrium model are approximated more closely than at either the international or national scales. In particular, there are fewer restraints on trade and factor mobility, so that goods and the means to produce them can be moved more quickly and more cheaply within such a region than between countries. Further, the strategic and balance-of-payments considerations which lead to the intervention of governments in international trade do not apply.

Labour and capital tend to move more freely within a small region. This is partly because the economic costs of migration are relatively small, and partly because both factors are more familiar with, and hence more responsive to, local price gradients. In addition, mobility, especially of labour, is enhanced by the absence, or weakness, of the social, psychological and political barriers which are so important at higher scales. People do not need to exchange a known for an alien environment when they move short distances in search of work. Similarly, the investor

in local projects is safe in the knowledge that his funds remain part of an economic system that he understands, rather than being exposed to the higher risks which may attend foreign investment.

In time, therefore, it might reasonably be expected that trade and factor mobility would remove income differentials within a region. Time, however, is a crucial variable, and it is one which the equilibrium model does not deal with adequately, since it leaves unspecified the period necessary for equalization to be achieved. This means that advocates of the model can counter criticisms that income levels show little tendency to converge by maintaining that insufficient time has elapsed.

Differences in growth rates and incomes can arise within the rural parts of a region, but the most significant and common disparity is generally that between rural and urban areas. For at least two centuries in Britain, towns and cities have been drawing population from their rural surrounds, a movement that promises to continue. Even so, equalization has not occurred; income differences between town and country remain, and encourage further migration. The fundamental reason for the persistence of urban-rural inequalities appears to be that the city benefits disproportionately from regional growth, whether it originates in urban or rural areas. Agriculture and other primary activities, the basic supports of the rural economy, require services, materials, equipment and markets which

only urban places can provide. Economic expansion in rural areas is therefore bound to have immediate repercussions in the central city. While the effects may be limited to straightforward increases in the demand for urban services and goods, it is more likely that growth in a rural district will stimulate growth in the urban centre that serves it.

Within the past two centuries, however, economic growth in the more advanced countries has typically been inspired by industrialization rather than agricultural change, though the latter has obviously made a significant contribution. Because it contains a disproportionate share of the regional manufacturing capacity, the city has consequently been in the van of economic development. Industries oriented towards labour or agglomeration economies or markets, as well as some that are footloose<sup>1</sup>, all tend to prefer urban locations. As a result, growth associated with changes in the manufacturing sector has been closely connected with large urban centres.<sup>1</sup> The more recent emergence of service industries as the leading sector in many parts of the world has underlined the locational advantages of the city, and has confirmed it in the role of growth centre.

There is some evidence that per capita income differentials between town and country are on the wane, but this is as likely to reflect government policy and political

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1. See Allan R. Pred, The Spatial Dynamics of U.S. Urban-Industrial Growth, 1800 - 1914, Cambridge, Massachusetts, 1966.

pressures as the purely economic forces favouring equalization. In an extensive survey, Williamson found that this combination of political and economic factors was encouraging the convergence of inter-regional income levels in many countries.<sup>1</sup> He also concluded that once an economy had attained a high degree of integration, Myrdal's spread effects became a potent influence, drawing backward areas into the mainstream of development. Before that stage was reached, however, regional disparities tended to increase.

Placing these empirical findings and theoretical schemes in the context of the present study, on the whole it would seem that for a small region undergoing industrialization, the short-term effect is likely to be grossly unequal spatial growth. Large urban-industrial centres will have growth rates and income levels that are higher than those of rural districts, which will tend to be slow to respond to change. Provided that the economy is commercially oriented, and not subsistence based, however, growth should occur in the rural periphery. Whether it will be sufficient to place the periphery on a par with the centre is uncertain, but it seems improbable, unless extra-economic factors intervene.

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1. Jeffrey G. Williamson, "Regional Inequality and the Process of National Development : A Description of the the Patterns", Economic Development and Cultural Change, vol.13 (1963), pp.3-84.

## CHAPTER FOUR

### ECONOMIC GROWTH ON TEESSIDE

That there was economic growth on Teesside between 1851 and 1881 might appear self-evident, but the question is sufficiently important to the conceptual framework of the thesis to require consideration. For Britain as a whole, if not for all its parts, the nineteenth century was an era of uninterrupted growth, whether per capita or total output is taken as the appropriate yardstick. National income estimates prepared by Deane and Cole indicate that the trend was consistently upward, though there were periods of relative quiescence interspersed between those of exceptionally rapid growth.<sup>1</sup>

The first decade of the nineteenth century was one in which growth was slow, largely due to the restraints placed upon the British economy during the Napoleonic Wars. With the end of hostilities, the pace quickened and a period of rapid development began which lasted until mid-century. Between 1851 and 1861 the growth rate was low again, and Deane and Cole have suggested that this was partially

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1. Phylis Deane and W.A. Cole, British Economic Growth, 1688-1959 : Trends and Structure, Cambridge, 1962, chaps. 5 and 9; and Phylis Deane, The First Industrial Revolution, Cambridge, 1965, chap. 14.

because "... the Irish famine ... flooded Britain with unskilled labour,"<sup>1</sup> though they admit that this is not an entirely satisfactory answer. Subsequently, expansion regained a higher level, and the peak nineteenth-century growth rates were attained during the final quarter of the century, immediately prior to the downturn of the 1890's.

The achievement of Deane and Cole in charting the progress of the national economy has not been matched at the regional scale in Britain. Even for modern periods there have been few attempts to compile sets of regional income accounts for parts of the British economy,<sup>2</sup> and the possibility of doing so for Teesside in the nineteenth century was not seriously considered during the course of the present study. This was mainly because the difficulty of obtaining adequate economic data on a regional basis, great though it is for modern studies,<sup>3</sup> is much more formidable an obstacle in relation to the nineteenth than the twentieth century. However, the question of whether or not economic growth occurred on Teesside in the nineteenth century is one that has scarcely been asked previously, let alone answered, and it was therefore decided to examine it at least by means of indirect guides to economic performance.

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1. Deane and Cole, op.cit., p.283.

2. See F.A. Leeming, "Problems in the Evaluation of Local Outputs in the United Kingdom", Transactions and Papers of the Institute of British Geographers, No.30 (1962), pp.45-58.

3. See Kenneth S. Lomax, "Regional Economic Statistics", in The Sources and Nature of the Statistics of the United Kingdom, ed. Maurice G. Kendall, Vol.2, London, 1957, pp.41-58.



Population and Economic Growth.

Population change provides one index of economic trends. There is a general consensus of opinion that in certain circumstances population growth is indicative of economic growth. However, there is some disagreement over the nature of the relationship between the two variables.<sup>1</sup> The classical view, attributable to Malthus, was that economic growth leads to population expansion, by paving the way for reductions in the death rate and increases in the birth rate.<sup>2</sup>

With time, this interpretation was modified, and the 'theory of demographic transition' emerged.<sup>3</sup> While retaining the notion of economic causation, the latter postulates a more complex sequence of events. Thus, in a typical "... agrarian peasant economy..." population increase is slow, with both birth and death rates at a relatively high level.<sup>4</sup> Economic growth has the effect of lowering the death rate - directly through improvements in the material standard of living, and indirectly through the fostering of medical progress, law and order, and more general environmental benefits -, thereby quickening the rate of population growth. The birth rate, though slower

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1. See Deane and Cole, op.cit., p.98.

2. Ansley J. Coale and Edgar M. Hoover, Population Growth and Economic Development in Low-Income Countries : A Case Study of India's Prospects, Princeton, New Jersey, 1958, p.9; and United Nations, Department of Social Affairs, Population Division, The Determinants and Consequences of Population Trends, New York, 1953, pp.25-27.

3. Coale and Hoover, op.cit., p.9.

4. Ibid., pp.9-13.

to react, is also affected by economic growth. For financial and social reasons, the small nuclear family is the desirable norm in a relatively prosperous urban-industrial society, and the birth rate declines as a result of the acceptance of this ideal. Eventually, birth and death rates find stability, at levels lower than the initial ones, and population expansion is once again slow.

Opposition to this standard explanation of demographic change during periods of vigorous economic growth has come from many quarters. Some of the criticisms are based on what is believed to be a lack of correspondence between theory and reality, as revealed by the empirical evidence available. This issue is illuminated by the continuing debate over the demographic changes which accompanied industrialization in Britain, a matter of special interest in the context of the present study.

The traditional interpretation holds that population increase in England during the late-eighteenth and early-nineteenth centuries was due to a declining rate of mortality and a constant, but relatively high, level of fertility.<sup>1</sup> Improvements in medicine are seen as having been of great importance in the lowering of the death rate.

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1. See Deane, op.cit., p.24; and H.J. Habakkuk, "English Population in the Eighteenth Century", Economic History Review, 2nd. Series, Vol.6, (1953), pp.117-33.

This explanation still finds some support,<sup>1</sup> but medical historians have succeeded in establishing, to general satisfaction, that advances in medicine were insufficient to have had a profound effect on the rate of mortality.<sup>2</sup> Moreover, there is now considerable doubt as to the reliability of the evidence of a decline in the death rate.<sup>3</sup>

On the other hand, few economic historians and historical demographers are inclined to accept Krause's contrary argument that population growth at that time was primarily due to a sharp rise in fertility.<sup>4</sup> Indeed, the fragmentary evidence available, which is of dubious reliability,<sup>5</sup> lends absolute credence to neither thesis. It consequently seems realistic, as Deane and Cole have suggested, to admit the possibility that there were variable trends in fertility and mortality in different parts of the country. In short, the sometimes flatly contradictory results of detailed local

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1. Eg. P.E. Razzell, "Population Growth and Economic Change in Eighteenth - and Early Nineteenth - Century England and Ireland", in Land, Labour and Population in the Industrial Revolution, ed. E.L. Jones and G.E. Mingay, London, 1967, chap.10.
  2. Deane, op.cit., pp.29-30; and T. McKeown and R.G. Brown, "Medical Evidence Related to English Population Changes in the Eighteenth Century", Population Studies, Vol. 9 (1955), pp.119-41.
  3. Deane and Cole, op.cit., pp.122-35.
  4. See. J.T. Krause, "Changes in English Fertility and Mortality, 1781-1850", Economic History Review, 2nd Series, Vol.11 (1958), pp.52-70, and "Some Aspects of Population Change, 1690-1790", in Land, Labour and Population in the Industrial Revolution, op.cit., chap.8; and Deane and Cole, op.cit., pp.122-35.
  5. Deane and Cole, op.cit., chap.3.

studies could be more usefully employed in discussing regional differences rather than national trends, since they are inadequate for the latter purpose.<sup>1.</sup>

Critics of the theory of demographic transition have also challenged the view that population growth resulted from economic growth during the Industrial Revolution.

Razzell, for example, argues that

... the large increase in population during the eighteenth and early nineteenth centuries was in no way due to economic factors, but on the contrary was a major cause of economic change, which in England culminated in those changes known as the Industrial Revolution.<sup>2.</sup>

In his view, therefore, population expansion was a virtually autonomous process, and was actually a cause of economic growth. Others have arrived at a similar conclusion, and it is quite possible that population growth as a causal agent in economic development has been seriously under-estimated in discussions of the origin of industrialization.<sup>3.</sup> Amongst other effects, it creates new and larger markets, which in turn make possible greater production and scale economies,<sup>4.</sup> and it provides the labour force with the additional units which are needed for expansion.

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1. Loc.cit. The authors argue, for example, that in the London district population growth in the second half of the eighteenth century was mainly due to a decline in mortality, whereas rising fertility was more important in Lancashire and the West Riding of Yorkshire.

2. Razzell, op.cit., p.260.

3. See R.M. Hartwell (ed.), The Causes of the Industrial Revolution in England, London, 1967, chaps.1,3 and 6.

4. Loc.cit.; United Nations, op.cit., chap.13; Simon Kuznets Modern Economic Growth : Rate, Structure and Spread, New Haven, 1966, chap.2.

In practice, it is very difficult to determine whether population or economic growth occurs first. Each obviously affects the other, but it is probable that the nature of the relationship varies with time and place. In their investigation of British industrialization, Deane and Cole concluded that "... the evidence appears to be consistent with the view that the growth of population was both a consequence and, in its turn, a cause of economic change".<sup>1</sup> Population expansion is thus closely associated with economic growth, especially during the industrialization phase,<sup>2</sup> regardless of whether it is primarily cause or effect,

The discussion has so far been conducted largely at the national level and it has not specified the role of migration, both of which are biases that require balancing in the context of the present study. If population expansion through natural increase is used as an index of economic growth, then allowance must be made for a time-lag, which may be of considerable duration.<sup>3</sup> This is particularly relevant when population growth is more significant as a cause than as an effect. Depending on the lower age limit of entry into the labour force, a sharp upward shift in the rate of natural increase will not affect the supply of

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1. Deane and Cole, op.cit., p.135.

2. Kuznets (op.cit., p.34) maintains that "... an increase in population is a distinctive characteristic and condition of modern economic growth".

3. See Everett S. Lee, et.al., Population Redistribution and Economic Growth : United States, 1870-1950, Vol.1 : Methodological Considerations and Reference Tables, Philadelphia, 1957, p.2.

labour for a number of years. Similarly, it will not have a very significant effect on the level of demand for a considerable period. When natural increase results from economic growth, there will also be a delay before the sequence runs its course, since changes in birth and death rates are unlikely to occur immediately.

The time-lag is much smaller, however, when population expansion is mainly a result of immigration.<sup>1</sup> Theoretically, at least, the population of an area may undergo a large alteration in size virtually overnight through migration, and where precious minerals have been discovered this has sometimes been the case in practice. The relationship between migration and economic change is thus more immediate than that between natural increase and the latter, and the movement of people from one place to another is a better guide to the timing of economic growth.

In the absence of war and similarly catastrophic events, the desire to attain a higher standard of living is probably the most important single incentive to migrate,<sup>2</sup> and areas experiencing rapid economic growth are generally most attractive to migrants. However, in so much as it makes possible a closer approximation to the optimum level of population for a particular area, migration can initiate and sustain economic growth as well as be a response

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1. Loc.cit.

2. United Nations, op.cit., p.111.

to it.<sup>1.</sup> In this context, the benefits of migration may apply to both areas receiving and donating migrants, provided that the latter are not stripped of their most valuable workers or left with a disproportionately large economically inactive population.<sup>2.</sup>

Especially at the regional scale, where there are relatively few and small obstacles to population movements, migration has generally been an important companion of economic growth. If growth involves industrialization, then an additional labour force is required which the region itself cannot supply initially. Until it can, immigrant labour must be used. Immigration, in turn, stimulates expansion, and perhaps productivity increases leading to further economic growth, in industries with high labour inputs and in those which stand to benefit from a larger home market.

To some extent, migration, particularly within one country, is a response to factors other than economic growth. In nineteenth-century Britain a variety of social

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1. The concept of an 'optimum population' level is necessarily rather abstract, but it nevertheless seems useful in an economic context. Briefly, it is based on the view that at any given moment there is an ideal population size which will enable an economic system to attain maximum productivity. The main objection to the concept is that technological change is endemic in modern societies, so that the optimum figure is obsolete before it is even calculated, and is therefore inapplicable. See Coale and Hoover, op.cit., chap.3; and Manuel Gottlieb, "The Theory of Optimum Population for a Closed Economy", in Population Theory and Policy: Selected Readings, ed. Joseph J. Spengler and Otis Dudley Duncan, Glencoe, Illinois, 1956, pp.159-81.

2. In practice, it is often the case that emigration does skim off a disproportionately valuable part of the population.

considerations helped to foster the movement of people from countryside to town and from predominantly rural to urban-industrial regions.<sup>1</sup> Particularly for the younger age-groups of the working population, life in the Victorian city had much to offer that has often been ignored or undervalued by those who accent its seamier aspects. Facilities for entertainment and recreation, freedom from some of the restraints on behaviour imposed by a close-knit rural society, and the sheer excitement engendered by large numbers of people living and working in close proximity to each other were some of the city's extra-economic attractions.<sup>2</sup>

Generally, however, it is agreed that it was the differences in economic opportunities between areas and places which did most to encourage migration,<sup>3</sup> and that social factors were of secondary importance. This would have been especially true of areas such as Teesside, which had several comparatively small and new towns rather than a single dominant city. As social or cultural centres, alone, it is improbable that Stockton or Middlesbrough, for example, had

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1. On the subject of migration within nineteenth-century Britain, see : A.K. Cairncross, "Internal Migration in Victorian England", chap.4 in Home and Foreign Investment, 1870-1913 : Studies in Capital Accumulation Cambridge, 1953, pp.65-83; R. Lawton, "Population Changes in England and Wales in the Later Nineteenth Century : An Analysis of Trends by Registration Districts", Transactions of the Institute of British Geographers, No.44 (1968), pp.55-74, and "Rural Depopulation in Nineteenth-Century England", in Liverpool Essays in Geography : A Jubilee Collection, ed. R;W.Steel and R. Lawton, London, 1967, pp.227-55; A. Redford, Labour Migration in England, 1800-50, 2nd ed., Manchester, 1964.
  2. See J.A. Banks, "Population Change and the Victorian City", Victorian Studies, Vol.11 (1968), pp.277-89.
  3. Eg. United Nations, op.cit., p.124; and Lawton, "Population Changes in England and Wales...", op.cit., p.57.



facilities sufficient to attract migrants from further afield than local farms and villages.

To establish that economic motives were uppermost in encouraging migration is not, however, the same as establishing that economic growth was itself the attraction. Growth is a statistician's concept, and whether or not it occurs turns on the change in per capita income or output between one date and another. Migrants do not, and did not, have the ability to judge such a change themselves. The critical factors for them are probably employment capacity and income differentials, of both of which they are likely to have some knowledge. Within an area of little or no growth, there may well be immigrants who have been attracted by the prospect of higher earnings and, or, better employment opportunities than were offered in their places of origin. Large-scale immigration, however, occurs only when the growth rate is sufficient to sustain a high and rising standard of living and to ensure the continuing provision of extra employment capacity. Indirectly, therefore, economic growth does attract migrants.

The population of the Teesside region, as defined in an earlier chapter, was 120,915 in 1851 and 336,998 in 1881.<sup>1</sup> In the period under review there was thus an approximately three-fold increase. For the region as a whole, it is not

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1. The sources of the data and the means of calculating migration are discussed below in Chapter 5.

possible to determine what proportions of this were due to migration and natural increase. It is possible to calculate these components of total population growth for registration districts, but the region includes some whole districts and only parts of others. To avoid the difficulties associated with making estimates, net migration and natural increase were therefore determined only for the area comprising registration districts almost entirely within the Teesside region.

Most of the parishes in the region, and the great bulk of its population, belonged to the registration districts of Hartlepool, Stockton, Darlington, Stokesley, Guisborough, and Middlesbrough, all of which were contained by the regional boundary.<sup>1</sup> The remaining parishes lay mainly in the districts of Easington, Northallerton and Richmond. About 80 per cent of the Teesside population in 1851, and 92 per cent in 1881, lived in the six central registration districts, and throughout the period the area within the region but without those districts contained approximately 25,000 people. Thus, any conclusions relating to the Teesside population as a whole should not be weakened significantly by the fact that the following analysis omits a small part of the region in which there was virtually no change in population.

Within the area covered by the six central registration districts, the population rose from 96,141 in 1851 to

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1. Not all of these districts existed in 1851, but this matter is dealt with in Chapter 5. The following parishes were included in those registration districts but were not in the region: Ferryhill, Chilton, Woodham, and Westerdale.

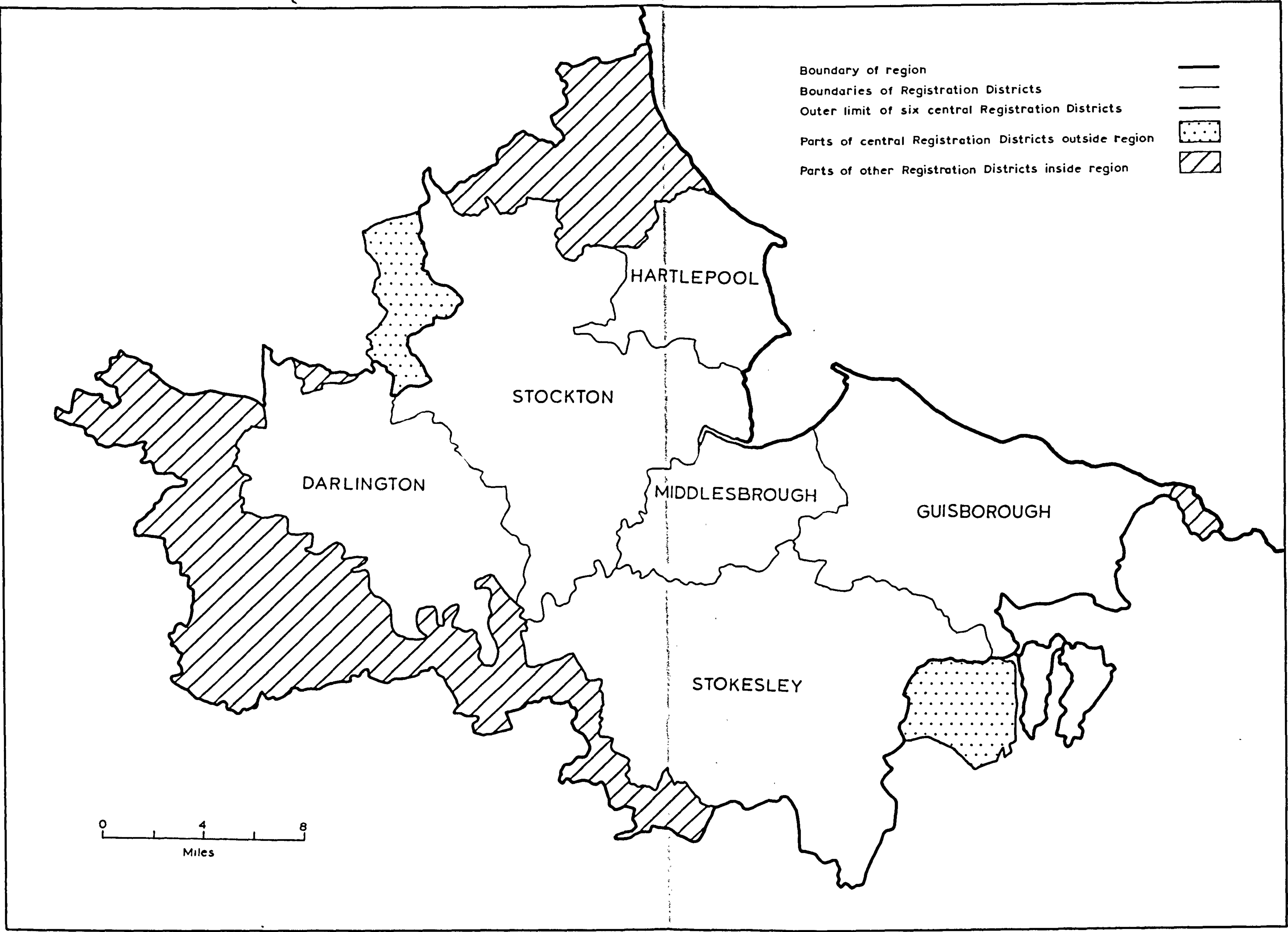


Figure 4.1 Registration Districts in the Area

309,589 in 1881, indicating that the rate of growth was higher than that for the region as a whole. Over this period, net immigration and natural increase contributed almost equally to the total increment of 213,448 people (Table 4.1). Net immigration alone amounted to slightly more than 100,000 which was larger than the initial size of the population, and this figure excludes children born in the region to immigrants.

The population rose by slightly more than 50 per cent from 1851 to 1861, and by 59 per cent between 1861 and 1871. In the decade 1871-81 the rate of increase fell drastically to 35 per cent. Both absolutely and relatively, expansion was at its highest between 1861 and 1871, and that was the decade in which immigration reached its peak; there were more net immigrants then than in the other two decades together, and the rate of net immigration was also higher. The last of the three decades was the only one in which natural increase exceeded net immigration, and it did so by a large margin.

It can be seen from Table 4.1 that there was an upward movement in the rate of natural increase between 1851 and 1881, from 22 per cent in the first decade to 25 per cent in the third, but this shift was small. Almost certainly, it was due to the region acquiring an exceptionally youthful population structure as a result of large-scale immigration, in which the young tend to be involved disproportionately. Material improvements in the quality of life were probably

a marginal influence. Throughout the period, the rate of natural increase on Teesside was higher than in the country as a whole.<sup>1</sup>

Net immigration ran at a high level throughout the period too, and it is this factor that suggests most forcibly that economic growth took place. Migrants must have been looking for a higher standard of living as well as work, and it is improbable that they would have found either on Teesside prior to mid-century, when the region was essentially rural in character and farming was not in a prosperous state.<sup>2</sup> The temporal pattern of migration indicates, however, that economic growth could not have been a continuous process, or that it varied in tempo. The substantial reduction in the rate of net immigration between 1871 and 1881 implies that there was a check to development in that decade, a conclusion which will be supported later with evidence relating to the iron and steel industries.<sup>3</sup>

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1. See Deane and Cole, op.cit., pp.285-90.

2. See Chapter 7.

3. See Chapter 8.

Table 4.1

Population Changes in the Area Including the Registration Districts of Hartlepool, Stockton, Darlington, Middlesbrough, Guisborough, and Stokesley.

Year	Total Change		Natural Change		Net Migration		
	Population	Number	Percentage of Initial Population	Number	Percentage of Initial Population	Number	Percentage of Initial Population
1851	96,141	+ 48,742	+50.70	+ 21,389	+22.25	+ 27,353	+28.45
1861	144,883	+ 85,370	+58.89	+ 34,175	+23.58	+ 51,195	+35.33
1871	230,253	+ 79,336	+34.45	+ 57,671	+25.03	+ 21,665	+ 9.41
1881	309,589	+213,448		+113,235		+100,213	

Changes in the Industrial  
Distribution of the Labour Force.

Rapid economic growth, particularly during industrialization, has almost invariably been accompanied by marked shifts in the industrial structure of employment.<sup>1</sup> According to the Clark-Fisher hypothesis this relationship or association is a very necessary one.<sup>2</sup> On the one hand, it reflects the differential elasticities of demand for the goods produced by the various sectors of the economy : demand elasticities are higher for secondary and tertiary than for primary goods, so that the pattern of demand alters in favour of the former with economic growth.<sup>3</sup> On the other hand, the association reflects the varying capacity of industries to take advantage of technological innovations and scale economies : that is, employment shifts are partly the result of the more rapid growth of productivity, and hence factor returns, in the secondary and tertiary sectors.<sup>4</sup> Changes in the industrial structure of the labour force are consequently both effect and symptom of economic growth. In an immediate and mechanistic

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1. Kuznets, op.cit., chap.3;  
and Colin Clark, The Conditions of Economic Progress, London, 1960, chap.9.
  2. See A.G.B. Fisher, "A Note on Tertiary Production", Economic Journal, Vol.62 (1952), pp.820-34, and "Tertiary Production : A Postscript", Economic Journal, Vol.64 (1954), pp.619-21.
  3. Clark, op.cit., pp.493-95;  
Kuznets, op.cit., pp.86-113.
  4. Loc.cit.

sense they are also the cause,<sup>1</sup> though they do not constitute an adequate explanation, of growth.<sup>2</sup>

Deane and Cole affirm that industrial revolution entails three types of long-term trend affecting the nature and distribution of employment.<sup>3</sup> The first is a reduction in the proportion of the labour force employed in agriculture, and a corresponding rise in that engaged in mining and manufacturing. The second is an increase in the specialization of labour, as new skills and knowledge are acquired, which not only extends the range of occupations practised but also leads to the expansion of employment in the service industries. Finally, the proportion of the total population which is fully and gainfully employed rises, due to the growth of economic opportunity and the need to make more efficient use of available resources. The existence of these trends may therefore be taken as legitimate evidence of economic growth.

The occupation tables of the decennial Population Census provide the best source of data relating to the employment structure of nineteenth-century Britain,<sup>4</sup> and

1. Impediments to the shift of production factors from one sector, or industry, to another are restraints on growth. See Kuznets, op.cit., pp.157-58.
2. Harry W. Richardson, Regional Economics : Location Theory, Urban Structure and Regional Change, London, 1969, p.341.
3. Deane and Cole, op.cit., p.136.
4. The Census material on occupations is discussed in Appendix II.



they have been used in the following analysis. Their value is limited, and use of them made difficult, however, by the numerous and sweeping changes made in the methods of compilation and organisation between censuses. This means that there are problems of comparability between one year and another, and not all of these can be overcome by adjusting the published tables. Occupation tables were produced for registration districts in 1851, 1861 and 1871 - but not for 1881<sup>1</sup> -, and these have been examined for the area comprising the districts of Darlington, Stockton, Hartlepool, Stokesley, Guisborough and Middlesbrough. This is the area for which population change was studied.

Between 1851 and 1871 the total population of the six registration districts included in this analysis rose by 140 per cent (from 96,141 to 230,253), and this rate of expansion was matched by an increase of 141 per cent (31,927 to 76,957) in the occupied adult population - consisting of people of twenty years of age and more, the age-group included in the occupation tables of the census. Contrary to what might be expected, therefore, the heavy immigration of the two intervening decades had not had the effect of raising the employed proportion of the adult population by a significant amount. The unoccupied proportion of the population aged twenty years and more remained relatively constant at approximately 39 per cent in 1851 and 1861, and 37 per cent

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1. The registration riding was the basic unit used in 1881.

in 1871. The small change entailed does not seem to give substance to the Deane-Cole prediction of a relatively larger economically active population. A rather different result might have been obtained had the working population under the age of twenty years been enumerated, but this is a matter for speculation. The existing result is interesting in that it suggests that most adult migrants moved to Teesside as part of a family unit rather than as individuals; otherwise, the ratio between the total population and the employed adult population would have altered more markedly.

Far from suggesting greater employment opportunities for women, which Deane and Cole maintain is another normal accompaniment of industrialization, the data available for Teesside imply the reverse. Thus, the unoccupied proportion of the adult female population rose from 74 per cent in 1851 to 81 per cent in 1871. The inclusion of younger working women might well have altered this trend, but it is unlikely that it would have reversed it. The most probable explanation of this apparent anomaly is that as industrialization on Teesside was based essentially on the expansion of 'heavy' manufacturing, fewer additional employment opportunities for women were created than would have been the case had lighter industries, such as textile manufacturing, been to the fore. Some support for this view is provided by the fact that the proportion of unoccupied adult males was declining, indicating that the opportunities were greater for men than women.

More in keeping with expectations, agriculture's share of the adult labour force fell from 25.6 per cent in 1851 (Table 4.2) to 17.9 per cent in 1861 (Table 4.3); a decrease of 7.7 per cent despite an absolute rise of 300 workers. In the following decade this decline became absolute as well as relative. The employment data for agriculture were combined with those for fishing in the 1871 Census, but the latter industry employed so few people - 191 in 1861 - that the joint figure for agriculture and fishing may be compared with that for agriculture alone in earlier years without the risk of significant distortion. Agriculture and fishing together employed 10.5 per cent of the adult labour force in 1871 (Table 4.4), indicating that agriculture's share had fallen by at least 15 per cent since 1851. This may be contrasted with a decline of 6.6 per cent for British agriculture as a whole in that period.<sup>1</sup>

Between 1851 and 1871 there were also shifts in employment away from many of the other industrial groups that can be distinguished from the Census tables. As a proportion of the total adult labour force, employment in the following categories declined: food and drink, textiles and dress, transport, government, the professions, and domestic and other services. Unlike agriculture, however, none of these categories also experienced an absolute decrease; on the contrary, most of them at least doubled their number of workers. Surprisingly, in view of Deane and Cole's comments, these industrial groups, despite the occasional marginal element, all belonged essentially to the tertiary sector.

Table 4.2<sup>1</sup>.

Occupations of Persons Aged Twenty Years and More in the Registration Districts of Darlington, Stockton, Guisborough and Stokesley, 1851.

Industrial Order	Males	Percentage of Male Labour Force	Females	Percentage of Female Labour Force	Total	Percentage of Total Labour Force.
I Agriculture.	7104	28.2	1074	15.9	8178	25.6
II Fishing	156	0.6	0	0.0	156	0.5
III Mines and Quarries.	1143	4.5	14	0.2	1157	3.6
IV Bricks, Pottery, Cement and Glass.	511	2.0	48	0.7	559	1.8
V Chemicals, Oils, Paints.	242	1.0	16	0.2	258	0.8
VI Metals and Enginecring.	2367	9.4	5	0.1	2372	7.4
VII Precious Metals, Precision Instruments, Etc.	82	0.3	5	0.1	87	0.3
VIII Textiles.	983	3.9	334	4.9	1317	4.1
IX Skins, Leather, etc.	322	1.3	5	0.1	327	1.0
X Dress	1814	7.2	1312	19.4	3126	9.8
XI Food, Drink and Tobacco.	1460	5.8	254	3.8	1714	5.4
XII Woodworking.	411	1.6	8	0.1	419	1.3
XIII Paper, Books, Printing, etc.	119	0.5	30	0.4	149	0.5
XIV Building.	1925	7.7	3	0.0	1928	6.0
XV Gas, Water, Electricity, etc.	28	0.1	0	0.0	28	0.1
XVI Transport.	3731	14.8	16	0.2	3747	11.7
XVII Commerce.	205	0.8	4	0.1	209	0.7
XVIII National and Local Government.	253	1.0	22	0.3	275	0.9
XIX Defence.	75	0.3	0	0.0	75	0.2
XX Professions.	585	2.3	340	5.0	925	2.9
XXI Domestic and Other Services.	646	2.6	3122	46.1	3768	11.8
XXII Other Occupations and Industries.	992	3.9	161	2.4	1153	3.6
	25154	100.0	6773	100.0	31927	100.0

1. Source : See Chapter 5.

Table 4.3<sup>1</sup>.

Occupations of Persons Aged Twenty Years and More in the  
Registration Districts of Darlington, Stockton, Hartlepool,  
Guisborough and Stokesley in 1861.

Industrial Order	Males	Percentage of Male Labour Force	Females	Percentage of Female Labour Force	Total	Percentage of Total Labour Force
I Agriculture.	7729	19.6	746	9.4	8475	17.9
II Fishing.	191	0.5	9	0.0	191	0.4
III Mines and Quarries.	3178	8.1	5	0.1	3183	6.7
IV Bricks, Pottery, Cement and Glass.	684	1.7	57	0.7	741	1.6
V Chemicals, Oils, Paints.	159	0.4	6	0.1	165	0.4
VI Metals and Engineering.	7192	18.3	19	0.2	7211	15.3
VII Precious Metals and Precision Instruments.	106	0.3	2	0.0	108	0.2
VIII Textiles.	732	1.9	231	2.9	963	2.0
IX Skins, Leather, etc.	328	0.8	2	0.0	330	0.7
X Dress.	2154	5.5	1788	22.6	3942	8.3
XI Food, Drink, Tobacco.	1867	4.7	311	3.9	2178	4.6
XII Woodworking.	641	1.6	26	0.3	667	1.4
XIII Paper, Books, Printing.	182	0.5	23	0.3	205	0.4
XIV Building.	3191	8.1	1	0.0	3192	6.8
XV Gas, Water, and Electricity.	70	0.2	1	0.0	71	0.2
XVI Transport.	5758	14.6	13	0.2	5771	12.2
XVII Commerce.	575	1.5	54	0.7	629	1.3
XVIII National and Local Government.	341	0.9	37	0.5	378	0.8
XIX Defence.	156	0.4	0	0.0	156	0.3
XX Professions.	866	2.2	441	5.6	1307	2.8
XXI Domestic and Other Services.	940	2.4	4025	50.9	4965	10.5
XXII Other Occupations & Industries.	2354	6.0	113	1.4	2467	5.2
	39394	100.0	7901	100.0	47295	100.0

1. Source : see Chapter 5.

Table 4.4<sup>1</sup>.

Occupations of Persons Aged Twenty Years and More in the  
Registration Districts of Darlington, Stockton, Hartlepool,  
Guisborough and Stokesley in 1871.

Industrial Order.	Males	Percentage of Male Labour Force.	Females	Percentage of Female Labour Force.	Total	Percentage of Total Labour Force.
Agriculture and Fishing.	7188	10.9	926	8.6	8114	10.5
Food and Drink.	2860	4.3	420	3.9	3280	4.3
Textiles and Dress.	3386	5.1	2965	27.6	6351	8.3
Transport.	5341	8.1	23	0.2	5364	7.0
National and Local Government.	572	0.9	34	0.3	606	0.8
Defence.	161	0.2	0	0.0	161	0.2
Professions.	1265	1.9	638	5.9	1903	2.5
Domestic and Other Service.	1194	1.8	5217	48.5	6411	8.3
Commerce.	1253	1.9	208	1.9	1461	1.9
General Manufacturing and Construction.	36054	54.5	220	2.1	36274	47.1
Other Occupations.	6931	10.5	101	0.9	7032	9.1
	66205	100.0	10752	100.0	76957	100.0

1. Source : see Chapter 5.

However, the shifts in employment were small on the whole, and they were not comparable in size with that from agriculture.

More fundamentally, industrialization was then at an early stage on Teesside and expansion in the tertiary sector tends to be strongest rather later, if only because manufacturing leads the way in the initial phase. Nevertheless, the services are bound to be affected to some extent by even the early stages of industrialization. The evidence for Teesside suggests that in the period 1851-71 there was some increase in productivity in the tertiary sector, with employment in it rising rather slower than the total labour force and the total population. This was especially true of the transport group, whose share of the adult labour force fell from 11.7 to 7.0 per cent, perhaps largely because of the expansion of the railway section, which had great scope for scale economies.

The industrial groups which benefited from the shifts in employment structure were mining, manufacturing and construction. Because of the gross nature of the classification system used to organise the data for registration districts in 1871, it is not possible to discuss industries in this sector individually. However, the three groups named above together raised their share of the adult labour force from 22.8 per cent in 1851 to 47.1 per cent in 1871. The occupations tables for 1851 and 1861 are comparable, and from them it can be seen that 'metals and engineering' and

'mines and quarries' were the two groups that advanced the most. In the decade 1851-61, alone, the former increased its proportion of the adult labour force from 7.4 to 15.3 per cent, and the latter from 3.6 to 6.7 per cent. Principally, this was due to the expansion of the iron manufacturing and iron-ore mining industries.

Although changes in male employment closely paralleled those in the labour force as a whole, this was less true of the shifts in female employment. The sharp decline in the proportion of the adult labour force employed in agriculture affected, or involved, both males and females, but it was greater in the case of the former. As would be expected, the proportion of adult women in the 'metals and engineering' group did not alter much between 1851 and 1861, nor did that in general manufacturing between 1851 and 1871. The main recipient of the shift of females from farming was the 'textiles and dress' category. In addition, there was a small movement towards 'domestic and other service', which employed nearly half of all adult working women in both 1851 and 1871.

It is worthy of note that on Teesside the major changes in the industrial distribution of the labour force, changes which justify the use of the term industrialization to describe them, took place half a century later than in Britain as a whole. Thus :



... It was in the first thirty years of the nineteenth century that the main shift of labour took place towards the mining, manufacturing and building groups of industries in Britain .<sup>1</sup>.

In this sense, then, the Industrial Revolution was late in reaching Teesside, but its arrival was followed by changes more drastic than usual. Even by 1871, agriculture accounted for a lower proportion, and manufacturing a higher proportion, of the labour force than in the country as a whole.<sup>2</sup>.

#### Summary.

Although the analysis of population and employment change does not lead to a closer quantitative appreciation of economic growth on Teesside in the period under review, it is submitted that it does allow the case for economic growth in the region to be made with greater confidence and justification. During the relatively short period from 1851 to 1881, there was a massive increase in the region's population, to which natural increase and net immigration directly contributed almost equally. Indirectly, however, net immigration was clearly of greater importance, since a high proportion of the children born within the region in that period must have been born to first-generation immigrants. Further, the slowing of total population increase in the decade 1871-81 coincided with a substantial reduction in the rate of net immigration.

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1. Deane and Cole, op.cit., pp.151-42.

2. Agriculture, Forestry and Fishing accounted for 15.1 per cent of the British labour force in 1871, and Manufacturing and Mining for 43.1 per cent. See ibid., p.142.

Immediately, the large inflow of migrants reflected the region's much expanded employment capacity. However, it must also have been a response to economic growth and a rising standard of living; the greater availability of jobs, alone, would not have been sufficient incentive, especially for long-distance migrants. In 1861, for example, almost 20 per cent of the population living in the six central registration districts had been born outside both Durham and North Yorkshire. About one-quarter of these long-distance migrants were actually from overseas, the bulk of them from Ireland but many from foreign countries. It is most improbable that these, at least, would have been attracted to Teesside if the standard of living there had not risen from its mid-century level, when the region was in a poor state of economic health, with farming in depression and the coal-shipping ports along the river losing the trade which was their support.

The great majority of the additional adult labour force which had developed by 1871 - nearly 30,000 out of a total of 45,000 extra workers - found employment in the mining, construction and engineering industries. Most of these were in fact concerned with the production and utilisation of iron. The service industries had also gained large numbers of recruits, but not enough to prevent their share of the adult labour force from contracting slightly. Agriculture, on the other hand, had actually lost about 200 adult workers, and its portion of the labour force had shrunk drastically.

Between 1851 and 1871, therefore, there was a large, though essentially relative, shift in employment from agriculture to mining and manufacturing.

The significance of this shift of resources - the movement of labour was accompanied by one of capital - is that it provides corroborative evidence of economic growth to match that afforded by the analysis of population change. As argued earlier, it is definitive of growth through industrialization. Agriculture is not necessarily less productive, or less capable of effecting productivity increases, than manufacturing at all times and in all places, but at a certain stage of an economy's development it is. During industrialization, there is no doubt that growth is achieved through the shift of resources from the one sector to the other.

These changes in the Teesside economy may usefully be placed in a wider context. By the middle of the nineteenth century, and indeed even earlier, the national income of Great Britain was dominated by the manufacturing-mining-construction group of industries. Although the real total output of this group grew rapidly between 1851 and 1881, it did so at a slower pace than that of trade and transport. However, its real output per capita was rising faster than that of any other group. This factor, plus its large share of productive resources, made the group the power-house of national economic growth. Teesside was thus in step with

the country as a whole, even though it was a late arrival on the industrial scene. However, it may be added that the region's growth was stimulated not by innovations in existing industries but by a relative shift of resources into new industries, which at the national level were achieving impressive increases in productivity.

## CHAPTER FIVE

### THE SPATIAL PATTERN OF ECONOMIC GROWTH ON TEESIDE

The spatial equilibrium and disequilibrium models discussed in Chapter 3 provide alternative theoretical guides to the course of economic growth within a single region. The former predicts that in the long run, differential growth rates between the parts of a region will not prevent the establishment of income equality between them. Trade and factor mobility will bring about equalization and equilibrium. In contrast, the disequilibrium model forecasts a concentration of growth in favoured areas, permanent and increasing income inequality, and the development of a centre-periphery structure within the economy which cannot be broken by the free play of market forces.

In relation to the early stages of development, however, the two types of model are not antithetical; both envisage a situation in which the income levels of different areas are diverging. It is in the long run that they are opposed to one another, but the 'long run' is a rather nebulous concept that cannot be defined in terms of a number of years. The present study is concerned with the relatively short thirty-year period from 1851 to 1881, and the empirical studies which have been made suggest that this is too short a period for income convergence to become apparent. It is to be expected, therefore, that the Teesside economy would reveal marked signs of disequilibrium.

There are obviously sharp limitations to what can be achieved in the study of economic growth as a spatial process when per-capita income data are not obtainable. Indirect evidence of economic performance must be used, and the problems associated with that approach have been discussed in the preceding chapter. Nevertheless, it was believed that such a study would prove useful in the present context, and the same methods were adopted to examine growth in parts of the Teesside region as were used to consider it in the region as a whole.

#### Population Change.<sup>1.</sup>

The overall pattern of population change in the Teesside region between 1851 and 1881 is represented in Figure 5.1, which has the civil parish as the basic areal unit. Visually, the pattern is very complex, even with groups of parishes distinguished for the purpose of simplification. Most parts of the region contained some parishes in which the population had risen by less than 50 per cent, others where it had increased by rather more, and others still which had experienced depopulation.

Approximately one-third of the total number of parishes included in the study (67 out of 198) lost population between 1851 and 1881. The rate of loss varied from near zero to slightly more than 40 per cent (Figure 5.1). It can be

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1. Population data from:  
Great Britain, Registrar General, Census of England and Wales, Population Tables, for 1851, 1861, 1871, 1881.

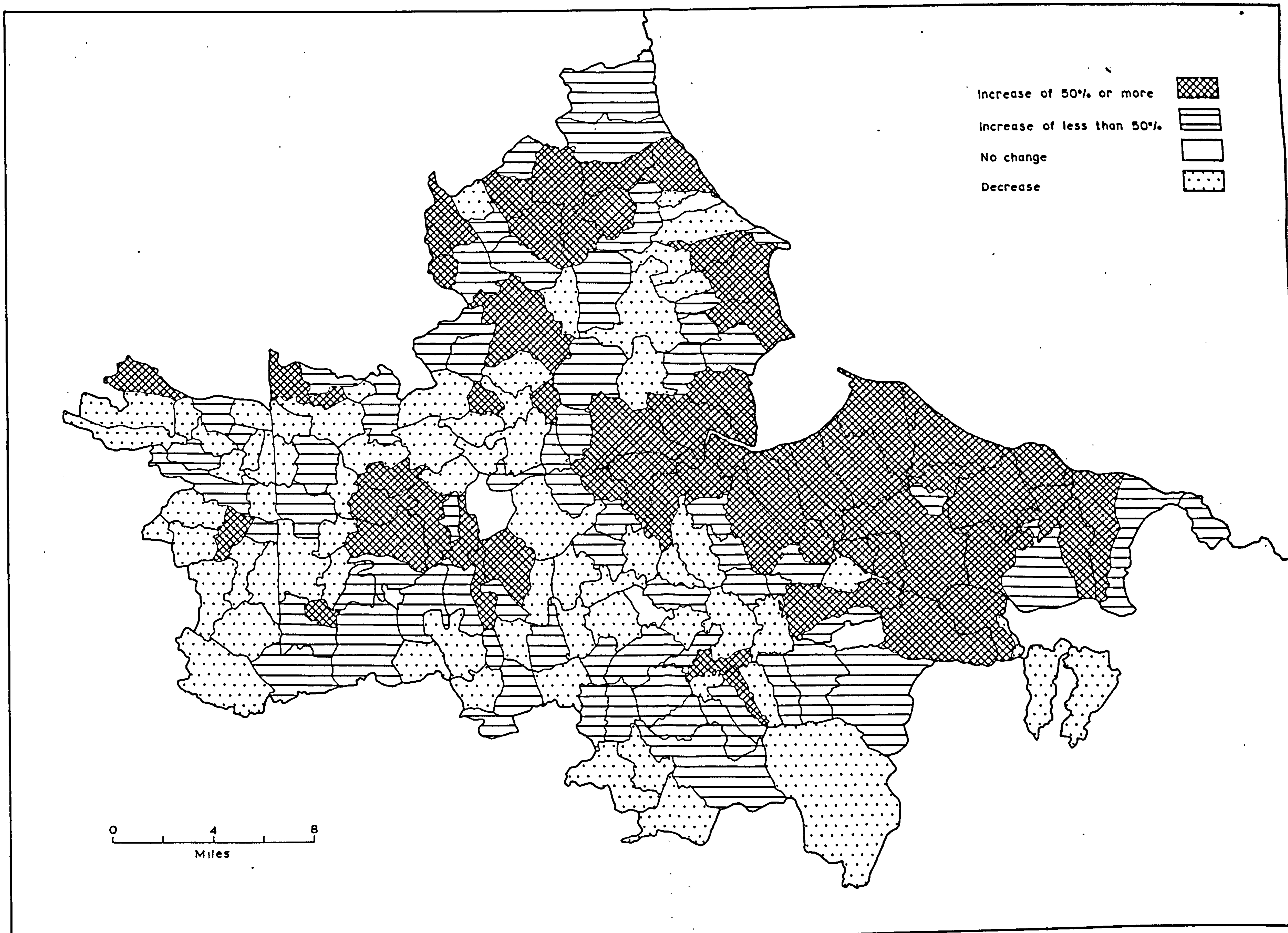


Figure 5.1 Population Change by Parish, 1851-81

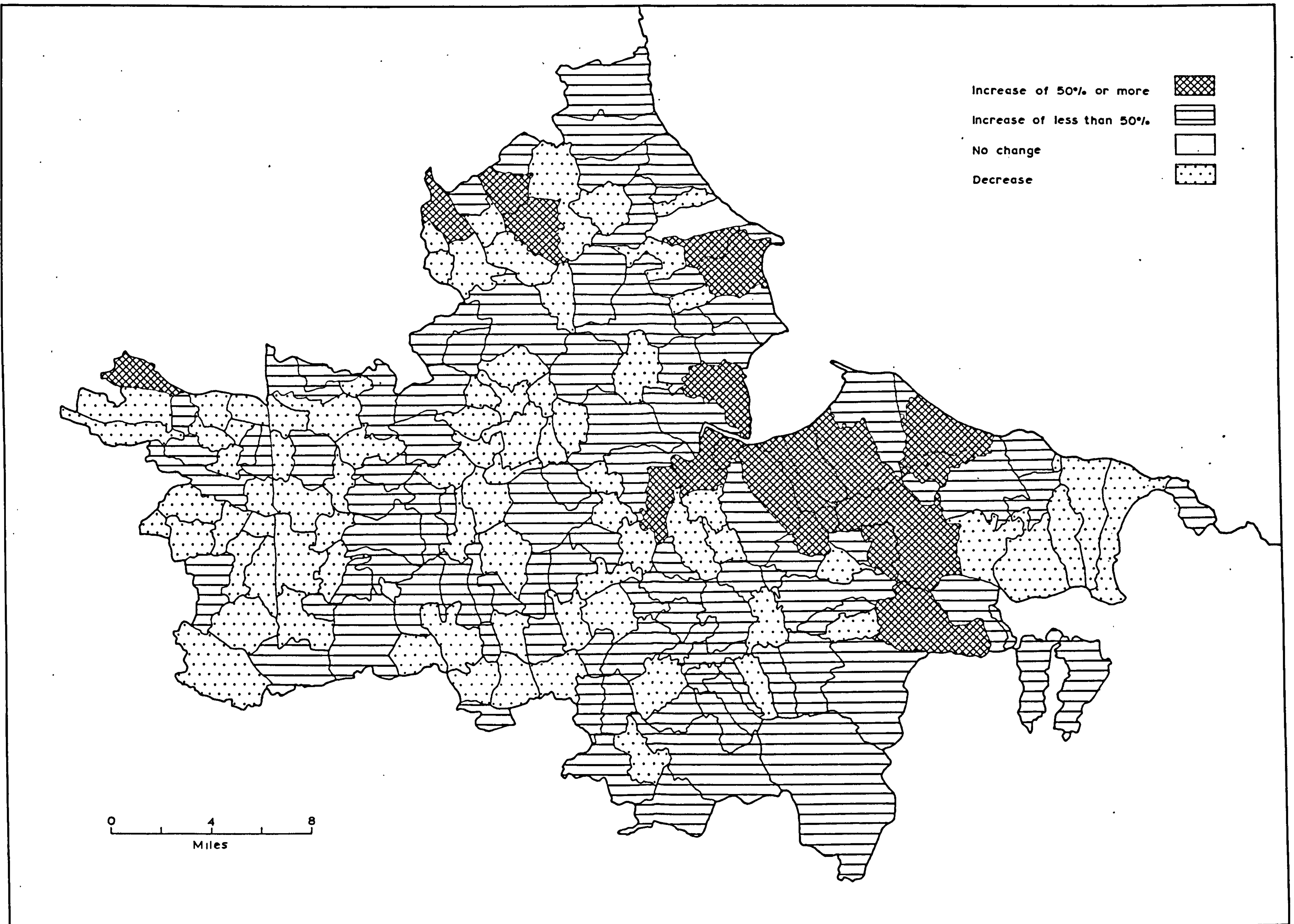


Figure 5.2 Population Change by Parish, 1851-61



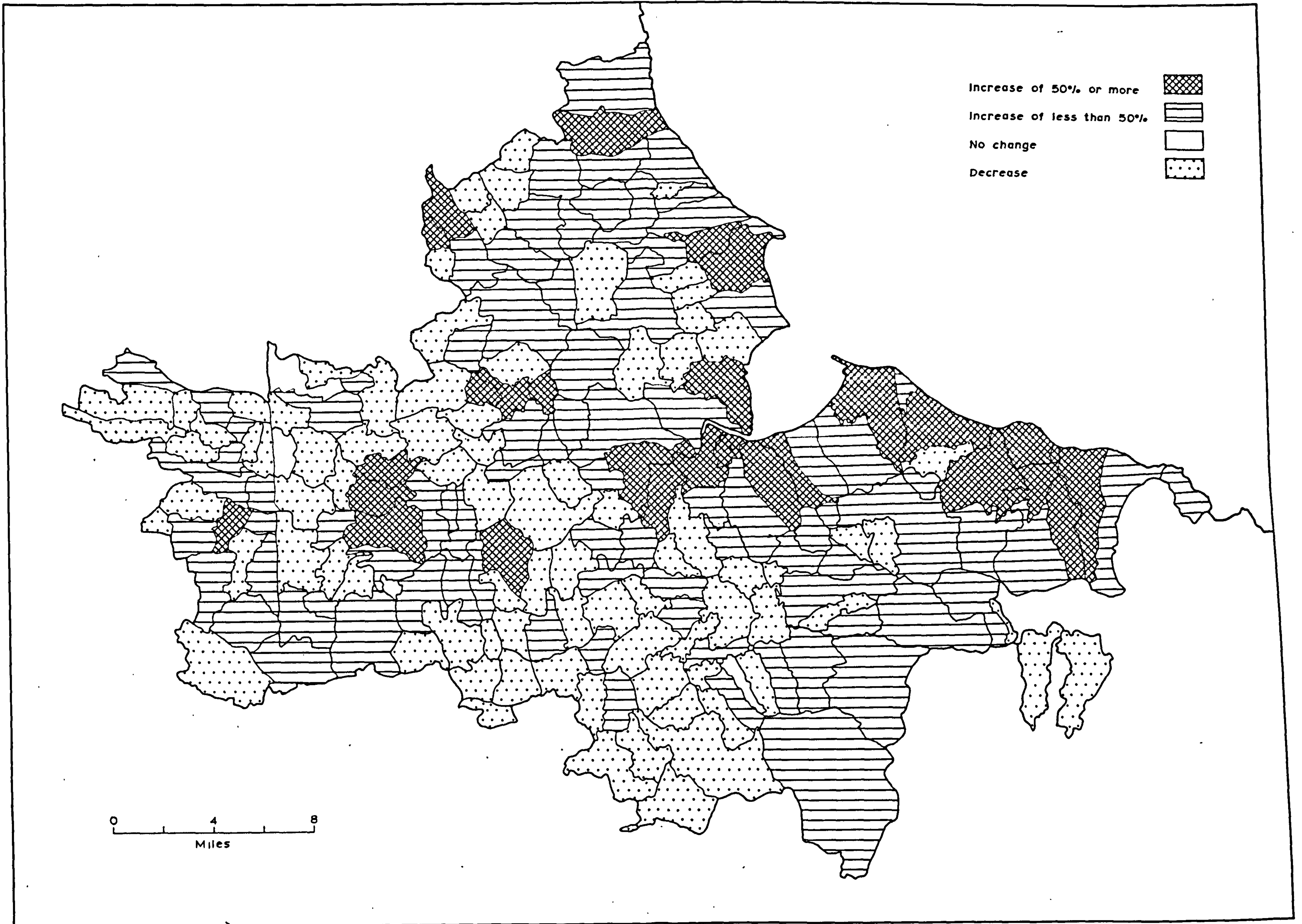


Figure 5.3 Population Change by Parish, 1861-71

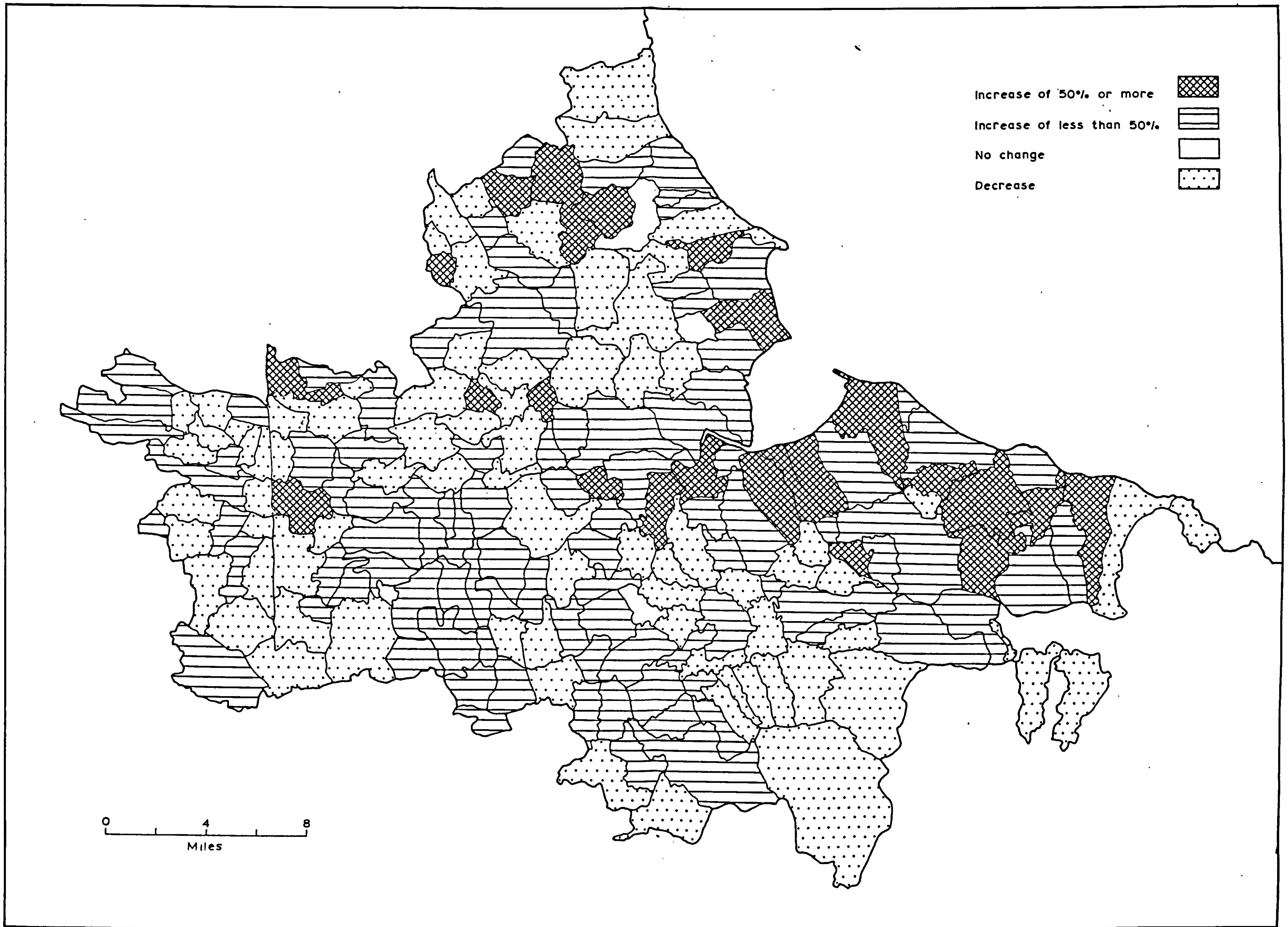


Figure 5.4 Population Change by Parish, 1871-81

seen from Table 5.1 that most of the parishes in this group experienced a decrease of under 20 per cent, but that a small number was affected more severely. The mean rate of loss was actually 14.24 per cent.

Table 5.1

Rates of Population Decrease, 1851-1881

<u>Rate</u>	<u>Number of Parishes</u>
0.01 to 10.00	29
10.01 " 20.00	24
20.01 " 30.00	7
30.01 " 40.00	6
40.01 " 50.00	1

The parishes which did lose population were widely distributed throughout the region, with some tendency towards concentration in the area west of Darlington and the area between that town and Stockton. From evidence to be presented later, in connection with population expansion, it would seem that the main common characteristic of the members of this group was that they were essentially agricultural parishes. With the exception of standard rural activities, such as the provision of low-order retail goods and services, farming was virtually the only source of employment within them. This characteristic was a more important correlate of depopulation than the location of a parish within the region; for some of the parishes which lost population were near the regional boundary, while others were close to the main urban centres.

One of the two main exceptions to the generalization that parishes in this group were essentially agricultural in economic character was Coxhoe, a mining parish on the Durham coalfield. Moreover, it was Coxhoe that experienced the highest rate of depopulation in the region, losing more than 40 per cent of its initial population between 1851 and 1881. The reason for this is almost certainly to be found in the closure of local collieries : Clarence Hetton in 1840, Crow Trees about 1870, and Coxhoe itself during the 1870's.<sup>1</sup> The other principal anomaly was the parish of Stokesley, which included a large market town with that name. Depopulation was in this case small, and it may be attributed to the fact that the town of Stokesley, though substantial, depended for its livelihood on serving the local farming populace, which was static or declining in size in neighbouring parishes.

In sharp contrast, a number of parishes experienced highly spectacular rates of population growth. Foremost amongst these was Linthorpe, with a quite exceptional increase of 7,051 per cent, which took the population from 262 in 1851 to 18,736 in 1881. However, several other parishes also had very high rates of increase. Because of their effect, the average increase in parishes which underwent growth was 157 per cent, a rate surpassed in only 28 of the

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1. Information from: Mines Department, Catalogue of Plans of Abandoned Mines, London, 1928, Vol. 1; and Robert Hunt, Mineral Statistics, "Memoirs of the Geological Survey of Great Britain and the Museum of Practical Geology : Mining Records", London. This was an annual publication.

130 involved. Quite arbitrarily, a rise of 50 per cent has been adopted as the divide between high and moderate growth, and on that basis an approximately equal number of parishes can be assigned to each of those two categories.

The 'high-growth' parishes are listed in Table 5.2. Again, it is illuminating to classify them on the crude basis of their essential economic character. Agriculture was practised to some extent in virtually all of the parishes, and most also had service outlets at one level or another. Almost two-thirds of the 59 parishes, however, may be termed 'mining parishes' in the sense that they had coal or ironstone workings within their boundaries. In the general absence of large manufacturing plants from all but the parishes with, or adjacent to, substantial towns, the relatively high capital and labour requirements of mining would obviously transform the economy of so small an area as a parish. The expansion of mineral working may therefore be looked to as possibly the main cause of high population growth in the 'mining parishes'.

Of the mining parishes which had experienced high rates of population increase, 11 were concerned with coal mining. Most of these were situated or towards the northern periphery of the region, and, with the exception of Redworth and Cockfield, belonged to the south-eastern district of the Northumberland and Durham coalfield. This was an area where colliery development had begun only in the second quarter of the nineteenth century, and where it was still at a comp-

aratively early stage in 1850.<sup>1</sup>

Table 5.2

Parishes in Which Population Growth Exceeded 50 per cent between 1851 and 1881.

<u>Those with Coal Mines.</u>	<u>Those with Ironstone Mines.</u>	<u>Others</u>
Wingate.	Normanby.	Stranton.
Castle Eden.	Eston.	Stockton.
Kelloe.	Marske.	Linthorpe.
Hutton Henry.	Guisborough.	Middlesbrough.
Trimdon.	Upleatham.	Darlington.
Thrislington.	Hutton Lowcross.	Thornaby.
Mainsforth.	Skelton.	Throston.
Cockfield.	Brotton.	Seaton Carew.
Redworth.	Stanghow.	Cowpen.
Cornforth.	Kilton.	Billingham.
Monk Hesleden.	Liverton.	East Hartburn.
	Loftus.	Norton.
	Kildale.	Whessoe.
	Comondale.	Haughton-le-
	Ormesby.	Skerne.
	Great Ayton.	Cockerton.
	Wilton.	Middleton St.
	Kirkleatham.	George.
	Morton.	Low Dinsdale.
	Upsall.	Morton Palms.
	Pinchingthorpe.	Whitton.
	Skinningrove.	Redcar.
		Eppleby.
		Newton Morrell.
		Skutterskelfe.
		Elstob.

The initial stimulus to this development emanated from the timely fusing of several favourable factors during the 1830's. Demand for household coal, though checked in the

1. Although Arthur E. Smailes describes it as the most developed part of the concealed coalfield in 1850. See his "The Development of the Northumberland and Durham Coalfield", Scottish Geographical Magazine, Vol.51 (1935), p.206.

1840's,<sup>1</sup> rose steadily and substantially during the first half of the century,<sup>2</sup> very largely as a direct result of the sustained growth of the London market.<sup>3</sup> Prices and profits were consequently especially high during the late-1820's and mid-1830's, encouraging further investment in the coal industry.<sup>4</sup> On the supply side, this period was one in which the Tyneside collieries, traditional suppliers of household coal and source of the highly esteemed 'Wallsend' variety,<sup>5</sup> were reducing their output; as the High Main

1. During the later 1830's, the growth of colliery capacity seems to have outstripped the rising demand for coal, resulting in a recession which began in 1843 and lasted for a decade. In 1850, coal shipped from Sunderland commanded its lowest price since 1790. See A.G. Kenwood, "Capital Investment in North Eastern England, 1800-1913", unpublished Ph.D. Thesis, University of London, 1962, pp.82 and 89.  
T.Y. Hall, a contemporary writer, mentioned that coal prices in 1843 were double their 1853 level. See his "The Extent and Probable Duration of the Northern Coal-Field...", Transactions of the North of England Institute of Mining Engineers, Vol.2 (1853-54), pp.148-49.
2. Arthur E. Smailes, North England, London, 1961, p.166.
3. Coal from the North East dominated the London market until quite late in the nineteenth century, and this trade absorbed 55 per cent of the Tyne's coastwise coal shipments in 1831. See N.R. Elliott, "A Geographical Analysis of the Tyne Coal Trade", Tijdschrift voor Economische en Sociale Geografie, Vol.59 (1968), pp.84-85.
4. Kenwood, op.cit., chap.4.
5. Initially referring to the produce of the Wallsend Colliery, 'Wallsend' became a trade name used to describe the best quality household coal from the North East - hence, 'Tees Wallsend' from south west Durham. See Smailes, "The Development of the Northumberland and Durham Coalfield", op.cit., p.206; and Richard Meade, The Coal and Iron Industries of the United Kingdom..., London, 1882, pp.7-8.

seam neared exhaustion.<sup>1.</sup> In what was a temporary phase, the old mining district around Penshaw and Fatfield, on the Wear, received a new lease of life from the Tyne's default,<sup>2.</sup> but this was a short-term solution. New producers were required, and they duly emerged around and on the East Durham plateau, where the successful sinking of a pit at Hetton in 1822 had proved the existence of large reserves of good quality household coal in an area previously thought to be barren.<sup>3.</sup>

During the 1830's mining was extended to the south-eastern part of the coalfield, following the construction of railway lines from the Teesside ports and the restoration of Hartlepool as a shipping point.<sup>4.</sup> Despite the development of transport facilities, the growth of demand, and the need for new producers, the extension of mining to this district was not an unqualified success. Some collieries were very short-lived, and the area appears to have been a marginal production zone under the prevailing economic conditions.<sup>5.</sup>

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1. Between 1829 and 1836, the centre of mining shifted from the Tyne to the Wear and South West Durham districts, due to the exhaustion of the best Tyneside seams. See Kenwood, op.cit., p.84.
  2. Smailes, "The Development of the Northumberland and Durham Coalfield," op.cit., p.206.
  3. Kenwood, op.cit., p.83.
  4. The Clarence and the Hartlepool railways were extended steadily during the 1830's, and a new dock was opened at Hartlepool in 1835. See Kenwood, op.cit., p.86; and Robert Wood, West Hartlepool, West Hartlepool, 1967, pp.10-20.
  5. These conditions changed, of course, with technical progress and the exhaustion of the more easily accessible and better quality coal seams. In the twentieth century, very large collieries were developed at Horden and Easington.



Considerable expense was entailed in overcoming the technical problems of sinking pit shafts through the magnesium limestone which overlay the coal measures<sup>1</sup>, and working costs tended to be higher than in many parts of the coalfield for this reason and because the seams were comparatively thin. With regard to the latter point, the Hett Dyke runs in a south-westerly direction inland from Easington, and to the south of it, the Hutton Seam - accepted further north as an excellent substitute for Tyneside's High Main - was scarcely worth working.<sup>2</sup> The best local coal came from the Five-Quarter Seam, which was both thinner and of a poorer quality than the Hutton to the north of the Hett Dyke.

The fall in coal prices during the 1840's consequently jeopardized the survival of collieries on the south-eastern edge of the coalfield, where profit margins were slim.<sup>4</sup> Wingate Grange, Trimdon Grange and Trimdon collieries were amongst those which changed ownership due to their lack of profitability,<sup>5</sup> even though their produce was of an adequate

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1. In addition to the great depths to which it was necessary to sink shafts, the problems of drainage and negotiating layers of sand added to the difficulty and expense. Murton, which was unusually expensive, cost £200,000 to win (Kenwood, op.cit., p.91). The large outlays required meant that colliery development on the East Durham Plateau was delayed even after good reserves of coal were known to exist - see Hall, op.cit., pp.152-53.
  2. Hall, op.cit., p.146.
  3. Ibid, pp.146-55.
  4. Ibid, p.153 and pp.166-67.
  5. Loc.cit.

quality. Many of the other collieries in the Teesside region were in a similar position. A contemporary judged Castle Eden and South Wingate to be the most marginal of all<sup>1</sup>, and the latter was duly abandoned in 1858.<sup>2</sup>

After 1850, the North East coal industry as a whole, and with it that part in south-east Durham, began to recover from its difficulties.<sup>3</sup> Prices rose, restoring confidence in the industry, and the period from 1854 to 1867 was one in which investment in new colliery development regained a high level after the standstill of the 1840's.<sup>4</sup> During the 1870's, investment rose even higher.<sup>5</sup> The districts supplying coking coal, particularly south-west Durham, were the main beneficiaries, as much of the rising demand emanated from the burgeoning iron industry.<sup>6</sup> In east Durham, however, development was stimulated by the growing demand for coal suitable for gas manufacture, which more than compensated for a declining share in the London market for

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1. Ibid., p.167.

2. Unless otherwise indicated, the opening and closure dates of collieries have been obtained from Hunt, op.cit.; and Mines Department, op.cit.

3. Kenwood, op.cit., chap.10.

4. Ibid., pp.217-18.

5. Loc.cit.

6. See : Kenwood, op.cit., chap.10; Smailes, North England, op.cit., pp.172-74, and "The Development of the North-umberland and Durham Coalfield", op.cit., p.207; S.H. Beaver, "Coke Manufacture in Great Britain : A Study in Industrial Geography", Transactions and Papers of the Institute of British Geographers, No.17 (1951), pp.136-38.

household coal.<sup>1.</sup>

Within this general framework, there was much scope for variety. In south-east Durham, for example, coal production rose substantially in some areas but not in others. While some collieries were new and had yet to attain maximum output, others were already working at full capacity and improved market conditions could not assist them further. The mining parishes listed in Table 5.2 all shared a high rate of population growth between 1851 and 1881, but the population rose in some parishes during a decade in which it fell in others. These variations are displayed in Figures 5.2, 5.3 and 5.4. Generally, as might be expected, population change was synchronized closely with the sequence of colliery development, so that an increase followed the opening of a new pit and a decrease the closure of an established one. An attempt has been made to correlate these changes in Table 5.3.

Kelloe, Cornforth and Wingate parishes fared especially well, in terms of population increase, over the period as a whole (Figure 5.1). In the case of Kelloe, the decade of greatest growth was 1851-61, in the midst of which the new East Hetton colliery was opened within the parish. Simil-

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1. After 1850, competition from more favourably located producers in the Midlands, who by then had railway access to London, began to undermine the North East's traditional monopoly of the London market, which rested on the coastwise shipping trade. See Smailes, "The Development of the Northumberland and Durham Coalfield", op.cit., pp.207-208; and Elliott, op.cit., pp.81-87.

arly, Hutton Henry (1871-81), Thrislington (1861-71), Redworth (1871-81), Mainsforth (1871-81), and Wingate (1871-81) all experienced their highest rates of increase during the decades in which new collieries were opened within their respective boundaries (Table 5.3). Conversely, Kelloe (1861-71), Hutton Henry (1851-61) and Thrislington (1851-61) all lost population during the decades when local pits were abandoned or closed temporarily.

It is most unlikely that the contemporary association of population change and colliery development was coincidental; for the population adjustments were usually so large as to dwarf the changes which could be expected to have followed other alterations in the rural economic fabric. In 1854, the average colliery, in the Hartlepool District employed 772 people.<sup>1</sup> Further west, in the Tees Inspection District, the equivalent figure was 1,225.<sup>2</sup> If allowance is made for the non-working members of a pitman's family, and for employment in the accompanying service industries, then it is clear that the opening or closing of a colliery must have precipitated the movement of a body of people very often larger than the residual population of the parish concerned.

Localization of the effects of colliery development and closure was made more pronounced by the normal tendency of

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1. Figures calculated from data given in Hunt, op.cit.
  2. Loc.cit.

Table 5.3

Population Growth and Colliery Development in Selected Parishes, 1851-1881

Parish	Decade of Greatest Growth	Decade of Loss	Collieries Within the Parish
Wingate	1871-'81	1851-'61	Wingate Grange Colliery open until 1876. Wheatley Hill and Deaf Hill Collieries both opened during the 1870's.
Castle Eden	1861-'71	-	Castle Eden Colliery open throughout. Castle Eden New Winning open for a short period in the early 1850's.
Kelloe	1851-'61	1861-'71	Kelloe, or Old Kelloe, Colliery open until 1869. East Hetton Colliery opened in 1857.
Hutton Henry	1871-'81	1851-'61	South Wingate, or Rodridge, Colliery open until 1858. Hutton Henry Colliery opened in the 1870's.
Trimdon	1851-'61	1871-'81	Trimdon and Trimdon Grange Collieries open throughout.
Thrislington.	1861-'71	1851-'61 1871-'81	Thrislington Colliery closed in early 1850's but re-opened, with the sinking of a new pit, in 1868.
Mainsforth.	1871-'81	1851-'61 1861-'71	Mainsforth Colliery opened in 1875.
Redworth	1871-'81	-	Middridge Colliery opened in 1871 but closed later in that decade.
Cornforth	1861-'71	1871-'81	A small land-sale colliery closed in 1857 (North Cornforth). Tursdale Colliery, on boundary of Cornforth and Cassop parishes, opened in 1858. Even closer to the main village, but not in Cornforth parish, Thrislington Colliery opened in 1868.

Sources : Hunt, op.cit; Mines Department, Catalogue of Plans of Abandoned Mines, London, 1928, Vol.1; Henry Louis and C. H. Vellacott, "Mining", pp.319-56 in Victoria History of the County of Durham, ed. William Page, Vol.2, London, 1907; William Green, "The Chronicles and Records of the Northern Coal Trade in the Counties of Durham and Northumberland", Transactions of the North of England Institute of Mining Engineers, Vol.15 (1865-66), pp.175-281.

miners to live close to their place of work, and hence within the same, or an adjacent, parish as that where they worked. Many collieries were located on the edge of existing settlements, which would be enlarged to accommodate the influx of miners and their families. Some, however, were placed in more remote areas, and around them new villages of a distinctive type were subsequently built.<sup>1</sup> Table 5.4 lists some of the new mining settlements built in south-east Durham prior to 1881.

In an age when most people walked to work, no doubt pitmen preferred to live only a short distance away from their place of employment. However, an additional reason for the close proximity of pit and village lay in the role of colliery owners in the housing field. Most companies provided their employees with "rented accommodation as well as work, sometimes undertaking the construction of houses themselves, but more often renting or purchasing them from small, speculative builders."<sup>2</sup>

For colliery companies, the direct financial advantages resulting from investments in housing cannot have been very substantial. The average two- or three-roomed pitman's

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1. See Arthur E. Smailes, "Population Changes in the Colliery Districts of Northumberland and Durham"; Geographical Journal, Vol.91 (1938), pp.220-32; and J.C. Creigh, "Landscape and People in East Durham", in Northern Geographical Essays in Honour of G.H.J. Daysh, ed.J.W. House, Newcastle upon Tyne, 1966, pp.217-26.

2. Kenwood, op.cit., p.155; and Frank Atkinson, The Great Northern Coalfield, 1700-1900 : Illustrated Notes on the Durham and Northumberland Coalfield, Barnard Castle, 1966, p.42.

Table 5.4<sup>1.</sup>

New Colliery Settlements Established in South-East Durham prior to 1881.

<u>Settlement</u>	<u>Parish</u>	<u>Associated Colliery</u>
Wingate Grange	Wingate	Wingate Grange.
Deaf Hill	"	Deaf Hill.
Wheatley Hill	"	Wheatley Hill.
New Winning Cottages.	Castle Eden	Castle Eden New Winning.
New Thornley	Thornley	Thornley.
Hesleden	Monk Hesleden	Castle Eden.
West Cornforth	Cornforth	Thrislington.
Trimdon Colliery or New Trimdon.	Trimdon	Trimdon Colliery.
Trimdon Grange	"	Trimdon Grange.
New Shotton or Shotton Colliery.	Shotton	Shotton
East Hetton	Coxhoe	East Hetton.

cottage cost about £50 to build in the middle of the nineteenth century, and it could be let for a rental of £5 per year.<sup>2.</sup> In the long run, there was some profit to be obtained from such houses, but the initial outlay required was quite large and it could lock up capital needed for the sinking of shafts and other preparatory work in the mines themselves. The latter was an important consideration, since a number of companies in east Durham went bankrupt before their pits could be put into production.<sup>3.</sup>

1. Various scattered references were drawn together in compiling this table. Especially useful were : Smailes, "Population Changes in the Colliery Districts of North-umberland and Durham", op.cit.; William Fordyce, The History and Antiquities of the County Palatine of Durham ...", Newcastle, 1857, 2 vols.; and the relevant Durham sheets of the 1st. edition of the Ordnance Survey's 6-inch map series.

2. Atkinson, op.cit., p.42.

3. See Kenwood, op.cit., chap.10.

At least in part, however, the coal owner's interests in housing were economically motivated. If labour, particularly skilled labour, were to be attracted from other parts of the North East, and the country as a whole, then it was necessary to provide living accommodation as well as work. In addition, that distinctive Victorian mixture of private philanthropy and paternalism, familiar on country estate and in manufacturing town,<sup>1</sup> seems to have had a part to play. In the North East, at least, this was encouraged by the strong ties of the landed aristocracy with the coal industry.<sup>2</sup> Many colliery owners felt obliged to assume responsibility for the moral and spiritual welfare of their employees, as well as their immediate material needs. The building of churches, schools and houses was one means by which that responsibility could be discharged. The Marquis of Londonderry, for example, considered it incumbent on himself to provide the miners and their families in the villages of Pensher, Pittington and Rainton with schools as well as houses.<sup>3</sup>

Whatever the motives involved, however, the fact that the mine owners were generally also landlords gave them a

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1. See Brian Harrison, "Philanthropy and the Victorians", Victorian Studies, Vol.9 (1965-66), pp.353-74.
  2. See David Spring, "The Earls of Durham and the Great Northern Coalfield, 1830-1880", Canadian Historical Review, Vol.33 (1952), pp.237-53, and "The English Landed Estate in the Age of Coal and Iron, 1830-1880", Journal of Economic History, Vol.11 (1951), pp.3-24.
  3. See Report of the Commissioners Appointed to Inquire into the Operation of the Act 5 and 6 Victoria c.99, and into the State of the Population in the Mining Districts, 1846.



useful aid to negotiation, and a potentially powerful means of retaliation if all else failed, in times of industrial unrest. This instrument was employed during the strike of 1844, when recalcitrant miners were dispossessed of their homes. The houses were given to men specially imported, many of them from Ireland, to break the strike.<sup>1</sup>

In a few cases, the colliery and its associated settlement, though close together, were located in different parishes. Hesleden and West Cornforth are examples of villages separated by parish boundaries from the mines they served. In Monk Hesleden and Cornforth, population change was consequently related to colliery development in neighbouring parishes. Nevertheless, these two parishes belong to the 'coal-mining' group. A final point is that population fluctuations were probably related to changes in the scale of production in individual collieries, as well as to their opening and closing, but there are insufficient data to permit an analysis of this relationship.

The remaining mining parishes in the high-growth category were concerned with the extraction of iron ore, and were located in Cleveland. They were more numerous, and had higher rates of population expansion, than the coal-mining parishes. As on the coalfield, the timing of population change in the mining parishes of Cleveland was geared closely to that of the development of mining itself. However, the pattern of change was somewhat clearer in Cleveland.

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1. Loc.cit.

Broadly, mining traced the ironstone seams southwards, in a logical sequence, so that the northern-most parishes were the first to experience population increase. With time, development moved south, and in the decade 1871-81 population expansion was greatest in the parishes nearest the southern boundary of the region (Figures 5.2, 5.3 and 5.4).

During the first decade following the opening of the Eston iron-ore mines, which occurred late in 1850, mining development was largely confined to the northern fringe of the orefield.<sup>1</sup> There, quarries and, later, adits were used to tap the Main Seam where it outcropped along the north-facing scarps of the Eston, Upleatham and Cleveland Hills.<sup>2</sup> The most northerly of the mining parishes were consequently the first to undergo population expansion. Normanby, Eston, Upsall, Hutton Lowcross and Marske all had particularly high rates of increase in the decade from 1851 to 1861. With the exception of the last of these, that was their decade of greatest growth. Ormesby, Marton, Guisborough, Wilton and Upleatham also experienced considerable expansion between 1851 and 1861. Although population increase was in most cases largely attributable directly to the development of

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1. With the exception of the Rosedale workings, mining in Cleveland was confined to the area north of the Leven and Esk valleys and west of a north-south line through Runswick.

See J.W. Bainbridge, "A Comparative Study in the Growth and Decline of Two Iron Ore Mining Districts : Cleveland and West Cumberland", unpublished M.Sc. thesis, University of Durham, 1964, chap.1.

2. Ibid., pp.41-43.

the mining industry,<sup>1</sup> mines were actually opened only in the parishes of Eston, Normanby, Hutton Lowcross, Marske and Guisborough during the first decade.<sup>2</sup> The other parishes housed workers and their families associated with those mines. It is noteworthy that in the south-eastern district of the orefield, then still untouched by mining, a number of parishes lost population between 1851 and 1861 (Figure 5.2).

With the exception of Upleatham, the iron-ore mining parishes which experienced population expansion during the first decade continued to do so between 1861 and 1871, though generally at a much reduced rate (Figure 5.3). The movement of people from Upleatham in this second decade was a very localized phenomenon, which may have resulted from the building of new mining settlements at Dunsdale and New Marske, just outside the parish boundary.<sup>3</sup> Ormesby and Marske, in contrast, underwent even greater expansion than in the previous decade, due to the opening of new mines within their respective boundaries and the beginning of

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1. Exceptions were Ormesby, Eston and Normanby, in the north of which industrial settlements began to develop during the 1850's.
  2. Information on the opening and closing of ironstone mines has, if not indicated otherwise, been taken from: S.K. Chapman, Gazeteer of Cleveland Ironstone Mines, Dorman Museum Research Report No.1, Middlesbrough, 1967, 11 pp.; and Hunt, op.cit.
  3. The important Upleatham mines, or, at least, the head of the workings, were in the parish of Marske. So, too, was New Marske village, which was built to house the Upleatham miners. Kirkleatham mine was within the parish of Upleatham, though the associated village of Dunsdale was in Kirkleatham.

urban development in the northern part of Ormesby.<sup>1</sup>

During the 1860's, however, despite the establishment of new workings in the parishes of Ormesby, Marske and Guisborough, the focus of development for the mining industry shifted south-eastwards. Exploratory shafts were sunk, though without success, in the parishes of Comondale and Kildale.<sup>2</sup> More significantly, for the future, exploration and development spread to the area where the iron-bearing strata are at their deepest in Cleveland : around the former synclinal basin centred on North Skelton.<sup>3</sup>

New mines were opened in the parishes of Stanghow, Loftus, Liverton, Brotton and Kilton, the Kilton mine requiring a shaft 700 feet deep.<sup>4</sup> Contemporaneously, population change in these parishes swung from decline to rapid growth (Figure 5.3). After the successful completion of the first deep shafts, at the Kilton and Liverton mines, others were sunk between 1871 and 1881. These sustained population expansion in the south-eastern part of the region. By 1882, the last of the Cleveland shaft mines was open,<sup>5</sup> and the Skelton-Loftus zone had become the most productive

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1. North Ormesby, for example was a settlement of 500 people in 1851 but one of 7,000 by 1881. See Ida Bowes, "Cleveland and Tees-side : A Geographical Study of Population and Occupational Changes since 1800", unpublished M.A. thesis, University of London, 1948, p.121.

2. Chapman, op.cit.

3. Bainbridge (op.cit., chap.1) gives a good description of the geology of the orefield.

4. Chapman, op.cit.

5. Bainbridge, op.cit. p.46.

Table 5.5 <sup>1.</sup>

Iron-Ore Mines within the Teesside Region

<u>Mine</u>	<u>Date Opened</u>	<u>Date Closed</u>	<u>Parish</u>
Belman Banks.	1856	1885	Guisborough.
Eston.	1850	1949	Eston.
Hutton (Cod Hill).	1855	1865	Hutton Lowcross.
Ingleby.	1860	1865	Ingleby Greenhow.
Normanby.	1854	1898	Normanby.
Port Mulgrave.	1854	1880	Hinderwell.
Runswick.	1856	1858	Hinderwell.
Skinningrove.	1848	1856	Loftus.
Upleatham.	1850	1923	Marske.
Skelton Shaft.	1861	1938	Skelton.
Brotton.	1865	1921	Brotton.
Cliff Mine.	1866	1887	Brotton.
Commondale.	1866	1868	Commondale.
Crowell.	1865	1870	Guisborough.
Hob Hill.	1864	1874	Marske.
Kildale.	1866	1868	Kildale.
Kilton.	1870	1963	Kilton.
Kirkleatham.	1870	1886	Upleatham.
Liverton.	1866	1923	Liverton.
Loftus.	1864	1958	Loftus.
Lonsdale.	1866	1868	Kildale.
Lonsdale Vale.	1866	1868	Kildale.
Ormesby.	1865	1879	Ormesby.
Slapewath.	1865	1906	Stanghow.
Spawood.	1865	1895	Guisborough.
Spa.	1864	1904	Stanghow.
Upsall.	1866	1929	Guisborough.
Cragg Hall.	1871	1892	Brotton.
Boosbeck.	1872	1889	Skelton.
South Skelton.	1872	1954	Stanghow.
Carlin How or Duck Hole.	1872	1946	Kilton.
Stanghow or Margrove Park.	1872	1921	Stanghow.
Cliff (Huntcliff).	1872	1906	Brotton.
Tocketts.	1875	1877	Tocketts.
Chaloner.	1872	1939	Guisborough.
Whitecliff.	1872	1884	Loftus-Brotton.
Grinkle.	1875	1934	Easington.
Lingdale.	1878	1962	Kilton-Skelton- Stanghow.
Loftus (North).	1875	1939	Loftus.
Lumpsey.	1881	1954	Kilton.
Longacres.	1876	1954	Skelton.
North Skelton.	1872	1964	Skelton.
Roseberry.	1876	1880	Great Ayton.
Skelton Park.	1872	1938	Skelton.
Waterfall.	1880	1901	Tocketts.
Swainby.	1857	1860	Whorlton.

1. See text.

district of the orefield.<sup>1.</sup>

In the meantime, while new mines were being opened and production was increasing, older workings were steadily being abandoned. Some had been very short-lived (Table 5.5) and had had little effect on the size of the local population. For Morton, Hutton Lowcross and a few other parishes, however, the closure of mines within their boundaries was accompanied by the loss of some of the population gained in earlier decades.

The expansion of the mining industry between 1851 and 1881 made possible a large influx of people into the district. By the early 1880's, when production was at its peak, almost 10,000 ironstone miners were employed in Cleveland.<sup>2.</sup> In 1851 there had scarcely been 200.<sup>3.</sup> To accommodate the additional people, similar arrangements to those on the Durham coalfield were made. Wherever possible, rows of terraced cottages were added to existing villages and hamlets. Elsewhere, new settlements were established, such as those listed in Table 5.6 below.

Table 5.6<sup>4.</sup>

Some New Mining Settlements Built in Cleveland  
up to 1881.

<u>Settlement.</u>	<u>Nearest Mine</u>
New Marske.	Upleatham.
Margrove Park.	Stanghow and Margrove Park.
Boosbeck.	Boosbeck.
Lingdale.	Lingdale.
Charltons.	Spa Wood.
New Skelton.	Longacres.
North Skelton.	North Skelton.
Dunsdale.	Kirkleatham.

1. Smailes, North England, op.cit., p.181.

2. Loc.cit.

3. This figure strictly applies to the registration districts of Guisborough and Stokesley, in which there were 196 ironstone miners in 1851, according to the Census for that year.

4. Data from Bainbridge, op.cit., and Chapman, op.cit.

In the final quarter of the nineteenth century, the process of amalgamation was begun which was to make Dorman, Long and Company the giant of the Teesside iron and steel industry in the twentieth century. As well as blast furnace plants and finishing works, this firm took over mineral royalties in Cleveland. With many of the mines went houses, some of which were still standing and occupied in 1969, and consequently appeared in a register of properties owned by the Company at that date.<sup>1</sup> This register showed that though much reduced in numbers, cottages built to house Cleveland miners in the nineteenth century were still to be found in Brotton, Carlin How, Kilton Thorpe, Skelton, North Skelton, Guisborough and Eston.

Most of the remaining parishes which experienced high rates of population growth either contained or were adjacent to one of the main towns. Between them the parishes of Middlesbrough, Linthorpe, Darlington, Stockton, Thornaby, Hartlepool and Stranton contained virtually the whole of the region's urban area and population. Of these, only Hartlepool, which was very small and almost entirely built-over,<sup>2</sup> failed to increase its population by more than 50 per cent between 1851 and 1881.

Together, the seven 'urban' parishes held 37 per cent of the region's total population in 1851 and 54 per cent in

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1. Dorman, Long and Company, Estates Office, Middlesbrough, "Cottage Register". The Company is now, of course, part of the British Steel Corporation.
  2. The Parish and Municipal Borough of Hartlepool were coincident in area.

1881. However, the genuinely urban component is more accurately represented by data for the towns themselves. About 33 per cent in 1851 and 51 per cent in 1881 of the region's population lived in the towns of Darlington, Stockton, Middlesbrough, Hartlepool and West Hartlepool. It is clear, therefore, that the period was one of urbanization, with a relative shift from country to town as well as large increases in the population size of the towns.

Table 5.7

Populations of the Main Teesside Towns.

	<u>1851</u>		<u>1881</u>
Middlesbrough.	7,431		55,934
West Hartlepool. <sup>1</sup>	2,000	(approx)	28,000 (approx)
Hartlepool.	9,503		12,361
Stockton.	9,808		41,015
Darlington.	11,228		35,104
Urban Total	<u>39,970</u>		<u>172,414</u>
Regional Total	<u>120,915</u>		<u>336,998</u>

In addition to those containing the main urban centres, or parts of them, a number of other parishes experienced large population increases because of urban expansion. These were parishes still separated from the towns by open land but functionally connected to them as suburban areas. Near Stockton, for example, East Hartburn had begun to receive

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1. The figures for West Hartlepool are estimates. In 1851 that town did not appear separately in the Census, and therefore it must have had fewer than 2,000 inhabitants, since places with more than that number were listed. However, West Hartlepool must have had close to 2,000 people, as the parish in which it was situated, Stranton, had a population of more than 4,000. In 1881, only towns which were municipal boroughs were listed in the Census, and West Hartlepool did not have that status. The population of Stranton was then over 29,000, the bulk of which lived in West Hartlepool.



residential overspill by the end of the period, while Norton had done so even earlier.<sup>1</sup> By the mid-1860's, the land bordering the main road between the town of Stockton and the village of Norton was virtually a continuous ribbon of mixed commercial, industrial and residential land use. Similarly, continuity was established during the 1850's between Stockton and Thornaby, on the southern bank of the Tees.<sup>2</sup>

To the north and north-east of Darlington, the parishes of Cockerton and Haughton le Skerne - parts of which were within the municipal boundary of Darlington in 1881 - received industrial and residential overspill. Throston and Seaton Carew bore much the same type of relationship with the Hartlepoons, while Billingham and Cowpen parishes, on the Northern bank of the Tees, were minor industrial annexes of Middlesbrough. Low Dinsdale and Middleton St. George were more distant from any of the main towns, but their high rates of population increase were related to the establishment of an ironworks at Fighting Cocks.

Approximately one-third, 72 in number, of the parishes in the region experienced what was earlier described as 'moderate' population growth. In them, the rate of increase did not exceed 50 per cent. As were those in the other two groups, these parishes were widely scattered throughout the region. They did not, however, have much in common econom-

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1. See J. Hetherington, "A Physical and Economic Geography of Northern Tees-Side", unpublished Ph.D. thesis, University of Durham, 1958, Vol.1, pp.220-22.

2. Loc.cit.

ically. To some extent, this is as might have been expected; for some narrowly escaped depopulation and others just failed to qualify for membership of the high-growth group. Agriculture was of some importance in all of them, but many also had small manufacturing or mining interests. The non-agricultural activities prevented the onset of the population decline generally experienced by pure farming parishes, without, however, being substantial enough to promote rapid expansion.

In the mining districts of Durham and Cleveland there were parishes which had a large population increase in one decade and a decrease in another, as a result of fluctuations in mining activity, and hence only a moderate increase overall. Thus, the opening of Shotton Colliery led to substantial population expansion in the parishes of Easington and Shotton up to 1871, and its closure in the 1870's was followed by depopulation. Similarly, the abandonment of Garmondsway Moor Colliery about 1851 was followed by two decades of population decline in the parish of Garmondsway Moor, a trend which was reversed between 1871 and 1881 with the development of new mines nearby. Much of the same pattern was adhered to in Bishop Middleham, where a local colliery was closed in 1851. In North Yorkshire, short-lived ironstone workings brought a temporary population increase in the parishes of Hinderwell, Ingleby Greenhow, Whorlton and Tocketts.

In summary, it may be concluded that between 1851 and 1881 population levels rose substantially in some mining parishes and in urban parishes, that they rose more moderately in rural parishes where mining was of some importance but not expanding, and that the purely agricultural parishes experienced depopulation. The immediate explanation of population growth in the non-agricultural parishes, or rather those whose economy was not entirely dependent on farming and ancillary activities, is that new employment capacity was concentrated in the urban areas and in those rural districts with substantial mineral resources. However, the sheer scale of expansion in many of those parishes indicates the importance to them of immigration, and this, in turn, suggests that economic growth was also concentrated in such areas.

### Migration

For parts of the Teesside region, the respective contributions of migration and natural change to total population change can be determined by making use of Census material for registration districts. The excess of registered births over deaths, between one Census year and the next, was published for each registration district. If this figure is compared with total population change over the same period, then it is a simple matter to calculate the migration and natural change components. For present purposes, the adoption of the registration district gives an unduly gross system of regional sub-division. It also means that those small areas :

of the region which did not belong to registration districts entirely within the regional boundary have had to be omitted from the following discussion.<sup>1</sup> However, these disadvantages detract from the value of the analysis without nullifying it.

Boundary changes between 1851 and 1881, and the transfer of parishes from one district to another, pose a problem of comparability at the sub-regional scale which does not apply at the regional level, where the changes effectively cancel each other. It has consequently been necessary to use some figures for registration districts which are estimates rather than accurate statements of the level of migration. During the first decade of the period with which this study is concerned, the Hartlepool registration district was created out of the Stockton district. For 1851-61, therefore, the Census provides only a joint figure for natural increase in these two districts. This figure was used to establish a ratio between population size and natural increase for the two districts together, and that ratio was in turn used to estimate natural increase, and then net migration, for each district alone. The operational assumption that the ratio was equally valid for both districts is not unrealistic, as the two had much in common.

In a series of changes made in 1875, some parishes were transferred from the Stockton to the Stokesley district, and others were taken from the Stockton, Guisborough and Stoke-

1. This matter was discussed in Chapter 4. The registration districts of Darlington, Hartlepool, Stockton, Guisborough, Stokesley and Middlesbrough have been included in the analysis.

sley districts in order to form Middlesbrough Registration District. To obtain comparability with earlier years, these changes have in effect been ignored or reversed, the parishes involved being returned to their original districts and the Middlesbrough district disestablished. Because of the various changes, however, the Census figures for natural increase between 1871 and 1881 in the districts concerned are interlocked. A population-natural increase ratio was therefore calculated for them as a group. This single ratio was subsequently used to estimate natural increase and net migration for each registration district. It was felt that any errors resulting from this procedure were likely to be small, though larger than normal in the case of Stokesley, which was more purely rural than the other districts.

It is apparent from Table 5.8 that Stokesley fared rather poorly in terms, of population expansion. The total population did increase between 1851 and 1881, but by only 18 per cent (1,668 people) in a period when other districts were doubling and trebling theirs. Significantly, the direction of net migration was outward throughout the period, even in the first decade when growth was at its highest. Thus, migration steadily drained much of Stokesley's natural population increase.

Although impressive in comparison with those for Stokesley, and in isolation, the figures for population increase in Darlington indicate that expansion there was less dramatic than in the remaining three districts on Teesside. Over the

period as a whole, the population of the Darlington district rather more than doubled, rising by about 26,000 people. Net migration contributed 9,000 people, or 35 per cent of this increase. As in the region as a whole, population growth and net immigration were at their highest between 1861 and 1871. In the final decade, net migration was draining people from the Darlington district, though there had been no significant rise in the rate of natural increase. In conjunction, these two factors suggest that economic development had reached a ceiling by the 1870's.

Hartlepool Registration District trebled its population size, which involved an increase of 33,000 people, between 1851 and 1881. Net migration contributed 37 per cent of the increase. Both net immigration and expansion as a whole were at a peak in the first of the three decades. As in the case of Darlington, and, of course, that of Stokesley, there was net emigration between 1871 and 1881.

Population growth and immigration were greatest in the districts of Stockton and Guisborough, which included the towns of Stockton and Middlesbrough and had a very large share of the region's manufacturing and mining industries. Together, these districts held two-thirds of the regional population in 1881. In the preceding thirty years, the population of the Stockton district had almost quadrupled, and that of the Guisborough district had grown five-fold. In both cases, immigration had played a more important role than in the other districts. Net immigration equalled

Table 5.8

Population Change and its Components in  
Registration Districts,  
1851-81.

Registration District	Year	Population	Total Change	Natural Change	Net Immigration.
Hartlepool	1851	16,068			
			13,085	4,131*	8,954 <sup>+</sup>
	1861	29,153			
			10,817	7,134	3,683
	1871	39,970			
			8,643	9,243	-600
			32,545	20,508	12,037
Stockton	1851	36,866			
			20,233	9,652 <sup>+</sup>	10,581 <sup>+</sup>
	1861	57,099			
			42,606	14,695	27,911
	1871	99,705			
			37,629	26,741 <sup>+</sup>	10,883 <sup>+</sup>
			100,468	51,088	49,380
Guisborough	1851	12,202			
			9,926	3,172	6,754
	1861	22,128			
			16,888	5,333	11,555
	1871	39,016			
			25,895	10,467 <sup>+</sup>	15,428 <sup>+</sup>
			52,709	18,972	33,737
Stokesley	1851	9,337			
			994	1,309	-315
	1861	10,381			
			369	1,529	-1,160
	1871	10,750			
			305	2,884 <sup>+</sup>	-2,579 <sup>+</sup>
			1,668	5,722	-4,054
Darlington	1851	21,618			
			4,504	3,125	1,379
	1861	26,122			
			14,690	5,484	9,206
	1871	40,812			
			6,864	8,336	-1,472
			26,058	16,945	9,113

+Denotes estimated value.

natural increase in Stockton, and almost doubled it in Guisborough. There were, however, chronological differences between the patterns of expansion of the two districts. Net immigration and overall growth were at a peak during the second decade in the case of Stockton, but in the third in that of Guisborough.

Net migration thus contributed substantially to population growth in all registration districts but Stokesley, where emigration took toll of natural increase throughout the period. Immigration was especially important to the districts of Stockton and Guisborough, presumably in reflection of the relatively high and sustained rate of economic expansion in them. This view is supported by the fact that net emigration occurred in the districts of Hartlepool and Darlington in the decade 1871-81.

There are certain possibly ambiguous features of the migration data which merit attention. Net migration may be calculated for the region as a whole, as was done in Chapter 4, by subtracting the figure for natural change from that for total change. It is also possible, as has been done in the present chapter, to determine net migration for each individual registration district. Net migration for the region as a whole equals the sum of the values for net migration for each district. However, it is not possible to draw any conclusions concerning the destinations of external immigrants to the region. Thus, although Stockton Registration District received nearly 50,000 net immigrants



between 1851 and 1881, it cannot be concluded that it received one-half of Teesside's net immigrants. It may have been the case, for example, that Stockton's immigrants were all from other districts within the region, and that the other districts absorbed all the external migrants.

Intuitively, however, it seems probable that the bulk of the newcomers to Teesside were destined for the registration districts of Stockton and Guisborough, that much smaller numbers were bound for Darlington and Hartlepool, and that very few settled in Stokesley. It also seems likely that net emigration within the region, from Stokesley throughout the period and from Hartlepool and Darlington in the final decade, took people to Stockton and Guisborough. On the subject of external immigrants, some support is given for the interpretation offered here by Census material relating to birth-places. Table 5.9 summarises this for the Teesside registration districts in 1851 and 1861, the only years in the period covered by this study for which data are available at the level of the registration district.<sup>1</sup> It can be seen that the proportion of residents born outside the counties of Durham and Yorkshire rose, between 1851 and 1861, for all registration districts except Stokesley, and that the increase was less marked in Darlington than elsewhere.

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1. In 1871 and 1881 the birth-place tables of the Census referred only to urban sanitary districts with populations in excess of 50,000, and the only Teesside administrative unit large enough to be included was the town of Middlesbrough.

Again without conclusive evidence, it also seems probable that within the various registration districts it was the urban-industrial centres which attracted most of the migrants. This, of course, would be in accordance with the pattern common to industrializing countries and regions, and which was well marked in Britain in the nineteenth century.<sup>1</sup> In the case of Darlington Registration District, it was in the town of Darlington itself that most of the population expansion occurred (Table 5.10). An increase of only 2,000 people was registered in the remaining rural area, while the town added 24,000 to its initial population. Most of the district's 9,000 net immigrants - and the unknown but certainly even larger number of gross immigrants - must therefore have settled in the urban area.

Within the registration district of Stockton, the population rose by 100,000 between 1851 and 1881, with net immigration accounting for half of that increment. If the urban population is taken as having included people living in the parishes of Thornaby, Linthorpe and Middlesbrough, as well as in the borough of Stockton, then it grew by almost 88,000, leaving the extra-urban population to rise by 12,000. Again, immigration must have favoured the urban areas. Much the same was true of the district of Hartlepool, where most of the population growth was concentrated into the town of

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1. See C.T. Smith, "The Movement of Population in England and Wales in 1851 and 1861", Geographical Journal, Vol. 117 (1951), pp.200-210; Arthur Redford, Labour Migration in England, 1800-1850, 2nd ed., Manchester, 1964; and R. Lawton, "Rural Depopulation in Nineteenth-Century England", in Liverpool Essays in Geography: A Jubilee Collection, ed. Robert W. Steel and Richard Lawton, London, 1967, pp.227-55.

Table 5.9<sup>1</sup>.

Birth-places of the Teesside Population in 1851 and 1861

Registration District	1851				1861			
	Number Born in Durham and Yorks-hire.	Total Population	Those Born in Durham and Yorks-hire as a % of Total	Those Born Elsewhere as a % of Total	Number Born in Durham and Yorks-hire	Total Population	Those Born in Durham and Yorks-hire as a % of Total	Those Born Elsewhere as a % of Total
Guisborough	11,493	12,202	94.19	5.81	18,033	22,128	81.51	18.49
Stokesley	8,233	9,387	87.72	12.28	9,684	10,381	93.3	6.7
Darlington	19,427	21,618	89.86	10.14	22,503	26,122	86.16	13.84
Stockton and Hartlepool	43,974	52,934	83.08	16.92	65,823	86,252	76.3	23.7

1. Data from Census, op.cit., Population Tables : Ages, Civil Conditions, Occupations and Birth-Places of the People, 1851 and 1861

Table 5.10<sup>1</sup>.

Rural and Urban Components of Population  
Increase in Registration Districts, 1851-1881.

Registration District	Urban Population			Rural Population		
	1851	1881	Incr- ease	1851	1881	Incr- ease
Darlington	11,228	35,104	23,876	10,390	12,572	2,182
Hartlepool <sup>2</sup>	11,503	40,361	28,858	4,565	7,315	3,687
Stockton <sup>3</sup>	18,998	107,744	88,746	17,868	29,590	11,722

West Hartlepool. Guisborough Registration District, however, was rather different. Population expansion and immigration were very large in scale but the district did not have a true urban centre. Rather, it had a number of small mining and industrial settlements, amongst which the immigrants must have been dispersed.

Changes in the Industrial  
Distribution of the Labour Force.<sup>4</sup>

The Census material relating to employment is sufficient to allow the analysis of broad changes in the industrial distribution of the labour force between 1851 and 1871 for the various registration districts.<sup>5</sup> At the beginning of the period, in 1851, agriculture dominated the employment

1. Data from Census, op.cit.
2. Includes Hartlepool and West Hartlepool, the figures for the latter being the estimates made earlier.
3. Urban areas include parishes of Thornaby, Linthorpe and Middlesbrough, as well as town of Stockton.
4. For the data used in this section see Appendix II.
5. As in the previous section, the registration districts of Darlington, Stockton, Hartlepool, Guisborough and Stokesley are covered.

structure of the Teesside region. In the district of Guisborough more than 40 per cent, and in that of Stokesley nearly 43 per cent, of the adult labour force was engaged in farming (see Table 5.11)<sup>1</sup>. The proportion was lower in the districts of Darlington and Stockton - the latter then included the area which later became the Hartlepool registration district - but at nearly 27 and 19 per cent, respectively, it was still comparatively high for districts which contained the region's main urban-industrial centres. Only in the case of Stockton, where the transport sector employed 18 per cent of the adult labour force - because of the inclusion of a large number of seamen<sup>2</sup> -, was there another industrial group of equivalent importance.

If the adult male labour force is considered alone, then agriculture was of even greater significance. It employed 52 per cent in Stokesley, 46 per cent in Guisborough, 30 per cent in Darlington, and 20 per cent in Stockton of the male workers over the age of twenty years. Rather surprisingly, the importance of agricultural employment for adult women varied relatively little between districts. Moreover, agriculture employed its highest proportion of this section of the labour force in Darlington, and its lowest in Stokesley, which would appear to contradict the usual assumption that there is a greater variety of work for women in and near towns than in more rural districts.

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1. By 'adult' is meant people of twenty years of age or more.
  2. Some 1500 seamen were included, most of whom were probably registered in the area which later became Hartlepool registration district.

There is no ready explanation available of this paradox. However, it may have been the case that there was some substitution of female for male labour on farms in the more urbanized registration districts. Certainly, the ratio of female to male agricultural workers was lower in the Stokesley and Guisborough than the Darlington and Stockton districts : respectively, it was 1 : 14.0, 1 : 12.4, 1 : 3.6 and 1 : 6.5. Under the prevailing conditions, which included an essentially static regional economy, it is probable that the greater use made of women in the Darlington and Stockton districts resulted not from a shortage of male agricultural workers near the main urban centres, but from a surplus of them in the more purely rural districts, where there were few sources of employment for men outside farming. This, of course, would have meant that there were correspondingly fewer opportunities for women in agriculture in such areas. It may also have been the case that the importance of dairying, which provides work particularly suitable for women, near the larger towns created an additional demand for female labour in the more urbanized districts.<sup>1</sup>

Between 1851 and 1871, the relative importance of agriculture to the employment structure of the various registration districts declined quite dramatically, as can be seen by comparing Tables 5.11 and 5.12. Because of changes made by the Census authorities in the method of organising employment data, the figures for agricultural employment in 1871

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1. For information on dairying see Chapter 7.

Table 5.11<sup>1</sup>.

Occupations of Persons Aged Twenty Years or More in Teesside Registration Districts in 1851.

Industrial Order	Darlington		Stokesley		Guisborough		Stockton					
	Percentage Employed of		Percentage Employed of		Percentage Employed of		Percentage Employed of					
	Males	Fe-males	Males	Fe-males	Males	Fe-males	Males	Fe-males				
Agriculture	29.70	19.39	26.73	51.56	12.81	42.90	46.15	15.92	40.42	19.56	13.97	18.50
Fishing	-	-	-	-	-	-	1.70	-	1.38	0.69	-	0.57
Sector I	29.70	19.39	26.73	51.56	12.81	42.90	47.85	15.92	41.80	20.25	13.97	19.07
Mines & Quarries	1.40	0.63	1.17	0.64	-	0.16	6.96	-	5.64	5.76	-	4.73
Bricks, Pottery, Cement & Glass.	1.22	0.32	0.95	1.31	-	1.02	1.26	-	1.02	2.63	1.33	2.40
Chemicals, Oils & Paints.	0.68	0.32	0.57	0.21	-	0.16	4.08	0.88	3.48	0.44	0.07	0.38
Metals & Engineering	6.85	0.05	4.80	5.25	0.30	4.14	3.94	-	3.19	12.34	0.07	10.16
Precious Metals & Precision Engineering	0.58	0.05	0.42	0.21	-	0.16	0.24	-	0.19	0.27	0.13	0.25
Skins, Hides, Leather, etc.	2.89	0.05	2.03	1.27	0.15	1.02	1.59	0.13	1.31	0.63	0.07	0.53
Woodworking.	2.31	0.10	1.64	0.51	-	0.40	0.73	0.25	0.64	1.79	0.13	1.50
Paper, Books & Printing.	0.56	0.10	0.42	1.27	2.06	1.45	0.12	0.13	0.12	0.39	0.42	0.40
Building.	8.22	0.10	5.78	6.01	0.15	4.70	7.55	-	6.12	7.75	-	6.37
Gas, Water & Electricity.	0.14	-	0.10	0.04	-	0.03	-	-	-	0.14	-	0.16
Sector II	24.85	1.72	17.88	16.72	2.66	13.24	26.47	1.39	21.71	32.14	2.22	26.88

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Table 5.11 (Cont.)

Industrial Order	Darlington		Stokesley		Guisborough		Stockton					
	Percentage Employed of		Percentage Employed of		Percentage Employed of		Percentage Employed of					
	Males	Fe-males	Total	Males	Fe-males	Total	Males	Fe-males	Total			
Textiles	8.79	12.17	9.80	6.56	1.18	5.36	1.18	-	0.95	2.35	1.82	2.26
Dress	8.67	14.20	10.34	8.97	18.26	11.05	7.26	23.81	10.40	6.38	22.19	9.19
Food, Drink & Tobacco.	6.42	3.12	5.43	4.83	5.60	5.00	4.35	2.63	4.02	6.10	4.10	5.74
Transport.	7.60	0.54	5.48	2.24	-	1.74	3.79	-	3.07	22.19	0.13	18.26
Commerce.	1.40	0.05	0.99	0.55	-	0.43	0.53	-	0.43	0.72	0.10	0.61
National & Local Government.	0.95	0.23	0.73	0.51	0.74	0.56	1.44	0.25	1.21	1.01	0.33	0.88
Defence	0.52	-	0.37	0.34	-	0.26	0.15	-	0.12	0.25	-	0.20
Professions.	3.05	4.10	3.36	2.71	4.12	3.03	2.47	5.39	3.02	1.97	5.78	2.65
Domestic & Other Services.	3.38	41.35	14.79	2.58	51.83	13.58	2.61	49.63	11.54	2.26	47.34	10.28
Other Occupations & Industries.	4.69	3.20	4.24	2.41	2.80	2.50	1.91	1.00	1.74	4.41	2.05	3.99
Sector III	45.47	78.96	55.53	31.70	84.53	43.51	25.69	82.71	36.48	47.64	83.84	54.06

1. See Appendix II.

cont/...



Table 5.12<sup>1</sup>.

Occupations of Persons Aged Twenty Years or More in Teesside Registration Districts in 1871.

Group of Industrial Orders	Darlington			Stokesley			Guisborough			Stockton			Hartlepool			Stockton & Hartlepool		
	Percentage Employed of		Total	Percentage Employed of		Total	Percentage Employed of		Total	Percentage Employed of		Total	Percentage Employed of		Total	Percentage Employed of		Total
	Males	Fe-males		Males	Fe-males		Males	Fe-males		Males	Fe-males		Males	Fe-males		Males	Fe-males	
Agriculture & Fishing	15.30	10.42	14.33	42.25	20.95	37.44	12.77	10.00	12.45	7.32	5.81	7.15	5.81	4.77	5.67	6.91	5.50	6.74
Sector I	15.30	10.42	14.33	42.25	20.95	37.44	12.77	10.00	12.45	7.32	5.81	7.15	5.81	4.77	5.67	6.91	5.50	6.74
General Manuf-acturing, Mining & Construction	53.35	1.15	42.95	25.58	0.74	19.96	60.32	1.75	53.33	56.18	3.17	49.98	52.06	1.81	45.53	55.05	2.77	48.73
Sector II	53.35	1.15	42.95	25.58	0.74	19.96	60.32	1.75	53.33	56.18	3.17	49.98	52.06	1.81	45.53	55.05	2.77	48.73
Food & Drink	4.84	3.53	4.58	4.97	2.45	4.40	3.26	3.31	3.27	4.39	3.84	4.32	4.59	5.98	4.77	4.44	4.48	4.87
Textiles & Dress.	7.26	26.89	11.18	7.44	16.54	9.50	3.57	24.69	6.09	4.85	30.40	7.85	4.73	30.27	8.04	4.82	30.36	7.90
Transport.	6.33	0.18	5.11	1.97	0.12	1.55	2.75	0.06	2.43	6.58	0.26	5.84	20.95	0.36	18.29	10.52	0.29	9.28
National & Local Govt.	1.02	0.25	0.86	0.93	0.37	0.80	0.64	0.44	0.61	0.75	0.26	0.69	1.24	0.42	1.13	0.89	0.31	0.82
Defence.	0.23	-	0.18	0.18	-	0.14	0.26	-	0.23	0.07	-	0.06	0.72	-	0.63	0.25	-	0.22
Professions	2.69	7.68	3.60	2.65	4.53	3.07	1.58	5.81	2.08	1.75	5.13	2.15	1.73	5.68	2.25	1.75	5.30	2.18
Domestic & Other Services	2.39	47.12	11.32	2.90	52.20	14.04	1.69	52.19	7.72	1.58	47.51	6.98	1.65	47.65	7.65	1.60	47.62	7.16
Commerce.	2.27	1.37	2.09	2.25	1.47	2.08	1.04	1.06	1.04	1.95	2.64	2.03	2.16	2.30	2.18	2.01	2.53	2.08
Other	4.35	1.37	3.76	8.91	0.61	7.03	12.12	0.69	10.75	14.56	0.97	12.97	4.40	0.54	3.90	11.79	0.85	10.46
Occupations.	31.38	88.39	42.76	32.20	78.29	42.61	26.91	88.25	34.22	36.48	91.01	42.89	42.17	93.40	48.84	38.07	91.74	44.97
Sector III	31.38	88.39	42.76	32.20	78.29	42.61	26.91	88.25	34.22	36.48	91.01	42.89	42.17	93.40	48.84	38.07	91.74	44.97

1. See Appendix II.

are combined with those for fishing. For comparative purposes, therefore, as was pointed out in Chapter 4, agriculture and fishing must also be combined for 1851. However, employment in the fishing industry was negligible on Teesside,<sup>1</sup> and it is justifiable to term Sector I (in Tables 5.11 and 5.12) the agricultural sector.

Even in the case of Stokesley, the most rural of the Teesside registration districts, the proportion of the adult labour force employed in agriculture was  $5\frac{1}{2}$  per cent lower in 1871 than in 1851. For Guisborough, the proportion had fallen by  $29\frac{1}{2}$  per cent, from 42 to  $12\frac{1}{2}$  per cent. By 1871, Sector I, accounted for less than 7 per cent of the adult labour force of the combined Stockton-Hartlepool district,<sup>2</sup> whereas it had employed 19 per cent in 1851. Similarly, there had been a reduction from 27 to 14 per cent in the Darlington district. In the cases of Darlington and Stockton-Hartlepool there had been a very small absolute increase in the number of agricultural workers, suggesting an intensification of production, but in the other two districts there had been a small decrease. The shift in employment away from agriculture was thus essentially relative; the absolute numbers of agricultural workers changed very little.

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1. In 1851, and probably also in 1871, there were no employees of the fishing industry in the districts of Darlington and Stokesley.

2. Stockton and Hartlepool are considered jointly to ensure the comparability of the data for 1871 with those for 1851, when the Hartlepool district had still not been formed.

Taking total adult employment first, the shift from Sector I was largely directed towards Sector II. The latter consists of the manufacturing, mining and construction industries, which is a rather cumbersome assemblage but cannot be disaggregated because of the nature of the data available. Sector II raised its share of the adult labour force in all districts, as would be expected during industrialization. The increase was most spectacular in the district of Guisborough, where employment in the manufacturing and mining sector rose from about 22 to 53 per cent. This was mainly attributable to the expansion of iron-ore mining and to the establishment of ironworks in some of the northern parishes.<sup>1</sup>

A much more modest rate of industrialization affected the district of Stokesley, where the proportion of adult workers employed in Sector II rose from 13 to 20 per cent. This increase was almost entirely due to the expansion of mining and quarrying in the district.<sup>2</sup> In the combined Stockton-Hartlepool district, employment in Sector II rose from 27 to 49 per cent, and in Darlington from 18 to 43 per cent, of the adult labour force. In both cases, the development of the iron and heavy engineering industries was largely responsible, for these districts contained Teesside's main manufacturing centres.

Sector III consists essentially of service industries, and normally the service sector would be expected to assume

1. In 1871, one-half of Guisborough's adult male labour force was employed in the Census industrial group which included iron manufacture and mining.
2. The increase amounted to a few hundred people, and in 1871 there were that many employed in the industrial group which included mining, whereas there had not been in 1851.

a position of greater importance in the employment structure as a result of industrialization, benefiting to some extent from the shift away from agriculture. In the case of Teesside, however, the proportion of working adults employed in the tertiary sector fell in all districts, and most substantially in those of Darlington and Stockton-Hartlepool, between 1851 and 1871. If the industrial orders within Sector III are compared in Tables 5.11 and 5.12, it can be seen that every group but 'Commerce' experienced a decline in its share of the labour force in nearly all districts. However, this relative shift was not accompanied by an absolute reduction in the numbers of service workers; Sector III gained large numbers of recruits in all districts but Stokesley, where the increase was small.

Superficially, it might appear that the tertiary sector failed to keep pace with the expanding mining and manufacturing industries, and that it was slow to respond to the challenge of new opportunities. However, the service industries did expand; they employed more people and they catered for a much larger population. That employment in the tertiary sector did not grow at the same rate as the labour force as a whole was largely due to rising productivity in its member industries. In addition, there were perhaps some social factors at work. Thus, the relative decline in the numbers engaged in domestic service can reasonably be attributed to the fact that Teesside was undergoing industrialization, and that the demand for dom-

estic servants tends to be proportionately lower in an industrial than a rural society.

Although the trends in male adult employment matched those in the labour force as a whole very closely, because of the preponderance of male workers, there were some interesting discrepancies between them and the changes taking place in female employment. For example, the proportion of adult working women engaged in agriculture rose substantially in the district of Stokesley, though it declined elsewhere. This shift into agriculture in Stokesley was absolute as well as relative, and it probably resulted from the need to replace males who were leaving farming to go into mining or manufacturing. In Stokesley Registration District, in the period 1851-71, there were more women who entered agricultural employment than there were men who left it, and there was consequently a small increase in the total number of agricultural workers.

In the other districts, agriculture's share of the adult female labour force declined, not, however, to the advantage of the secondary sector. Generally, female employment in Sector II also declined proportionately. This was because Sector II was on Teesside dominated by mining and heavy engineering, which provided relatively few employment opportunities for women. It was the service industries, particularly the 'Food and Drink' and 'Textiles and Dress' group, which absorbed the shift from agriculture in the registration districts other than Stokesley.

Finally, there was a small but general decline in the proportion of the adult population which was unoccupied (Table 5.13). As was explained in Chapter 4, this is a normal concomitant of industrialization. Interestingly, this decline was brought about by changes in male rather than female employment. Indeed, the proportion of unoccupied females rose in all districts but Stokesley, presumably because economic expansion on Teesside created relatively more employment opportunities for men than for women.

Table 5.13<sup>1</sup>.

Unoccupied Percentage of the Population over  
Twenty Years of Age in Registration Districts.

	<u>1851</u>			<u>1871</u>		
	<u>Males</u>	<u>Females</u>	<u>Total</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Darlington	2.81	65.27	36.93	0.23	73.72	35.99
Stockton-Hartlepool	2.59	78.09	39.67	0.17	83.10	37.32
Guisborough	2.94	76.70	39.40	0.14	81.85	35.03
Stokesley	3.43	73.33	39.08	0.46	71.09	35.87

Summary.

In one-third of the Teesside parishes the population declined, generally by less than 20 per cent, between 1851 and 1881. The parishes in this category were scattered throughout the region, and their common characteristics were of an economic rather than a locational nature. They were essentially rural parishes almost totally dependent on agriculture, though some employment was afforded by residentiary service industries, and as such they underwent depopulation regardless of their proximity to or distance

1. See Appendix II.

from the main urban centres:

Another third of the region's parishes experienced population growth in excess of 50 per cent. The members of this group contained at least part of one of the large towns, were in an area where coal mining was expanding, or they were development points within the Cleveland ironstone-mining district. The remaining parishes underwent a more moderate increase in population size, and, predictably, they were intermediate in character between those of the other two groups. Some were parishes in which mining was well established but had little tendency to expand. Most, however, had a strong agricultural base with just a leavening of small-scale manufacturing or mining enterprises.

Migration can be discussed only at the comparatively broad scale of the registration district, but it played an important part in each of the Teesside districts. Stokesley was the most rural and agricultural of the registration districts within the region, lacking a large town and being without a substantial manufacturing or mining element in its employment structure. There, migration imposed a heavy toll on natural increase. In each of the three decades from 1851 to 1881, Stokesley lost population through net migration. Overall, this process drained away more than two-thirds of the district's increment due to natural increase.

In the other registration districts net migration resulted in large influxes of people. The population of the

Darlington district more than doubled in size, and net migration was responsible for a third of the increase, which was about the same proportion as in the case of Hartlepool. Net immigration equalled natural increase in the district of Stockton, where the population quadrupled in size, and in Guisborough, which had a five-fold growth, it was twice as large. In each registration district, with the obvious exception of Stokesley, the decade in which overall population expansion was highest coincided with that in which net immigration was at its peak. This was 1861-71 in the cases of Darlington and Stockton, 1851-61 for Hartlepool, and 1871-81 for Guisborough.

As well as being a period of population growth, 1851-81 was also one of urbanization, in that during it a greater proportion of the region's population became domiciled in the main towns of Darlington, Stockton, Hartlepool, West Hartlepool and Middlesbrough. This proportion was 33 per cent in 1851 and 51 per cent in 1881. Although many individual parishes experienced depopulation in the interim, the rural component of each registration district, as a whole, underwent population growth. Urbanization was achieved, therefore, largely through immigration, though the limitations of the available data prevent a fuller analysis of this relationship.

The basic economic character of Teesside in the mid-nineteenth century is revealed by the fact that agriculture was the major employer of labour in 1851. In the Stokesley



registration district farming employed 43 per cent of the adult labour force at that date. The proportion was somewhat lower in other districts, but even in Stockton almost one-fifth of working people over the age of twenty years were engaged in agriculture. There were some fundamental changes during the following twenty years. The number of agricultural workers remained at about the same level, but agriculture's share of the labour force fell dramatically in all districts but Stokesley, and even in the latter there was a small decrease. It was the manufacturing and mining sector which benefited from this shift; for there was also a general, though small, decline in the proportion of the labour force employed in service industries.

These various trends require comparison with the theoretical models of spatial development described at the outset. The very high rates of population increase in the urban and some of the mining parishes, which were largely due to immigration, are not in themselves conclusive evidence that economic growth occurred in those parishes, or, if it did, that it was greater than normal. They could, for example, simply reflect the creation of new employment capacity and a shortage of jobs elsewhere. Equally, depopulation in parishes where agriculture provided the economic base is not significant in isolation. These changes should be examined in conjunction with shifts in the employment structure.

The areas where population expansion, and immigration, were concentrated were also the areas in which there was a relative shift of labour - and obviously other resources too - from agriculture into manufacturing and mining. In effect, bearing in mind the nature of the Teesside economy in 1851, this amounted to industrialization in those localities. Resources were transferred or shifted to industries with higher and faster growing rates of productivity than agriculture. The fact that this relative movement was accompanied by a large absolute expansion of the labour force intensified the effect on the regional economy. Hence, the urban parishes and some parishes in the coalfield and orefield districts were the areas where economic growth was most rapid and substantial.

This conclusion differs somewhat from the situation envisaged by the Myrdal-type model, in that it recognises some rural places as high growth points. However, this is a short-term discrepancy. In the long run, rural districts with high rates of economic growth based on mining will either become fully-fledged urban industrial centres or will tend to stagnate, as mineral resources and opportunities for obtaining further rises in productivity are exhausted. The latter was the fate of the Cleveland mining district in the twentieth century.

CHAPTER SIX  
THE LOCATION OF MINING

The spatial pattern of economic growth as a whole having been considered, this chapter is the first of a series concerned with the locational adjustments growth involves in individual sectors of the economy. The basic approach adopted throughout is that of subjecting orthodox location models to the forces experienced by growth areas, and comparing the theoretical results with the patterns of events on Teesside.

A Theoretical Framework.

In one sense, at least, the location of mineral-extracting industries presents only a trivial problem; such industries must be materials oriented. Nevertheless, there are locational matters of theoretical interest. To argue that coal mining, for example, is oriented to coal deposits is as unhelpful as it is verging on the tautological. Moreover, coal is not mined wherever it occurs. Why one mineral deposit should be worked and another left untouched, and why there should be variations in the timing and extent of development between places within a mineral field are problems for the location theorist. Generally, however, they have attracted little interest; "for too long the problem of location, whether at the level of the individual mine or the producing field, has been considered in only the most cursory fashion . . . ."<sup>1</sup>

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1. M.G.A. Wilson, "Towards a More Analytical Geography of Mineral Production", Professional Geographer, Vol.19 (1967), p.176.

### The Least-Cost Principle.

One avenue of approach to the location problems set by mining industries is provided by Weberian least-cost analysis. The location of extractive industries, like that of other economic activities, may be considered at two levels: that of the industry and that of the firm or, rather, the individual establishment. At the industrial scale, the location involves the choosing of one from a number of potentially productive and profitable areas, or mineral fields. Both Hoover and L<sup>ö</sup>sch have noted that the choice is based upon the consideration of the cost of producing a particular commodity in, and despatching it from, each of the feasible areas together with the price to be obtained for it in known or anticipated markets.<sup>1</sup> Under conditions of perfect competition, and in other, less idealistic circumstances,<sup>2</sup> profit maximization is obtained by keeping costs to a minimum. The area selected for development, with a particular market in mind, will therefore be the one where total costs, including transfer and production costs, will be lowest.

In a recent publication,<sup>3</sup> Wilson used the least-cost principle to account for the emergence of the spatial pattern

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1. E.M. Hoover, Location Theory and the Shoe and Leather Industries, Cambridge, Massachusetts, 1937, pp.7-8; August L<sup>ö</sup>sch, The Economics of Location, 2nd.ed., trans. William H. Woglom, New Haven, 1954, p.35.
  2. As, for example, when either buyers or sellers fix the market price of a commodity, which is common with primary products.
  3. M.G.A. Wilson, "Changing Patterns of Pit Location on the New South Wales Coalfields", Annals of the Association of American Geographers, Vol.58(1968), pp.78-90.

of individual firms or mines within a single coalfield. He formulated a simple descriptive model of development based on a hypothetical field with one thick coal seam dipping away from its line of outcrop, which runs close to the regional market or collection point for the coal. During the initial phase of exploitation, total costs are minimized by tunnelling adits into the outcrop at points as close to the market as possible. This ensures both low working and low haulage costs, since the face requires little preparation and can be mined with the simplest of methods, while the produce has to be transported only a short distance.

With time, it becomes necessary to establish new adits further removed from the market. This is because the working and underground-haulage costs have risen to such a level that it is cheaper to open new mines, despite the higher surface-transport costs that entails, than to continue pushing the original adits to still greater depths and distances from the market. Even so, total costs will be higher than they were initially.

In the third phase of development, the model predicts a return to the original mines, which once again have the coal faces nearest to the market. At this stage, however, technical and economic limitations to the depth at which it is feasible to work adits may require the sinking of shafts<sup>1</sup>. Despite the adoption of this relatively expensive innovation

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1. Drainage and ventilation problems may require the sinking of shafts.

total costs will be kept to a minimum. In a final stage, the model foresees the sinking of deeper and deeper shafts, with each set still further from the market, as the more easily accessible coal is exhausted.

Although Wilson himself did not do so, it is logical to suggest that one more stage should be added to the model to complete the sequence of development. Thus, costs will rise steadily, though technical innovations may bring temporary relief, as the depth of workings and their distance from the market increase. Ultimately, there will come a time when mining is no longer profitable at the prevailing price level, and the price cannot rise further without opening the regional market to coal from alternate sources. The mineral field will then be exhausted in an economic sense, even though it still possesses physical reserves of coal. As it stands, however, Wilson's model appears to provide a satisfactory explanation of development in Australia's New South Wales Coalfield, which is still productive.

An even simpler and more fundamental model can be applied to a wide range of primary industries. The necessary assumptions or conditions are : a resource field of uniform quality - and with horizontal seams in the case of a mineral deposit -, equal transport facilities in all directions, a single and contrally located market, and a perfectly competitive economy. According to the least-cost principle, producers will attempt to maximize their profits by minimizing their costs. If transport outlays are the only cost variable,

as they are in this basic model, then producers must locate as near to the market as possible. Development will therefore lead production away from the market, in all directions, until the point is reached at which transport costs are so high that profit margins disappear and production comes to a halt.

This basic model of development is highly simplified, but it can be modified quite readily to admit more realistic conditions. In particular, for both theoretical and practical purposes, it is preferable to regard spatial variations in the cost of working raw materials as normal rather than aberrant. Internationally, and to a lesser extent inter-regionally, such variations are encouraged by differences in the availability of capital, technical sophistication, levels of knowledge and skill, factor prices and many other circumstances. Within a single region, however, these tend to be less important than differences in the quantity and quality of the material resources in question.

Wilson's coalfield model tentatively admits the possibility of variations in working costs by stipulating a coal seam that is constant in quality and thickness but which dips with distance from the market. Effectively, this is the equivalent of a horizontal seam which decreases in thickness or quality, or both, since the result in both cases is a steady rise in working costs. Thus, the increasing depth, deteriorating quality and diminishing thickness of a mineral bed, like greater distance from the market, all

tend to raise total costs. These considerations may be usefully elaborated with reference to the basic location model in which transport outlays are the only cost variable.

If the cost of working a mineral increases with distance from the market, then the radius of the potentially productive area will be smaller than if rising transport costs alone set the limit. Conversely, a steady decrease in working costs with distance from the market will give the supply area a larger radius than would otherwise have been the case. Here, however, the effect may be relatively slight, with falling production costs only partially offsetting rising transport costs. On the other hand, working costs may decline at a faster rate than transport costs increase, with distance, so that total costs also decrease. In this event, development should logically have begun at a distance from the market and moved towards it, because of the reversal of the total-cost gradient. With perfect knowledge on the part of entrepreneurs, this would have occurred.

A third possibility is that physical conditions may be such that working costs do not change regularly with distance but exhibit high and low values in different parts of the resource field. This situation could arise where a mineral has been deposited on an uneven surface, and is consequently very dense in former hollows and sparse elsewhere. In this case, there will be a series of localized working cost gradients. Provided that the field has been thoroughly surveyed beforehand, development should occur first at those scattered



points where total costs are lowest, regardless of the respective contributions of working and transport costs.

Further deviations from the basic model can be accommodated by relaxing the initial stipulations of a single market and uniform transport facilities in all directions, conditions which give rise to a circular supply area. The introduction of several competing market centres has the effect of reducing the extent of the supply area each would have in isolation, since there will be zones of overlap which must be apportioned to the various centres. The basic circularity of the supply areas will therefore give way to geometric forms outlined by straight edges, as zones of contention are bisected or otherwise divided. The existence of differential transport facilities will also cause some distortion of the supply areas. The building of a railway, for example, would reduce transport costs in the areas through which it passed, causing the outward extension of the supply area in that direction.

#### Land-Rent Theory.

It is also possible to approach the location problem for the primary sector through the medium of land-rent theory, which has its origin in the model of agricultural land use proposed by von Thünen.<sup>1</sup> Essentially, it is

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1. See : Walter Isard, Location and Space-Economy, Cambridge, Massachusetts, 1956, pp.200-206; Edgar S. Dunn, The Location of Agricultural Production, Gainesville, 1954; Michael Chisholm, Rural Settlement and Land Use, 2nd ed., London, 1968, chap.2; Edwin von Böventer, "Towards a United Theory of Spatial Economic Structure" Papers of the Regional Science Association, Vol.10 (1963), pp.165-68; William Alonso, Location and Land Use : Toward a General Theory of Land Rent, Cambridge, Massachusetts, 1965.

concerned with the determination of the optimum pattern of land use in a given area, and applies to industries rather than firms. For rural areas around a city, and for urban areas around a city centre, the theory predicts a decline in the value of land and in the intensity of land use with distance from the central point.<sup>1.</sup>

Briefly, the projected equilibrium pattern of land use is attributable to spatial competition amongst the potential users of land.<sup>2.</sup> In the case of agriculturists, proximity to the market centre of a region confers certain advantages, notably those of low transport costs and ease of access to consumers. These very advantages, however, ensure that land is more expensive the nearer it is to the market. Through the price system, land is allocated to different uses on the basis of their respective abilities to bid for it, which in turn depend on their respective capacities to derive advantage from it. To be represented in a region, a particular type of land use, or industry, must be able to out-bid all potential rivals for land at some location.

Firms and industries are thus obliged to compete with one another for production sites. In placing spatial competition to the fore, land-rent theory is more general than Weber's least-cost mode. of analysis, which concentrates on one firm or industry at a time and ignores the fact that a

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1. Boverter, op.cit., p.167.

2. This matter is dealt with more thoroughly in a later chapter.

particular location may be the optimum for more users than can be accommodated. As Dunn has said, Weber

"... does not allow for the fact that the minimum transport point for the firm may coincide with that of another firm producing a different product and capable of paying a higher premium for the use of that site".<sup>1</sup>

It follows that an individual firm, or industry, may be unable to afford the location which would allow it to minimize costs, in which case it must seek the best alternative. The location eventually adopted will be that where costs are lower than at any of the others where potential rivals can all be out-bid.

For the non-agricultural part of the primary sector, however, land-rent theory is usually of limited value. Mining, for example, normally occurs in unequivocally rural areas, where the only competition for land comes from agriculture. In contrast with farming, mining requires comparatively little surface land and its rental payments are a minor item in the total cost bill.<sup>2</sup> Generally, therefore, a mining industry can afford to pay more than agriculture for a given unit of land, and it takes precedence over the latter in the event of competition for a particular location arising.

Other extractive industries may be in a less strong

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1. Dunn, op.cit., p.88.

2. Mining's sub-surface land requirements are irrelevant because it is only on the surface that there is competition with other industries.

competitive position than mining. Stone, clay, gravel and similar materials are usually relatively ubiquitous, compared with minerals. The optimum locations, determined on the basis of the least-cost principle, for firms engaged in their extraction are accordingly very close to the markets for those materials. As the markets are normally towns and cities, competition for land often arises in a very acute form.

This point may be illustrated with reference to the wartime surveys undertaken to evaluate Britain's sand and gravel deposits.<sup>1</sup> The riverine gravel beds of the Thames valley, for example, represented not only a vital resource for the London construction industry, but provided high quality land for both building and intensive farming. Competition for this land meant that while quarrying was steadily displacing agriculture, and thereby sterilizing good farm-land, urban expansion was debarring quarrying, and sterilizing good gravel deposits. In theoretical terms, therefore, the extractive industries were able to out-bid agriculture for the land in question, but were themselves unable to compete with urban-industrial uses.<sup>2</sup>

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1. See : S.H. Beaver, "Minerals and Planning", Geographical Journal, Vol.104 (1944), pp.166-93, and S.W. Wooldridge and S.H. Beaver, "The Working of Sand and Gravel in Britain : A Problem in Land Use", Geographical Journal, Vol.115 (1950), pp.42-57.

2. In this context see R.H. Best and R.M. Gasson, The Changing Location of Intensive Crops : An Analysis of their Spatial Distribution in Kent and the Implications for Land-Use Planning, Studies in Rural Land Use, Report No.6, Department of Agricultural Economics, Wye College, Kent, 1966, 91 pp.

Locational Change During  
Economic Growth.

Since the present study, in its empirical aspects, is concerned with a region undergoing industrialization, this section is focused upon locational change in an economy experiencing growth through industrialization. Historically, the primary sector has shared fully in the process of industrial revolution. It has done so by passively supplying, in sufficient quantity and at a reasonable cost, the materials required to make possible the development and expansion of manufacturing, and by stimulating that expansion through raising its output and lowering its costs. Particularly in relatively backward areas, it has often been the primary sector that has initiated economic growth and created favourable conditions for industrialization. Rapid change in, and affecting, the extractive industries is therefore normal during industrialization, with significant consequences for their location patterns.

On the demand side of the equation, industrialization is accompanied by a massive increase in the total demand for raw materials and by structural shifts in the pattern of demand. For most materials demand rises, but for a few it declines, as manufacturers find cheaper or superior substitutes and as changes in taste or fashion cause the market to shrink. Amongst the industries producing materials for which there is an expanding market, there will be differences in the rate of development.

For suppliers, rising demand makes possible the attainment of greater scale economies and tends to encourage innovation. Both of these lead to a reduction in unit costs, which may bring about a further increase in demand. Through its effect on costs, innovation in the primary sector may actually be the origin of expansion in the secondary sector. In this respect, it may be aided by external developments which reduce the costs of primary products at the market. Historically, railway development has been of great importance in this context. During industrialization, these various types of change are usually closely interwoven, with the demand for primary commodities growing both independently of and because of falling costs. The net result for the typical primary industry is a rise in output.

With the introduction of the spatial dimension, the orthodox economic explanation of how the output of an industry is raised becomes inadequate, especially with reference to the primary sector. If existing firms are operating at the optimum scale for a given industry and no innovations occur to alter this position, it would normally be the case that a rise in demand, and hence price, would be countered by the entry of new firms to supply the additional demand and force a return to the original price level. Taking the example of a mining industry, however, new firms would not be able to compete on equal terms with those already established; they would be obliged to adopt production sites where costs were relatively high - due to their greater

distance from the market or the poor quality of their mineral resource -, since not all firms can have the least-cost location for the industry. For the newcomers to accept inferior locations, the price of the commodity in question would need to be sufficient to offer the prospect of a normal profit, despite the relatively high costs.

In the short run, the original firms would be able to earn excess profits, because of their cost advantage. In the longer term, however, that advantage would be annulled; according to land-rent theory, competition would arise for the best locations and the firms occupying them would be required to pay a higher premium. Hence, their total costs would be no lower than those of firms at other locations. Overall, average cost and price levels would be higher than they were originally, because of the entry of new and poorer locations into production.

This, however, takes no account of the innovations and cost reductions which, as was stated earlier, normally accompany industrialization. Depending on their scale, cost reductions through innovation - whether internally or externally inspired - partially or totally offset the increase in costs due to the industry's adoption of poorer locations. The building of a railway, for example, can so reduce costs that mining becomes economically feasible at locations far from the market. Similarly, the development of a new process of extraction can give economic value to a mineral resource which would previously have been too costly to be

worth working. Thus, the utilization of poorer locations may be quite compatible with a general decline in the cost of producing a material and conveying it to market.

Not all primary industries in a particular region will benefit from rapid economic growth. Innovations in the transport sector, such as the construction of a network of railways, may bring about the demise of some industries by exposing them to competition from regions with superior natural resources at their disposal. Again, technical progress in the manufacturing sector may lead to the decline of an industry by resulting in the discovery of a substitute for its product, which is preferable in terms of quality, cost or both. Similarly, changes in public taste, as a result of greater affluence, may contribute to the decline of demand for certain materials, and hence to the reduction of the industries producing them. Industrial contraction is therefore as much a part of economic growth as expansion, though it tends to be overshadowed by the latter. During contraction, it is to be expected that the poorest, or most costly, locations will be the first to be abandoned by an industry.

#### Mining Industries on Teesside.

Within the boundaries of the Teesside region there were sufficient minerals and other raw materials to support a variety of extractive industries in the nineteenth century. Ironstone mining was the most important of these in the period with which this study is concerned, but there were



others operating at a smaller scale. Of the latter, jet working provides one example. This was an ancient trade, though neglected since the Elizabethan era, which experienced a mild resurgence in the early nineteenth century.<sup>1.</sup>

By 1850, ornaments and jewellery fashioned from jet were very popular in Britain. Whitby, the centre of the industry in North Yorkshire, had acquired a certain fame for the quality of its jet ware.<sup>2.</sup> The raw material occurs, rather erratically, in the Upper Lias shales and it was worked almost wherever these strata were exposed, along the coastal cliffs of the North Riding and the inland scarps of the Cleveland Hills and their northern outliers at Eston and Upleatham.<sup>3.</sup>

In the later 1870's the jet industry began to decline, in North Yorkshire at least, and it provides an interesting example of industrial contraction at the regional scale. Competition from French and Spanish suppliers, who were able to offer cheaper though poorer quality goods, and an adverse change in fashion, which reduced the demand for jet, were largely responsible.<sup>4.</sup> The latter is a factor to which producers of luxury goods are especially vulnerable.

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1. C. Fox-Strangways, Yorkshire, Vol.1 of the Jurassic Rocks of Britain, Memoirs of the Geological Survey of the United Kingdom, London, 1892, pp.455-56.
  2. Loc.cit. By 1873, there were 200 workshops in Whitby, giving employment to 1,500 people. The value of the output in that year was put at £90,000.
  3. Ibid., pp.127-30.
  4. Ibid., p.456; and M.R.G. Conzen, "The Growth of Whitby", chap.1, pt.2 of A Survey of Whitby and the Surrounding Area, ed. G.H.J. Daysh, Eton, Windner, 1958, p.68.

It also seems probable, however, that production costs were on the rise in North Yorkshire by that time, and this would have damaged the industry's position. The traditional practice of the jet miners was to obtain their supplies by means of quarrying, but by the 1870's the more easily, and cheaply, won deposits had been exhausted and the tunnelling of adits was common.<sup>1</sup> This was more costly than quarrying. It would almost certainly have been the case, therefore, that the industry would have met with difficulty even without the growth of foreign production and a decline in demand related to fashion rather than price.

A second minor extractive industry was represented by coal mining in North Yorkshire. Although the Coal Measures of the Carboniferous era do not extend south of the Tees,<sup>2</sup> there are younger coal seams in the North York Moors which, though thin and of a relatively poor quality, were worked throughout the nineteenth century at certain places. These seams occur amid the shales and sandstones of the Inferior Oolites, in the Middle Jurassic, and they were mined mainly in the Esk valley and the moorland dales to the south of it.<sup>3</sup> Further north, the working of coal was rarer, but by no means unknown.<sup>4</sup> At Clitherbeck, near Castleton, there was

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1. See quotation from an article by J.A. Bower in Fox-Strangways, op.cit., p.457.
  2. A.E. Smailes, North England, London, 1960, p.19
  3. Fox-Strangways, op.cit., pp.192-94 and 223-27.
  4. For example, in the vicinity of Skelton. See ibid., pp.223-27 and 459-60.

a pit which is said to have employed more than forty men even in the 1880's.<sup>1.</sup>

Apart from its use in the home, moorland coal found : : its main application in lime-burning in the Pickering district.<sup>2.</sup> The miners were local men, many of them farmers, and the coal deposits gave them domestic fuel, part-time employment at least, and a means of subsidising their purchases, and carriage, of lime from Pickering for their land. Both before and after the building of railways around the edge of the upland area and through the Esk valley, coal from Durham reached the moorland settlements of north-east Yorkshire by means of pack animals driven by pannier-men.<sup>3.</sup> It therefore seems probable that the mining of coal in this district would not have survived, other than for domestic purposes, without the trade in lime. Though of poor quality, the Jurassic coal was suitable for burning lime and the moorland farmer, who was often little above the subsistence level and seldom had much cash available, took advantage of it.

At various places, scattered throughout the region, a number of other materials were extracted on a relatively small scale. Limestone, for example, was quarried at Coxhoe and near Middleton Tyas, though virtually all of that

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1. Ida Bowes, "Cleveland and Tees-Side : A Geographical Study of Population and Occupational Changes since 1800", unpublished M.A. thesis, University of London, 1948, p.29.

2. Fox-Strangways, op.cit., p.459.

3. J.T. Sewell, An Account of Some Mediaeval Roads Crossing the Moors South and South-West of Whitby, Whitby, 1923, p.18.

used in the Teesside blast furnaces came from Weardale, outside the region. Most of the villages and towns provided markets for local sandstone, torn from the scarp edges and valley sides to be used as a building material.<sup>1</sup> In the phase of rapid urban expansion, however, it was clay, from the drift covering the lowlands of the Tees basin, and not stone which provided the main constituent of the rows of terraced, brick houses which were erected to accommodate the influx of industrial workers.<sup>2</sup> Whinstone, from a dyke which traverses Cleveland in a south-easterly direction from Preston on Tees, also proved a valuable local construction material. It was particularly useful as a road-metal and was employed to cobble the main streets of Yarm, Stockton, Stokesley, Guisborough and even Leeds.<sup>3</sup>

For most of the extractive industries represented on Teesside, however, it would be neither practicable nor of much value to examine their spatial development. Generally, they employed few people (Table 6.1) and had small outputs. The Durham coalfield extended into the region, but the development of coal mining would be better studied in relation to the coalfield as a whole. It was therefore decided to focus upon the Cleveland iron-ore mining industry.

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1. Bowes, op.cit., pp.25-27.

2. Ibid., p.44.

3. Ibid., pp.41-42. In the 1890's, the quarries at Great Ayton were purchased by the Leeds Corporation.

Table 6.1<sup>1</sup>.

Employment of Persons of Twenty Years of Age or More in Mining  
and Quarrying in Registration Districts

	<u>Stockton-Hartlepool</u>		<u>Darlington</u>		<u>Guisborough</u>		<u>Stokesley</u>	
	<u>1851</u>	<u>1861</u>	<u>1851</u>	<u>1861</u>	<u>1851</u>	<u>1861</u>	<u>1851</u>	<u>1861</u>
Coal Mining.	589	1196	3	4	25	27	3	3
Stone Quarrying.	40	72	16	19	7	55	6	30
Limestone Quarrying.	5	4	7	16	-	-	1	1
Lead Mining.	1	1	-	-	-	-	-	-
Clay & Stone Extra- ction.	93	22	27	7	5	1	4	-
Ironstone Mining.	-	2	-	-	195	1300	1	71
Others in Mining.	-	4	-	10	-	147	-	58

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1. Data from Census; see Chapter 5.

Iron-Ore Mining in Cleveland.

The Development of the  
Industry to 1850.

Although little use was made of the knowledge until after 1850, iron-ore deposits were known to be widespread in north-east Yorkshire long before that date. Quite apart from the evidence of medieval iron working<sup>1</sup>, there are reports from geologists, mining engineers, naturalists and others to indicate as much.<sup>2</sup> In addition, Cleveland iron ore was used virtually continuously, though on a small scale, from at least the mid-eighteenth century.

During its working life, which lasted from 1745 to about 1800, a blast furnace at the Whitehill Ironworks, near Chester-le-Street in Durham was operated on ore collected from Robin Hood's bay on the North Yorkshire coast.<sup>3</sup>

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1. Scoria heaps and the remains of ancient forges, which had clearly used local ore, were known in Westerdale, Bransdale, Rosedale, and Eskdale. See : J.C. Atkinson, "Existing Traces of Mediaeval Iron Working in Cleveland", Yorkshire Archaeological Journal, Vol.8 (1884), pp.30-48; and B. Waites, "Medieval Iron Working in Northeast Yorkshire", Geography, Vol.49 (1964), pp.33-42.
  2. Eg. see G. Young and J. Bird, Geological Survey of the Yorkshire Coast, London, 1828; J. Phillips, Illustrations of the Geology of Yorkshire, 3rd ed., London, 1875; and John Marley, "Cleveland Ironstone : Outline of the Main or Thick Stratified Bed, its Discovery, Application, and Results in Connection with the Ironworks in the North of England", Transactions of the North of England Institute of Mining Engineers, Vol.5 (1856-57), pp.165 - 223.
  3. I. Lowthian Bell, "On the Manufacture of Iron in Connection with the Northumberland and Durham Coal-Field", Transactions of the North of England Institute of Mining Engineers, Vol.13 (1863-64), p.115.

Similarly, the Tyne Iron Company, which had a works at Lemington on Tyneside, drew supplies of ironstone from the coast between Saltburn and Scarborough from very early in the nineteenth century.<sup>1</sup> Initially, the ore was simply collected in baskets from the fallen debris at the foot of the cliffs, and then shipped northwards in vessels small enough to be beached for loading purposes. Between 1815 and 1820, however, the Tyne Iron Company began to supplement this material with ironstone quarried from the cliffs and the rock pedestal at their base.<sup>2</sup>

Most of the ore gathered in this early period seems to have been in the form of nodules found in the numerous, though discontinuous and erratic, bands of nodular ironstone belonging to the Mid-Lias shales.<sup>3</sup> It has been suggested, however, that some must almost certainly have come from the more substantial Main Seam of the Ironstone Series,<sup>4</sup> which actually forms part of the beach at Kettleness, one point where quarrying was undertaken. Bewick believed firmly that it was in this period that Cleveland ore gained the poor reputation which hindered its acceptance by ironmasters and hence its development, for many years.<sup>5</sup>

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1. Josephy Bewick, Geological Treatise on the District of Cleveland in North Yorkshire . . . ., London, 1861, pp.9-10.
  2. Loc. cit.
  3. R. Tate and J.F. Blake, The Yorkshire Lias, London, 1876, p.k58.
  4. Loc. cit.
  5. Bewick, op.cit., p.10.

Whether as a result of ignorance or cupidity, the men employed by the Tyne Iron Company supplemented the iron ore they collected with generous quantities of ordinary stone. This practice, which had a deleterious effect on the working of blast furnaces and the quality of the pig iron, went undetected for a considerable time and led to the disenchantment of the ironmasters with Cleveland ore. As there were eminent geologists of the day who failed to recognise the bedded ironstone of the Main Seam,<sup>1</sup> and as the furnace managers obviously found it difficult to distinguish between the ironstone and ordinary stone, it seems probable that the episode was a genuine mistake. Perhaps converted to scepticism by this experience, the representatives of the Tyne Iron Company became more cautious, though scarcely more discerning, in later years; in 1837 the Company's agents roundly condemned a trial shipment of ore from a new mine at Grosmont, reportedly declaring that "... they were ashamed to see such refuse on the Quay!"<sup>2</sup> Soon afterwards, nonetheless, Grosmont became their major source of ironstone.

During the first half of the nineteenth century there were relatively few iron-smelting works in North East Eng-

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1. Young and Bird, for example, seem to have mistaken the Main Seam for limestone, while the early editions of Phillip's work mentioned only the nodular ironstone seams.

See Bowick, op.cit., pp.8-9.

2. Marley, op.cit., p.178.



land. Even in 1850 there were still only ten, with a total of thirty-eight blast furnaces, in the counties of Durham, Northumberland and the North Riding.<sup>1</sup> All of these had great difficulty in obtaining sufficient iron ore of an adequate quality at an acceptable cost. The works at Lemington, Birtley, Wylam, Consett and Crookhall had been built with the intention that they should use local ores from the Coal Measures.<sup>2</sup> Those at Ridsdale, Hareshaw and Stanhope were to rely on local deposits in the Carboniferous Limestone. Tow Law, more cautiously, was expected to draw on both sources. In the event, however, most of these plans failed. Indeed, they were more declarations of faith than plans, for little preparatory work seems to have gone into them.

The works at Hareshaw and Ridsdale were isolated from their markets on Tyneside and high transport costs, which effectively debarred the use of non-local ores as well as raising the delivered price of the finished goods, led to their early closure.<sup>3</sup> More generally, local resources of iron ore were soon found to be inadequate to support even small smelting plants. The North East coalfield, unlike the fields in Scotland, Staffordshire and South Wales, proved to be remarkably deficient in black-band iron ores.<sup>4</sup> The Birtley works, for example, was expected to obtain its sup-

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1. Bell, *op.cit.*, p.124.

2. Marley, *op.cit.*, pp.166-69.

3. *Ibid.*, p.167.

4. Bell, *op.cit.*, p.109.

plies of ironstone from a two-inch thick band in the roof of some old coal workings nearby.<sup>1</sup> The Consett and Crookhall works were exceptional in that up to 1850 they were able to rely almost entirely on Coal-Measures ore.<sup>2</sup>

Most of the North East's smelting works drew their supplies of iron from a variety of sources, including some in Scotland,<sup>3</sup> and the Tyne Iron Company was not alone in being interested in the North Yorkshire deposits. Joseph Bewick, senior, was in 1827 sent by the Birtley Iron Company, then his employer, to reconnoitre the coast between the Tees and Flamborough Head.<sup>4</sup> In his subsequent report, Bewick recommended Kettleness as a suitable point for the working of ironstone, but the Company declined to accept his advice. The main reason, apparently, was that the transportation problem was considered insuperable.<sup>5</sup> There was no railway in the vicinity and it was questionable whether the cost of building proper docking facilities could be justified. Without a harbour, it was doubtful whether or not the project could be a success; for the shipping of stone directly from the beach was difficult and relatively expensive. In addition, it could only be undertaken during

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1. Ibid., p.111. Bewick (op.cit., p.12) adds that in addition to tearing down the roofs of old coal mines to extract ore from the thin seams in them, it was also common to sift and sort colliery spoil heaps for the same purpose, such was the shortage.

2. Marley, op.cit., p.168.

3. Ibid., pp.166-69.

4. Bewick, op.cit., pp.12-13.

5. Ibid., p.14; and Marley, op.cit., p.167.

the summer months, which meant that it would not be possible to secure a regular supply of ore for the works.

These objections were eventually largely substantiated. Eleven years later, in 1838, Bewick did begin quarrying ore from the beach at Kettleness and Staithes, on behalf of the Wylam Iron Company. As had been predicted, while the quality of the stone and the actual working costs were acceptable, transporting the ore to the furnaces proved to be a serious problem. For this reason, the project was short-lived. The Company decided to look to alternative sources, and it abandoned the workings at Staithes in 1840 and those at Kettleness in 1842.<sup>1</sup>

Meanwhile, the discovery of ironstone in the Esk valley, during the course of excavations connected with the building of the Whitby and Pickering Railway, had stimulated interest in the possibility of the coastal deposits extending inland. In 1835 the Whitby Stone Company opened a mine at Grosmont.<sup>2</sup> This was followed, in 1840, by the establishment of the Wylam Iron Company's Eskdaleside mine.<sup>3</sup> Both of these worked the Pecton and Avicula seams. Soon after these developments occurred, ironworks at Lemington, Wylam and Walker, on Tyneside, and at Birtley, Witton Park and Bedlington,

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1. Bewick, op.cit., pp.14-15.

2. S.K. Chapman, Gazeteer of Cleveland Ironstone Mines, Dorman Museum Research Report, No.1, Middlesbrough, 1967, p.5.

3. Ibid., p.4.

elsewhere in Durham and Northumberland, were using ore from the Grosmont district<sup>1</sup>. - 'Whitby stone' as it was usually known, after the port from which it was shipped. At Walker, a furnace was built to smelt a mixture of mill-furnace cinder and Whitby stone, and a second was erected to use only the latter material.<sup>2</sup>

Nevertheless, the exploitation of Whitby stone did not have a revolutionary effect on the North East iron industry.<sup>3</sup> It did not, for example, put the area's pig-iron producers on a competitive footing with those in Scotland. Ironstone from the Coal Measures was comparatively expensive in the North East; in 1835 and 1836 it cost 16s. per ton at Birtley, 7s.6d. per ton at Wylam and 7s. to 8s. per ton at Shotley Bridge.<sup>4</sup> Whitby stone was little different, selling on Tyneside for about 9s. per ton at that time.<sup>5</sup> Thus, although the Tyneside ironmasters were pleased to have access to this new source of iron ore, for many firms it was no cheaper than the local product, and for those with inland works it was more expensive. An additional consideration was that the iron content of Whitby stone was only 25 per cent, whereas that of ore from the Coal Measures was usually about 30 per cent.

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1. Bell, op.cit., p.124.

2. Ibid., pp.122-23; and Bewick, op.cit., p.25.

3. See Bell, op.cit., p.116.

4. Ibid., pp.111-12.

5. Ibid., p.115.

In 1844 Lowthian Bell was made responsible for the construction of the second blast furnace at the Walker works of Losh, Wilson and Bell. It was intended that this furnace should use Whitby stone alone.<sup>1</sup> To minimize transport costs, Bell arranged for the ore to be calcined at Grosmont. This procedure was reluctantly abandoned a year later, as it had been found that the advantage it gave was outweighed by extra costs resulting from the tendency of calcined stone to crumble very easily during transit. Shortly afterwards, Bell became so dissatisfied with Whitby stone that he terminated the contract with his Grosmont suppliers and leased a black-band royalty at St. Andrews in Scotland. This arrangement proved even less satisfactory, and shipments of ore from Whitby to the Walker works were soon resumed. Like others, Bell found that the long haul to the blast furnace meant that Scottish ironstone was quite as expensive as ore from more local resources.<sup>2</sup>

The Whitby stone was thus neither cheap nor of a high quality, but it was plentiful. This was an important factor in the development of mining in the Grosmont area; for the black-band deposits in Durham and Northumberland were rarely sufficient to keep a furnace in blast for long.<sup>3</sup> Moreover, the Grosmont mines were located alongside a railway and were

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1. See Bewick, op.cit., p.26, and Greville Jones, "A Description of Messrs. Bell Brothers' Blast Furnaces from 1844-1908", Iron and Coal Trades Review, Oct.2, 1908, p.1423.

2. Bewick, op.cit., pp.26-28; and Bell, op.cit., p.116.

3. Bell, op.cit., p.115

very close to the harbour installations at Whitby, which was only six miles away. Ironmasters could therefore obtain large and regular supplies of medium-cost ore without the prior necessity of heavy investment in transport facilities. Most works in the North East consequently drew some of their ironstone supplies from the Grosmont district. As Bewick - who worked one of the royalties - admitted, however, those on Tyneside were the most favourably located to use Whitby stone.<sup>1</sup> Firms with inland works had to meet additional haulage costs.

The mining of iron ore in the North East prior to 1850 was thus of greatest importance to, and in, places outside the Teesside region. However, it is of interest in the present context in that it provides a historical perspective for later developments. In a very general sense, too, the events in this early period are amenable to interpretation within the framework of location theory. Much of the mining was undertaken, in their own interests, by iron manufacturing firms rather than genuine mining companies, but this does not disguise the fundamental concern with minimizing costs. Apart from any other consideration, this was necessitated by the keen competition from Scottish iron manufacturers, who had the advantage of cheap supplies of ore.

The blast furnaces in Durham and Northumberland in this period - there were none in North Yorkshire - were generally

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1. Bewick, op.cit., p.30.

located close to deposits of iron ore. Coal could be obtained over a wide area, but ore in quantum was comparatively rare. This policy meant that the costs associated with the mining of ironstone were kept as low as possible. Transport costs were minimal, since the 'market' for the ore was immediately at hand. As the black-band ironstone was often worked in abandoned coal mines, production costs were also low. However, the deposits were generally small, and when they were exhausted, the blast furnaces had either to be abandoned or supplied from alternative sources.

For manufacturers with works close to navigable water, such as those on Tyneside, the Grosmont ironstone deposits were generally the nearest in economic terms once local resources had been consumed. From the Grosmont district, large supplies of ore could be obtained at a cost little different from that incurred when black-band deposits were worked in the North East. Bewick argued that Whitby stone would have been still cheaper if steps had been taken to enlarge and otherwise improve the harbour at Whitby, which suffered from congestion and silting.<sup>1</sup> Then, the coal ships returning empty from London to the Tyne could have filled their holds with iron ore. As it was, there was insufficient space to accommodate such large vessels, and in any case they could not have left the harbour fully laden.

On the other hand, had there been no harbour at Whitby, and had the Whitby-Pickering Railway not been built, it is

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1. Ibid., pp.157-65.

probable that the ironstone resources of the Grosmont district would not have been developed at all. The ironmasters were unwilling, and perhaps unable, to invest in transport facilities, as is shown by their reluctance to make permanent arrangements for shipping ore from the North Yorkshire coast. As late as 1847, men were employed at Saltburn to collect ironstone from the beach and load it on to small vessels bound for Tyneside which were run ashore at low tide.<sup>1</sup>

While the Tyneside ironmasters could be reasonably satisfied with their arrangements for obtaining supplies of iron ore at this stage, firms with works at inland locations were in a more difficult position once local deposits had been exhausted. One such was the firm of Bolckow and Vaughan, which had a finishing works at Middlesbrough, and blast furnaces at Witton Park near Bishop Auckland. Its smelting plant was built on the understanding that adequate quantities of ore would be forthcoming from nearby coal workings. This expectation failed to materialise and resort was made to Whitby stone, an expedient that involved transport outlays which brought the firm to the brink of bankruptcy.<sup>2</sup>

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1. An account is given of this work by Samuel Frederick Okey in "Ironstone Working in Cleveland in the 19th. Century", typescript dated 1884 in Middlesbrough Public Library, Reference : CL 622.9 .
  2. See Ron Gott, Henry Bolckow : Founder of Teesside, Middlesbrough, 1968, p.28.



While searching for a solution to the problem facing his firm, John Vaughan was shown some samples of ironstone collected from the property of a Mr. A.L. Maynard at Skinninggrove,<sup>1</sup> which was on the coast and only a few miles from the mouth of the Tees. The samples suggested the presence of ironstone of a satisfactory quality, and, through the offices of Samuel Okey, it was eventually agreed that Messrs. Roseby would begin working Maynard's property on behalf of Bolckow and Vaughan in 1848. The first consignment of ore from Skinninggrove was sent to Witton Park in August of that year.<sup>2</sup> The stone was found to have an iron content of 31 per cent, which was appreciably higher than that of ore from Grosmont.<sup>3</sup> In all, the Rosebys sent about 800 tons of Skinninggrove ironstone to Witton Park. Then, in the summer of 1849, they met with financial difficulty and Bolckow and Vaughan took over the workings themselves.<sup>4</sup>

The skinninggrove deposits, which were an outcrop of the Main Seam, provided a solution to Bolckow and Vaughan's immediate difficulties. The ore was of a high quality and the deposits were substantial and much nearer to the Witton Park works than were those in the vicinity of Grosmont. Encouraged, the firm sponsored investigations further inland and in the summer of 1850 the Main Seam was identified at Eston, where it outcropped along the northern scarp of the hills.<sup>5</sup> Within a few weeks, arrangements had been made to

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1. By Okey - see op.cit.,

2. Marley, op.cit., p.185

3. Bell, op.cit., p.116.

4. Marley, op.cit., p.185.

5. Ibid., p.187.

begin mining at Eston and for conveying the ore to Witton Park. A little later, work was started on the construction of blast furnaces near Middlesbrough.

#### Post-1850 Development.

The Cleveland iron-ore field was not contained entirely by the Teesside region, and the southern districts around Rosedale and Grosmont have been excluded from the following discussion. In some respects the orefield approximated quite closely to Wilson's model coalfield. Thus, the former, like the latter, had one effective mineral seam. While the pre-1850 workings took ore from various seams and nodular beds along the coast, and from the Pecten and Avincula seams at Grosmont, development after the Eston discovery was confined to the Main Seam.<sup>1</sup>

Effectively, too, there was but one market, the Stockton-Middlesbrough area to the north of the orefield and in the centre of the Teesside region. It was to that central area that the great bulk of the Cleveland ironstone was sent initially, though some was subsequently forwarded to places outside the region. Again, as in Wilson's model, the mineral seam attained its maximum elevation and outcropped

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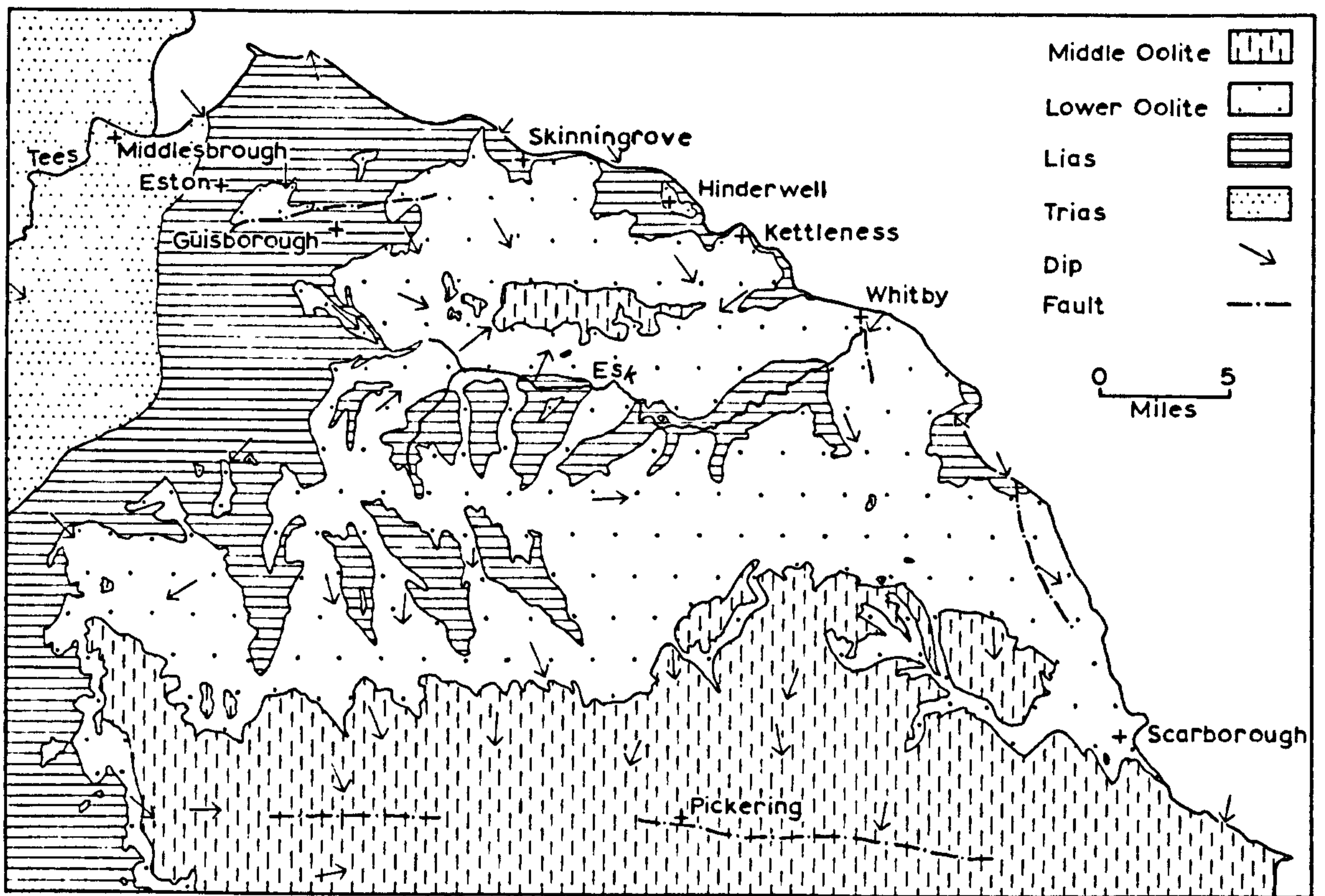
1. The Pecten Seam was worked occasionally in North Cleveland, but only incidentally to the Main Seam. The poor quality of the ore from it discouraged the practice, unless the Pecten was so close to the Main that little extra cost was incurred. See T.H. Whitehead, et.al., The Liassic Ironstones, "Memoirs of the Geological Survey of Great Britain: The Mesozoic Ironstones of England", London, 1952, pp.50-51 and 55-58.

where it was closest to the market. From there, it dipped in a general south-eastward direction.

The analogy should not be pressed too far, however, as there are some important differences between the Cleveland orefield and Wilson's hypothetical coalfield. These are explored at a later stage, but mention may be made here of spatial variations in the thickness and quality of the Cleveland Main Seam, geological faults affecting the working of the ironstone and the fact that Teeside was a more complex region than that depicted by the model.

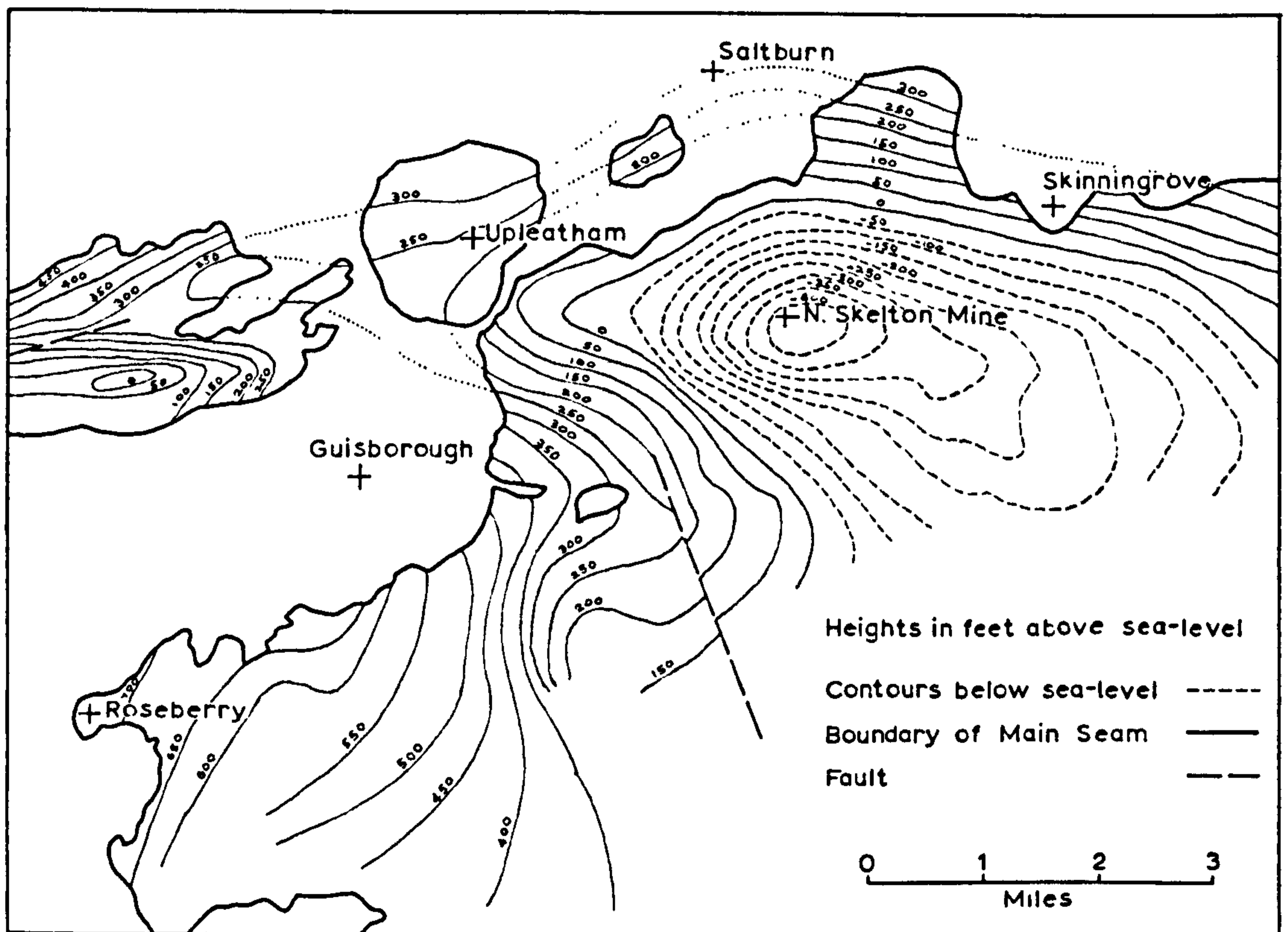
In common with the Pecten, Two-Foot and Avicula seams, the Cleveland Main Seam is part of the Ironstone Series of the Middle Lias.<sup>1</sup> It is found throughout the Cleveland Hills and their outliers, where the Middle and Upper Lias shale formations have been protected by a cap of relatively resistant sandstones dating from the Middle Jurassic period, but the Ironstone Series as a whole has been removed by erosion from low-lying areas such as the vale of Guisborough.<sup>2</sup> These various strata reach their highest elevation in north-

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1. Most of the geological information comes from the following sources :  
Whitehead, op.cit., chap.3; Vernon Wilson, British Regional Geology : East Yorkshire and Lincolnshire, Department of Scientific and Industrial Research, Geological Survey and Museum, London, 1948;  
Fox-Strangways, op.cit.; G.W. Lamplugh, C.B. Wedd and J. Pringle, Iron Ores : Bedded Ores of the Lias, Oolites and Later Formations in England, vol.12 of "Memoirs of the Geological Survey : Special Reports on the Mineral Resources of Great Britain" London, 1920, chap.2.
  2. John Jones, "On the General Geological Features of the Cleveland Iron District", Proceedings of the Institution of Mechanical Engineers, (1871), p.191.



Source: Whitehead, *op.cit.*, p.34.

Figure 6.1 Geological Map of North-East Yorkshire



Source: Whitehead, *op.cit.*, p.43.

Figure 6.2 Contours of the Cleveland Main Seam

west Cleveland, and they dip south-eastwards from there towards North Skelton, which lies at the centre of a synclinal basin.

The Main Seam outcrops at an altitude of 400 feet at Eston, but in the vicinity of North Skelton it is more than 400 feet below sea-level. In part, however, its great depth in the latter area is due to an easterly downthrow of 200 feet which is associated with the Lockwood Beck Fault. A second major disturbance, the Upsall Fault, affected the ironstone strata. This runs in a general east-west direction through the vale of Guisborough and it has a northerly downthrow. As a result, the Main Seam outcrops along the northern scarps of the Eston and Upleatham Hills as well as the Cleveland Hills.

The Ironstone Series as a whole varies in character from one part of Cleveland to another, but in a regular manner.

The outstanding effect is that the bands show comparatively little variation if followed in the direction of the prevalent strike, viz. E.N.E. and W.S.W., but deteriorate rapidly both in thickness and quality in the direction of dip, that is towards the S.S.E.<sup>1</sup>.

Thus, the Main Seam is at its thickest at Eston, where it reaches  $11\frac{1}{2}$  feet. From that point, it diminishes towards the coast - being  $10\frac{1}{2}$  feet at Upleatham and  $8\frac{1}{2}$  feet at Skinningrove - and towards the west. Two to three miles

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1. Whitehead, op.cit., p.37



south of this northerly outcrop, the Main Seam is split into two blocks by a wedge of dogger ironstone which, in turn, gives way to shale. With distance, this wedge widens and, as it does so, the separate blocks of the Main Seam become thinner and further apart. It is doubtful whether even a trace of them survives so far south as the Esk valley.<sup>1.</sup>

The quality of ore from the Main Seam also deteriorates to the south of Eston. In an east-west line drawn through Eston, Upleatham and Skelton, the iron content of the stone ranges between 33 and 31 per cent.<sup>2.</sup> South of this line it steadily declines, until it becomes too low for commercial purposes. In the vicinity of the most southerly workings, the iron content is between 25 and 27 per cent. Additionally, the proportion of silica, a substance with a deleterious effect on the value of ironstone, increases from 8 per cent in the north to 15 per cent in the south.<sup>3.</sup>

Thus, the position and character of the Cleveland ore-field were such that the total cost of mining and marketing the ironstone might reasonably be expected to have been lowest in the neighbourhood of Eston, where the Main Seam came closest to the market, where it outcropped at the surface, and where it attained its maximum thickness and quality. Costs should have been marginally higher to the east, along

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1. Ibid., pp.40-44.

2. Ibid., p.43.

3. Loc. cit. Ironstone is not marketable if its silica content is more than two-thirds that of the ore.

the outcrop, because of the increasing distance from the market and the slight deterioration of the Main Seam in that direction. To the south and south-east, costs should have risen steadily, with the growing distance from the market and as the Main Seam became thinner, poorer and deeper.

These hypotheses, however, are difficult to substantiate in detail. Many of the more important ironstone mines in Cleveland were eventually taken over by the firm of Dorman, Long and Company, which has very recently become a part of the British Steel Corporation. So far as is known, cost accounts of mining operations in the nineteenth century have not survived the ravages of time.<sup>1</sup> Many records were undoubtedly discarded during the process of company amalgamation, and the remainder are believed to have perished during World War II, when a number of Dorman-Long buildings were destroyed or damaged by fire.

Nevertheless, there is little doubt that in general the cost hypotheses offered above are correct. In terms of production costs, Eston, Normanby and Upleatham were accepted by contemporaries as the best locations for mining. Costs were certainly higher in the Loftus area, which was more distant from the market and where deep shafts were necessary to tap the Main Seam. Further south, where conditions steadily deteriorated, "... a good deal of money was lost in

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1. Information supplied by Mr. G. Gull, former Secretary of the Cleveland Mine Owners' Association.



sinking shafts and making railways which were never used".<sup>1.</sup>

There is, however, some fragmentary evidence to suggest that a rather paradoxical situation with regard to labour costs arose in the 1870's. The payment to labour constituted a large part of the total cost of producing ironstone, but in 1879 some of the better-placed mines incurred higher labour costs per unit of output than some of those in relatively poor locations. To explain this anomaly, it is necessary to take account of local conditions in the labour market.

One of the more persistent problems facing the Cleveland mining industry in the period covered by this study was a shortage of labour, especially of skilled labour. Enough general labourers could normally be attracted into the industry, though the poorer firms met with difficulty in times of expansion, but there were generally insufficient experienced men. Many of the Cleveland miners were ex-agricultural workers, and even in 1873, after more than twenty years of the industry's development, two-thirds of them had previously held other types of job.<sup>2.</sup> In Durham, by way of contrast, only one-tenth of the coal miners had

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1. H. Palmer, Mines Agent for Dorman, Long & Co. Ltd., "A Talk on Ironstone and Limestone Delivered to Members of the Head Office Staff, Dorman Long & Co. Ltd., at Brunswick St<sup>1</sup>/<sub>2</sub>, October 12, 1936, "typescript in the possession of Mr. G. Gull, p.2.
  2. Information from extracts of " Mr. Rupert Kettle's Award in the Matter of the Claim Made in March, 1873, by the Ironstone Miners of Cleveland for a Rise in the Rate of Wages," 9th July, 1873, in Cleveland Mine Owners' Association, Minute Book, No.1 (1873-75).

known any form of employment other than mining.<sup>1.</sup>

The shortage of skilled and experienced miners in Cleveland was undoubtedly partly due to the speed with which the industry developed until the early 1880's, when it reached its zenith in terms of output and employment. Another, and probably more important, factor, however, was that the mine owners used the shortage as a justification for keeping wages below those paid in the coal industry, arguing that because of the discrepancy between them in terms of skill and experience the average Cleveland miner was not worth as much as his counterpart in Durham. This attitude tended to perpetuate the problem; for the owners were unlikely to be able to attract the men they wanted by paying lower wages than they were already earning in the coal industry.

A result of the shortage was that the skilled miners in Cleveland were highly mobile, tending to move from one mine to another whenever there was an opportunity to increase their earnings. New firms had to offer wages higher than the norm to attract sufficient manpower, and the established firms were obliged to raise their rates in order to retain their men. The highly competitive bidding for labour meant that companies with mines in the poorer parts of the orefield had to pay higher wages than they could reasonably afford in many instances, while even those in a strong position suffered from the instability of their labour forces.

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1. Loc. cit.

To encourage more settled conditions, members of the Cleveland Mine Owners' Association agreed amongst themselves to adopt a policy designed to bring about the equalization of earnings within the district.<sup>1</sup> While some categories of employees were paid a daily rate, the men actually engaged in the winning of the ironstone were paid according to piece-rates. The basis of these was 'tonnage', the amount paid for each ton of ore won, loaded into tubs and sent to the surface. The Owners' Association declared a standard tonnage rate and fixed daily wages to be paid by member firms.

Tonnage, however, was only the basic norm for men on piece-work. In addition, 'yardage' was paid for the removal of waste material, and 'consideration' money for working in unusually difficult, dangerous or uncomfortable conditions. These extra payments were intended to compensate miners employed in places where productivity was unavoidably low for reasons outside their control. They were thus a means of equalizing earnings between mines. To ensure their use for no other purpose, firms belonging to the Owners' Association were required to obtain the consent of that body before making yardage and consideration allowances.<sup>2</sup>

1. This body was formed on the 18th. March, 1873, as a prelude to establishing a Joint Committee of representatives of the owners and the miners, which had been suggested by the Cleveland Miners' Association. It is probable, however, that the policy of trying to equalize earnings pre-dated the Owners' Association, on an informal basis.
2. A committee was appointed to investigate an application if there was some doubt about its propriety. Often, too, the applications were dealt with by arbiters appointed by the Joint Committee of Owners and Miners.

Ideally, this arrangement should have resulted in the full equalization of earnings throughout the district, with miners in difficult places being paid higher rates than those working where the stone was easier to win. It should also have meant that all firms were able to obtain a fair share of the available labour. Labour-cost differentials would still have remained, however, since mines in the better parts of the orefield would have had a higher output per shift - because working was easier - and would have paid less to labour for each ton of ore won.

In practice, the results of the Owners' policy were less straightforward. Conditions could vary considerably, and from week to week, within a mine as well as between mines, and rates of remuneration for the miners were continually being adjusted, often under pressure from the Miners' Association, to meet local circumstances. It was consequently difficult for the Owners' Association to keep tight control of rates of pay. In 1875 an investigation was made into yardage and consideration payments in Cleveland.<sup>1</sup> Not surprisingly, it was found that since the tonnage rate had been fixed for the district, yardage and consideration rates had been deliberately used as instruments to attract labour. The move towards the equalization of earnings had thus been checked, but differentials were smaller than they had been.

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1. "Report by Thomas Allison and J. Dennington on Yardage and Consideration Payments", in Cleveland Mine Owners' Association, Minute Book No.1 (1873-75), April 19, 1875.

Table 6.2<sup>1</sup>.

Earnings of Cleveland Miners in 1879

<u>Average Payment Per Man per Ton of Ore Raised.</u>		<u>Average Earnings per Man per Shift.</u>	
	<u>d.</u>		<u>s. d.</u>
Normanby.	9.61	Lofthouse.	4. 5.9
Brotton.	9.45	Upleatham.	4. 5.9
Park Pit.	9.36	Chaloner.	4. 5.7
Chaloner.	9.34	Craggshall.	4. 4.7
Lingdale.	9.23	Lingdale.	4. 4.6
Spa.	9.13	Normanby.	4. 4.4
Eston.	9.09	North Skelton.	4. 1.5
Upleatham.	8.91	Eston.	4. 1.1
Huntcliff.	8.85	Park Pit.	4. 0.7
Lofthouse.	8.62	Spa.	4. 0.4
North Skelton.	8.61	Kirkleatham.	3. 9.4
Ormesby.	8.53	Brotton.	3. 8.4
Kirkleatham.	8.18	Huntcliff.	3. 6.9
Longacres.	8.18	Ormesby.	3. 5.8
Craggshall.	7.94	Longacres.	3. 5.7

Because of the complexity of the factors governing the labour market, labour costs and earnings varied between mines less simply than might be supposed, as is indicated by Table 6.2. For example, Normanby, which was in one of the best locations on the orefield, incurred the highest labour costs. This may have been because Bell Brothers, who owned that mine and were primarily iron manufacturers, were concerned most of all with obtaining a large and regular supply of ore for their works, and were prepared to pay relatively high wages in order to keep their labour force. In addition, the northern mines, such as Normanby and Eston, had certain advantages which meant that labour

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1. Data from : "Abstract of Pay Books of Cleveland Mines Presented by Secretary to a Meeting of the Cleveland Mine Owners' Association", 11 December, 1879, in Minute Book No.1.  
The data refer only to one fortnightly pay in each case, and they are only for miners' wages; they do not include the earnings of men paid a daily rate.

costs were less critical to the companies owning them. They had been the first to be established and their royalties were low,<sup>1</sup> they were nearest the market so that transport costs were also low, and their ore was of a higher quality than that of mines further south. In all, therefore, it is not necessary to revise the hypotheses made initially concerning variations in the total cost of mining in different parts of Cleveland.

Returning to the subject of the actual development of mining, in Cleveland, the 'commercial discovery' of the Main Seam at Eston in 1850 was a crucial turning-point for the industry.<sup>2</sup> In little more than two months, Bolckow and Vaughan opened the first trial quarry; in less than three, the first load of ore was sent to the Witton Park furnaces; and by the end of 1850, more than 4,000 tons of ironstone had been won and despatched.<sup>3</sup> In 1851 a private branch line was built to connect the Middlesbrough and Redcar Railway with the quarries at Eston, which yielded 188,000 tons of ore in that year.<sup>4</sup> Also in 1851, the Derwent Iron Company opened quarries at Upleatham, and a branch railway to serve them.<sup>5</sup>

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1. Bolckow and Vaughan contracted to pay only 8d. per ton royalty on ore from Eston, but many firms had to pay much higher rates.
  2. The term 'commercial discovery' is probably most accurate historically, since there were many who subsequently claimed to have known of the presence of ironstone in the vicinity before 1850.
  3. Marley, op.cit., p.187.
  4. Ibid., p.190.
  5. William Weaver Tomlinson, The North Eastern Railway : Its Rise and Development, Newcastle upon Tyne, 1917, p.509.

The Eston discovery was not so fortuitous as has often been assumed. The ironmasters of the North East had been searching for many years for deposits of iron ore which would assure them of a sufficient supply at an acceptable cost. The exploratory surveys undertaken by Bolckow and Vaughan in northern Cleveland were merely the latest in a long series. They were made because of the need to find a source of ironstone nearer to the smelting works than Gros-mont; high transport costs had placed the company in difficulty. The beginning of mining at Skinningrove in 1848 helped to alleviate the problem. Soon afterwards, as part of a continued effort to reduce transport costs, Bolckow and Vaughan's "... attention was turned to the Eston and Upleatham hills, not from any geological reasoning at first, but from their proximity to Middlesbro' and to railway communication ...."<sup>1</sup>. There followed a period of a year in which these inland areas were examined for traces of the deposits found at the coast.<sup>2</sup> Trial drifts were made at Upleatham, Eston and Normanby, all with negative results, before the Main Seam was eventually located and traced along the edge of the Eston Hills. Thus, the decision to open the first mine at Eston was the result of a deliberate attempt to minimize transport costs, though it was fortuitous that the Main Seam was at its best where it came closest to the market.

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1. Marley, op.cit., p.186.

2. Ibid., pp.186-87.

Details of transport costs in this period have not come to light, but there is no doubt that Bolckow and Vaughan benefited a great deal from their initiative. Prior to 1850, ore was shipped by sea to Middlesbrough, from Whitby and Skinningrove, and then forwarded to Witton Park by rail. The establishment of mines at Eston immediately removed the necessity for the first stage of this journey, which must have been time-consuming and expensive. With their private railway, Bolckow and Vaughan could send ore from Eston to a point on the Stockton and Darlington Railway system, near Middlesbrough, for a very small cost. Once there, the ore could be moved on to Witton Park in the same trucks, without the cost of transferring it from ship to shore. The building of blast furnaces in the vicinity of Middlesbrough increased the overall savings in transport costs, though the furnaces at Witton Park were kept in use.

The boundary of the royalty leased by Bolckow and Vaughan enclosed the greater part of the Eston Hills. Other firms were quick to lease the mineral rights in neighbouring areas. The Derwent Iron Company obtained the Upleatham royalty to the east and began work there in 1851.<sup>1</sup> In 1854 Bell Brothers established mines on R.W. Jackson's property at Normanby. In both cases, as at Eston, it was possible to

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1. Chapman, op.cit., provides a useful chronological guide to mining development in Cleveland, and, unless otherwise stated, the dates referred to here have been taken from his Gazeteer.



work the Main Seam by quarries at first, and later by adits. For the Derwent Iron Company, as for Bolckow and Vaughan, it was also a simple matter to build a short railway to connect the ironstone workings with the Stockton and Darlington Railway Company's branch line from Middlesbrough to Redcar. Bell Brothers, however, were denied this facility for moving ironstone for a number of years, because of the terms of their agreement with the Normanby lessor and the internicine struggles of rival railway interests in the district.<sup>1.</sup>

With the principal royalties in the northern part of the orefield quickly leased, the next phase of development involved the opening of mines along the north-facing scarps of the Cleveland Hills, to the south. First, however, it was necessary to extend the local railway network, in order to make that practicable, and railway construction had fallen into disfavour with investors as a result of the many failures amongst railway projects in the 1840's.<sup>2.</sup> Another obstacle to be overcome was that few of Cleveland's industrial leaders were at all sanguine about the prospect of mining to the south of the vale of Guisborough being a success. Even John Vaughan, whose perseverance had resulted in

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1. This point is dealt with more fully in the chapter concerning the manufacturing industries. Basically, however, R.W. Jackson, whose property the Normanby royalty was, hoped to capture part of the mineral traffic for the railway combine he represented by building a line north from Normanby to join the Stockton and Darlington Company's Middlesbrough-Redcar branch. He was prevented from doing so by Parliament, where the latter firm had a powerful lobby, and Bell Brothers had to use a more circuitous route to take ore from Normanby to Middlesbrough.
  2. See Tomlinson, op.cit., p.509; and J.S. Jeans, Pioneers of the Cleveland Iron Trade, Middlesbrough, 1875, pp.124-25, and pp.139-40.

Table 6.3<sup>1</sup>.

Chronology of Mining Development in Cleveland.

Date of Opening	Mine	Date of Closing	Type of Mine.	Company Responsible for Establishment.
1850	Eston.	1949	Adit.	Bolckow & Vaughan.
1851	Upleatham.	1923	"	Derwent Iron Co.
1854	Normanby.	1898	"	Bell Brothers.
	Cod Hill.	1865	"	J.W. Pease & Co.
1856	Belman Bank.	1885	"	Weardale Iron Co.
1857	Swainby.	1860	"	Holdsworth & Co.
1860	Ingleby.	1865	"	Ingleby Mining Co.
1861	Skelton Shaft	1938	Shaft.	Bell Brothers.
1864	Hob Hill.	1874	Adit.	Pease & Partners.
	Spa.	1904	"	Gjers, Mills & Co.
	Loftus.	1958	"	Pease & Partners.
1865	Ormesby.	1892	"	Swan, Coates & Co.
	Spawood.	1931	"	Weardale Iron Co.
	Brotton.	1921	Shaft.	J. Morrison & Co.
	Crowell.	1870	"	Bolckow & Vaughan.
	Slapewath.	1906	"	B. Samuelson & Co.
1866	Liverton.	1923	"	Cargo Fleet Iron Co.
	Upsall.	1945	"	Bolckow & Vaughan.
	Commondale.	1868	"	Commondale Iron Co.
	Lonsdale.	1868	"	Leven Vale Iron Co.
	Lonsdale Vale	1868	"	" " " "
	Cliff.	1887	"	Bell Brothers.
	Kildale.	1868	Adit.	Leven Vale Iron Co.
1870	Kirkleatham.	1886	"	Kirkleatham Ironstone Mining Co.
	Kilton.	1963	Shaft.	Kilton Iron Co.
1871	Cragg Hall.	1892	"	Pease & Partners.
1872	Boosbeck;	1889	"	Stevenson, Jacques & Co.
	South Skelton	1954	"	T. Vaughan & Co.
	Carlin How.	1946	"	Bell Brothers.
	Whitecliff.	1884	"	Swan, Coates & Co.
	Stanghow.	1921	"	Stanghow Ironstone Co.
	Chaloner.	1939	"	Bolckow & Vaughan.
	North Skelton	1964	"	" "
	Skelton Park	1938	"	Bell Brothers.
	Cliff (Hunt-cliff)	1906	Adit.	" "
1875	Grinkle.	1934	"	Palmer & Co.
	Loftus (North)	1939	Shaft.	Pease & Partners.
	Tocketts	1877	"	Walker, Maynard & Co.
1876	Roseberry	1880	Drift.	Roseberry Ironstone Co.
	Longacres.	1954	Shaft.	Bolckow & Vaughan.
1878	Lingdale.	1962	"	Pease & Partners.
1881	Lumpsey.	1954	"	Bell Brothers.

1. Data from Chapman, op.cit.

the Eston discovery, questioned the value of the ironstone in that area.<sup>1.</sup>

As in so many other local matters, it was left to members of the Pease family - the Darlington industrialists who had largely been responsible for the building of the first railways in the Teesside area, and for the establishment of Middlesbrough - to muster support for a railway from Middlesbrough to Guisborough. With a fine display of entrepreneurial initiative, Joseph Pease and his son eventually obtained sufficient subscriptions for the project, which they had been the main instruments in promoting, by guaranteeing the shareholders' dividends for a number of years.<sup>2.</sup> Construction began in 1852 and by the end of 1853 the new line was open for mineral traffic. It had a short branch to Hutton Lowcross, where J.W. Pease and Company began work on the Cod Hill mine as soon as the railway was complete.

During 1856 the Weardale Iron Company established ironstone workings at Belman Bank, little more than a mile to the east of Cod Hill. In terms of keeping costs as low as possible, the Cod Hill and Belman Bank mines represented a logical stage in development. Their locations were the places where costs were likely to be lower than those anywhere else in the undeveloped parts of the orefield. They

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1. Loc. cit.

2. Loc. cit.

were virtually the nearest points on it, south of Eston Moor, to Middlesbrough, so that transport costs were potentially low. Once the railway to Guisborough was open, the cost of carrying ore to Middlesbrough would have been little different from the Cod Hill and Belman Bank mines than from Upleatham. Working costs would also have been relatively low at Cod Hill and Belman Bank, since they were places where the Main Seam outcropped. As at Eston, Normanby and Upleatham, therefore, work could begin with quarries and proceed later, as they became necessary, with adits tunnelled into the scarp.

Other attempts were made to establish outcrop workings in this early period, and they were also intimately associated with railway development.<sup>1</sup> In 1854 the North Yorkshire and Cleveland Railway Company obtained Parliamentary sanction for its proposed line from Picton, on the Northallerton-Stockton route, to Grosmont. Early in 1857 the portion from Picton to Stokesley, with a branch to Swainby, was opened. In the same year, a mine was established at Swainby to work the Main Seam. The ironstone was soon found to be too poor and meagre in that locality, however, and the Swainby mine was abandoned in 1860. The main line of the North Yorkshire and Cleveland Railway reached Kildale in 1858, and the Ingleby Mining Company built a private railway

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1. Unless otherwise stated, chronological details of mining have been taken from Chapman, op.cit., and of railway development from Tomlinson, op.cit.

to join it there and opened a mine at Ingleby Greenhow in 1860. Here, too, however, the Main Seam was found to be inadequate, and mining ceased five years later.

Up to 1860, therefore, the development of the Cleveland mining industry was cautiously limited to the establishment of mines along the escarpments of the Eston, Up-leatham and Cleveland Hills, where the Main Seam came to the surface and there was no need to sink expensive shafts. A prior condition of development was that there should be access to a railway for transporting the ore to the Middlesbrough district, where blast furnaces were being constructed in large numbers and facilities existed for shipping it to markets outside the Teesside region. The short-lived mines at Swainby and Ingleby Greenhow, though failures, were useful in that they helped to define the limits of the commercially valuable part of the orefield.

Mention should also be made of the establishment of a coastal mine at Port Mulgrave in 1854<sup>1</sup>, although it lay outside the mainstream of contemporary development in Cleveland. The mine was owned by Palmers, the Tyneside shipbuilding firm, which used the entire output in its own operations. Ore from this mine, and from that opened by Palmers at Grinkle in 1875, was shipped from Port Mulgrave, where a dock was built for the purpose. Although the Main

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1. See S. Keith Chapman, "Port Mulgrave Ironstone Workings" Bulletin of the Industrial Archaeology Group for the North East, No.5 (March, 1968), pp.3-7.

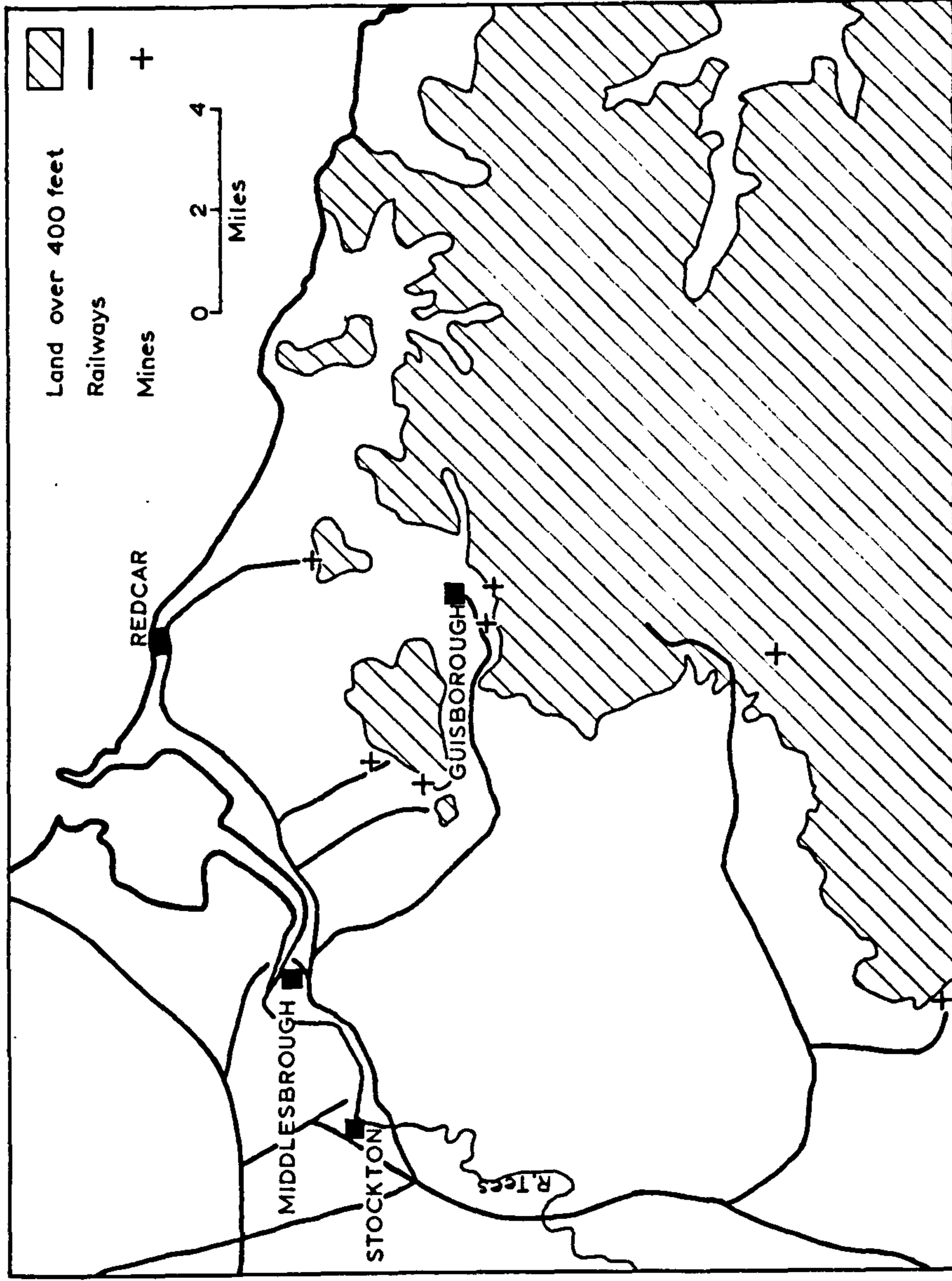


Figure 6.5 Distribution of Cleveland Ironstone Mines in 1860

Seam was worked, the venture was part of the tradition established before 1850, and it had little relevance to events after that date.

During the 1860's, there were two main types of development. The first of these amounted to the consolidation of the mining industry in the original area of exploitation to the north of the vale of Guisborough, where the small remaining royalties were leased and workings established in them. In this category, mines were opened at Hob Hill in 1864, Ormesby in 1865 and Kirkleatham in 1870. All of these were worked initially by quarries and later by adits, and in each case a private railway was built to give access to the Middlesbrough-Redcar branch. The companies responsible for developing these mines presumably decided that in terms of costs their locations were preferable to alternatives further south. That the royalties had been left unoccupied for so long was perhaps due to their small extent; the firms with large ironworks, in particular, might well have preferred royalties with a potentially longer economic life.

Because of the firm's expansion as a manufacturer of iron and iron goods, Bolckow and Vaughan soon required an increase in the output of ore from the Eston royalty. Since this was already being worked along its full length from the northern side, shafts were sunk on Eston Moor to tap the southern area. These were the Crowell, Upsall and Chaloner pits, which were established in 1865, 1866 and 1872 respectively. Eventually, the workings associated with these pits

and the main Eston drifts coalesced and the three shafts were thereafter used for ventilation and transport purposes.

The second type of development during the 1860's took mining in the Cleveland Hills to the east of Guisborough, and it followed the building of the Cleveland Railway from that town towards the coast in the early part of the decade. Bell Brothers' Skelton Shaft, the first shaft mine in Cleveland, came into operation in 1861. In quick succession, it was followed by the opening of the Spa mine in 1864 and by the Spawood and Slapwath mines in 1865, the last of which also had a shaft. All of these were located less than two miles east of Belman Bank, and two of them were drift mines which worked the Main Seam where it outcropped along the scarp of the Cleveland Hills.

Less successfully, shafts were sunk in Comondale and Lonsdale and a drift mine opened in Kildale in 1866, in an attempt to take advantage of the opportunities created by the building of the North Yorkshire and Cleveland Railway through Kildale and Eskdale. All three mines failed, because of the poor nature of the ore in that area. Like those at Swainby and Ingleby, however, they helped to delimit the extent of the Main Seam as a commercially useful deposit.

The Cleveland Railway reached the coast at Skinningrove in 1865, and its progress was matched by the opening of new mines, as successive royalties came within the reach of the railway system. At the Loftus mine, which was established



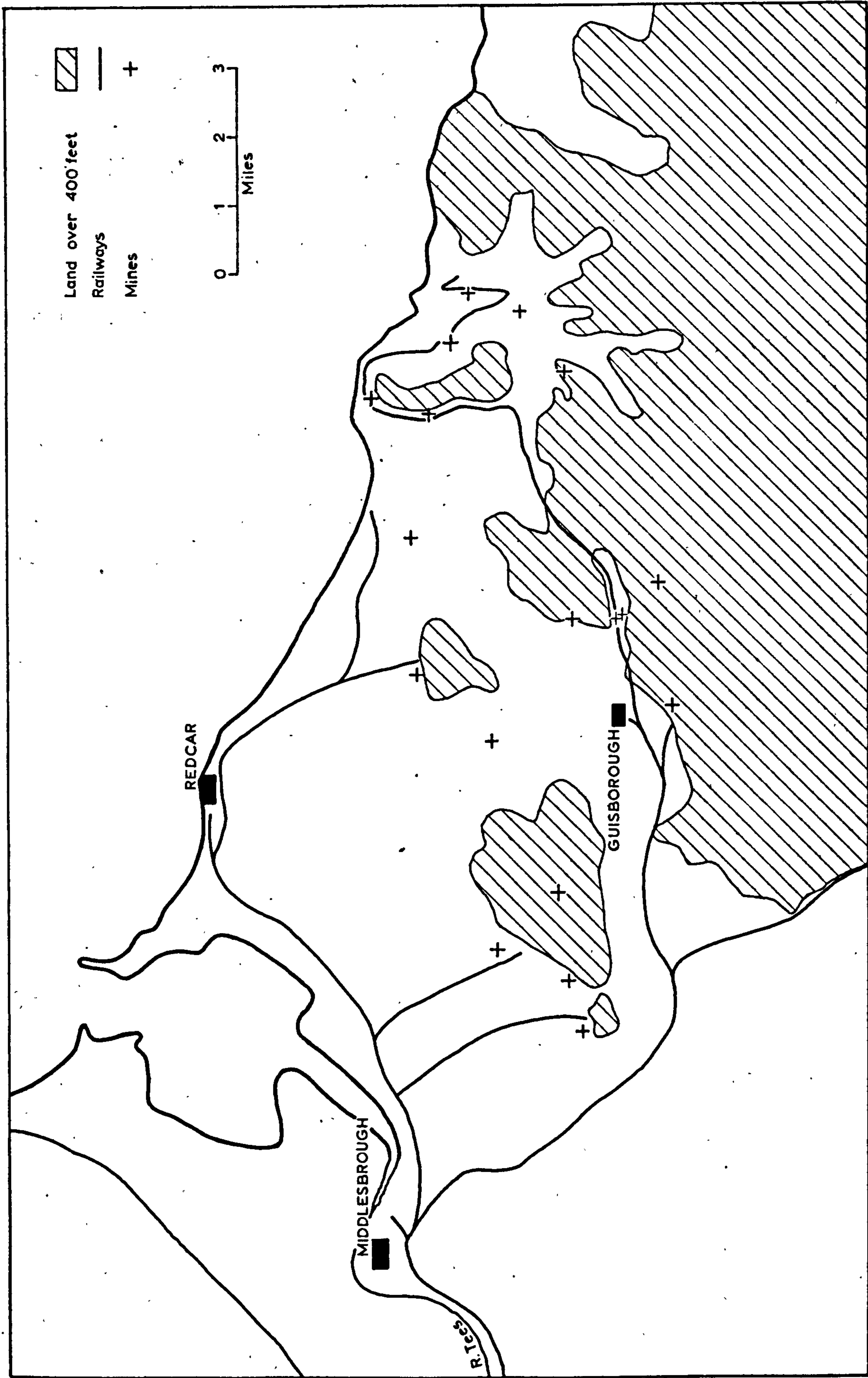


Figure 6.6 Distribution of Cleveland Ironstone Mines in 1871

in 1864, an adit was used to tap the Main Seam. At Brotton in 1865, Liverton in 1866 and Kilton in 1870, however, shafts were necessary. Moreover, the shafts required were steadily becoming deeper, as that part of the orefield was reached where the ironstone lay furthest beneath the surface, and beneath sea-level. Whereas the Skelton Shaft was a mere 114 feet deep, those at Brotton, Liverton and Kilton were respectively 270 feet, 480 feet and 680 feet.

During the 1870's further, though small, additions were made to the railway network in east Cleveland, encouraging the establishment of more new mines. Nearly all of these had shafts, and in most cases the shafts were deep. The extreme limit was reached at North Skelton in 1872, with the sinking of a shaft to the depth of 720 feet. By the end of the decade, there was little scope for further new development; the best part of the orefield had been delimited, and most of the royalties of any value were being worked.

From the viewpoint of the location theorist, the spatial development of ironstone mining in Cleveland was geared quite nicely to cost factors, and the broad pattern was much as would be expected on theoretical grounds. The first mines to be opened were drift mines in the royalties closest to the market, where the Main Seam came to the surface and was at its best quantitatively and qualitatively. The companies owning these mines had the benefit not only of low transport costs, but also potentially at least, of relatively low working costs.

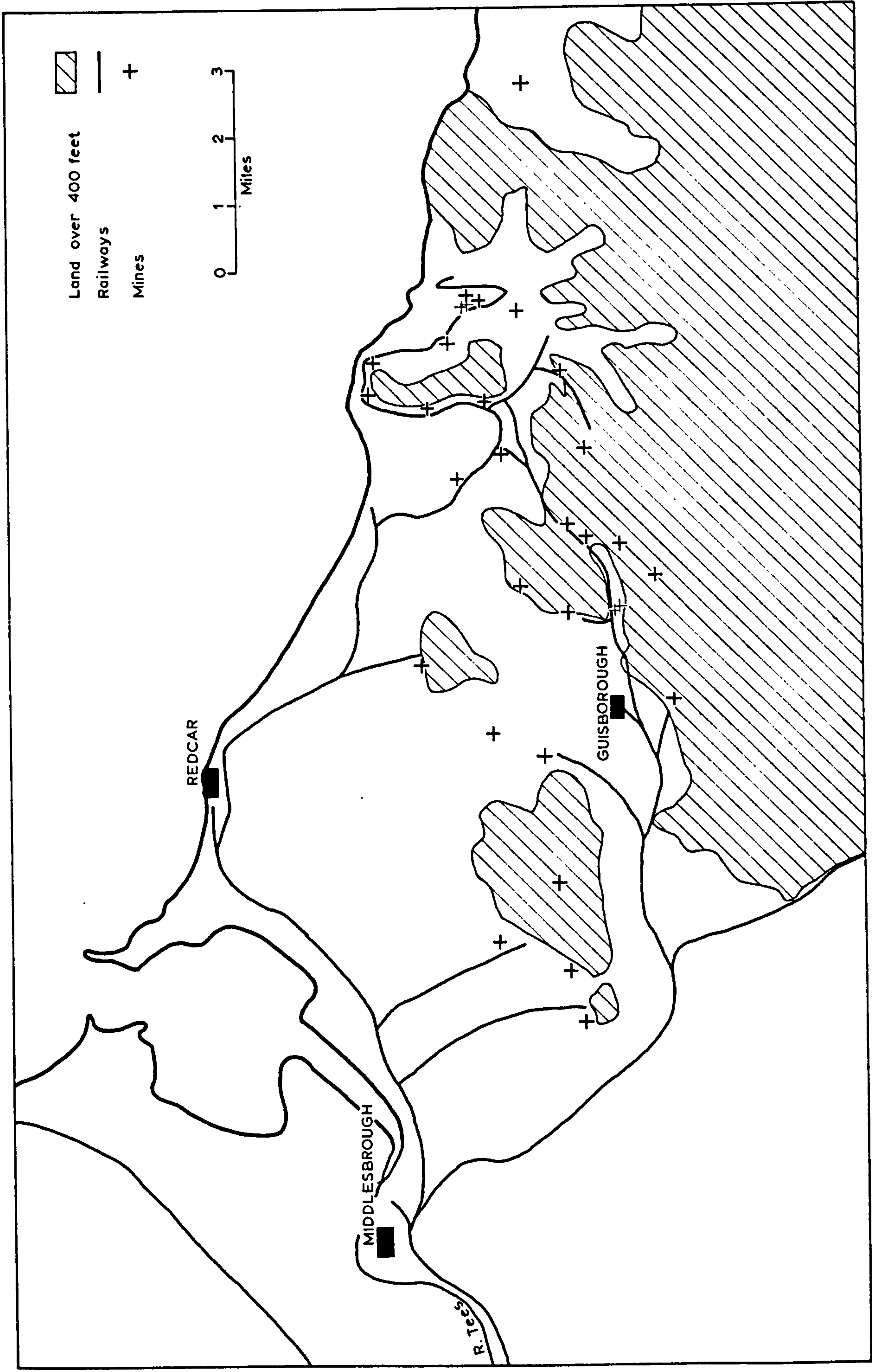


Figure 6.7 Distribution of Cleveland Ironstone Mines in 1881

Later, drift mines were established along the escarpment of the Cleveland, further away from the market. The total cost of producing ore at, and transporting it from, those locations must certainly have been higher than the cost incurred by firms working royalties to the north, in the Eston and Upleatham Hills. On the other hand, it must also have been lower than would have been the case elsewhere in the orefield. During the 1860's, development spread south-eastwards in an orderly sequence, with one royalty after another being leased. These were progressively further from the market, which meant rising transport costs. In addition, working costs must also have been increasing, as shafts became necessary, and as the shafts grew deeper.

Whatever the spatial variations in production costs and capital requirements resulting from the physical character of the orefield, however, there can be little doubt that transport costs were the major influence on the pattern of development. It was their concern with effecting transport economies that persuaded Bolckow and Vaughan to continue their explorations after the Main Seam had been found at Skinningrove, and to initiate mining at Eston. Subsequently, new mines were generally established according to the order in which royalties were reached by the burgeoning railway network. The lowering of transport costs which resulted from the gaining of access to the railway system was a far more important determinant of the direction taken by mining development than variations in working costs in different parts of the district.

There was, however, some concern with differences in working costs; otherwise, shaft mines would have been established as soon as, or sooner than, drifts. The general pattern of development also indicates as much. The railways built in Cleveland, with the exception of the original Stockton-and Darlington line and its extension to Redcar, were primarily intended to serve the mining industry, which was expected to generate most of the traffic. They were financed in part, or wholly, by companies and individuals who possessed, or hoped to acquire, a direct stake in that industry. It is not surprising, therefore, that the earliest railways to be built tapped those parts of the ore-field which were nearest the market, and in which production costs would have been lowest.

The spatial development of the Cleveland mining industry thus bore a general relationship to the pattern of costs within the orefield. Nevertheless, the fact that firms could establish themselves and prosper in such a variety of locations suggests that minimizing costs was a matter of desirability rather than necessity. Relatively high costs might have reduced profit margins somewhat but, up to a point, they did not debar survival. Disregarding differences in working costs, for which data are not available, this point can be substantiated by referring to variations in transport costs alone.

According to data presented in a publication by Lowthian Bell, the rate charged for carrying iron ore by rail in the

early 1880's ranged from 1.10d. to 0.78d. per ton-mile.<sup>1.</sup> The higher rate was for distances of up to 10 miles, and the lower rate was for distances of between 22 and 30 miles. On this basis, the cost of transporting ironstone from Eston to Middlesbrough would have been perhaps 3d. per ton. For firms with mines in the vicinity of Loftus, on the other hand, the cost must have been about 2s. per ton. The selling price of Cleveland ironstone in Middlesbrough was then 5s. per ton.<sup>2.</sup> Despite their relatively high costs, mining companies in the more outlying districts seem to have survived quite comfortably.

There were several reasons why firms with such different cost structures could co-exist. Basically, however, the situation was one envisaged in the theoretical introduction, where it was pointed out that a substantial growth in demand would mean that progressively poorer - more costly - locations would be brought into production, and the price level would accordingly rise. In Cleveland, more expensive locations were brought into use, and the price of local ore rose from 3s. in the late 1850's to 5s. in the early 1880's.<sup>3.</sup> By the latter period, the original firms and mines, such as Bolckow and Vaughan at Eston, were probably earning excess profits on their mining operations. They were allowed to do so by the fact that the prices paid for their locations were not free to find the level of the

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1. I. Lowthian Bell, Principles of the Manufacture of Iron and Steel, London, 1884, p.597.

2. Ibid., p.647.

3. Data from Hunt, op.cit.

of the market; they were generally fixed by long-term leasehold agreements.

Firms with relatively expensive locations were able to enter the industry, and the price of the product was allowed to rise, because the Cleveland ironstone producers collectively enjoyed a privileged position. The cost of Cleveland ore was lower than that of other British ores, and this advantage was compounded by the distance between Teesside and alternative sources of ironstone. Once iron manufacturing began to expand in the region, and to provide the main market for Cleveland ore, the local mining companies were safe from outside competition, and the local price of iron ore was such that even those firms with relatively high costs were able to stay in business. This situation was not altered fundamentally by the growth of imports of Spanish ores in the 1870's, though a limit was then set to the freedom of the Cleveland mining industry from external competition.

#### Summary.

The least-cost principle thus provides a useful means of analysing the spatial progress of development in the Cleveland iron-ore mining industry after 1850. However, the fact that producers were allowed considerable latitude in their choice of location by the absence of rigorous competition means that development differed somewhat from the pattern embodied in Wilson's model. In particular, there

was no sequence of entry, withdrawal and re-entry to and from production on the part of firms with mines in a given area, as a result of cost movements. If the cost advantage did shift from one district to another, this was not of great significance.

Although it is difficult to distinguish the direct role played by economic growth, there is no doubt that industrialization within the region had an important influence on the development of ironstone mining. The expansion of iron manufacturing on Teesside created more demand for Cleveland ore, and hence opportunities for the mining industry, than the external market alone could have done. The increase in demand allowed distant parts of the ore-field with their higher costs, to be brought into production. On the supply side, the most important innovation was the extension of the railway system, not some change within the industry itself. This tended to reduce costs generally, but it favoured the more far-flung districts in particular, since without railways transport costs would have been too high for production in them to have been feasible.



## CHAPTER SEVEN

### THE SPATIAL PATTERN OF AGRICULTURE

#### The Theoretical Framework

Agricultural location theory has been derived from von Thünen's early nineteenth-century model of the 'Isolated State',<sup>1</sup> and from the more recent work of Lösch, Dunn, Isard and others,<sup>2</sup> who have sought to give the basic model a normative character.<sup>3</sup> In its modern form, the model is more general and more rigorously defined than it was originally, when it was essentially an idealized description of von Thünen's own estate and district of Germany.

The fundamental assumptions or conditions of the model are : a homogeneous plain, with uniform resources and production costs everywhere; one market, in a central position; and a framework of perfect competition, so that there is but one price for each commodity. Like Weber's model of industrial location, the model of agricultural location is based on the least-cost principle.<sup>4</sup> From the entrepreneur's

1. J.H. von Thünen, Der Isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie, Rostock, 1826. This work is available in a modern translation - Peter Hall (ed.) Von Thünen's Isolated State : An English Edition of Der Isolierte Staat, trans. Carla M. Wartenberg, Oxford, 1966, 304 pp. For a summary see Michael Chisholm, Rural Settlement and Land Use : An Essay in Location, 2nd. ed., London, 1968, chap.2.
2. August Lösch, The Economics of Location, 2nd ed., trans. William H. Woglom, New Haven, 1954, chap.5; Edgar S. Dunn, The Location of Agricultural Production, Gainesville, Florida, 1954, 115 pp.; Walter Isard, Location and Space-Economy : A General Theory Relating to Industrial Location, Market Areas, Land Use, Trade, and Urban Structure, Cambridge, Massachusetts, 1956, chap.8.
3. David W. Harvey, "Theoretical Concepts and the Analysis of Agricultural Land-Use Patterns in Geography", Annals of the Association of American Geographers, Vol.56(1966) p.363.
4. See Melvin L. Greenhut, Plant Location in Theory and in Practice : The Economics of Space, Chapel Hill, North Carolina, 1956, pp.254-57.

viewpoint, the object is to maximize profits by minimizing costs; for society as a whole, the aim is to put agriculture on as efficient a footing as possible by minimizing the cost of producing given quantities of a given range of commodities.

The agricultural location model, however, is the more primitive, or simple, in that the assumption of a uniform plain removes the possibility of variable production costs. More fundamentally, the two models differ in that the scale of analysis associated with each is not the same. Weber was primarily concerned with the individual firm, and with finding the optimum location for its plant, regardless of factors other than its own costs of production. Von Thünen was concerned with the industry rather than the firm, and his mode of analysis also allows for the possibility of spatial competition arising between industries, as a result of more than one finding a particular location to be optimum. Agricultural location theory thus effectively transforms the problem into one of determining the optimum use for a unit of land, though it also provides a procedure for assigning the various uses to locations.

These differences in approach and scale of enquiry are the main reason for the separate development of the location theories for agriculture and manufacturing. Agriculture's relatively large land requirements, which tend to highlight the distinction between farming and other types of economic activity, have favoured the retention of a separate body of

spatial theory pertaining to it. Nevertheless, Weber's and von Thünen's models share the same conceptual base, and, as has been remarked by Dunn and Isard, the gap between them is partially bridged by the farmer's concern with industrial agglomeration and the latter's applicability to the individual firm.<sup>1</sup>

The basic situation envisaged by von Thünen can be summarised briefly. Given that there is one market in a region, that the only costs to vary spatially are those associated with transportation, and given the other conditions described earlier, then the optimum location for any farmer is at the market. There, transport costs, and total costs, are at a minimum. The fact that agriculture is an extensive user of land, however, means that not all farmers can locate on the edge of the market. Farmers must compete for the land available, and some will be obliged to accept locations at a considerable distance from the market. Location theory evaluates the respective claims of potential users of given units of land, and allocates the land in such a manner that the best possible use is made of it.

Basic to the theory of agricultural location is the concept of 'economic rent', which is the return to a factor of production over and above its necessary supply price or transfer cost.<sup>2</sup> The latter is the amount that a factor could earn in the most lucrative alternative employment open

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1. See Dunn, op.cit.; chap.7; and Isard, op.cit., chap.8.

2. This paraphrases the definition given by Edward Nevin, Textbook of Economic Analysis, London, 1960, pp.214-20.

to it, and is therefore the minimum price that must be paid if a factor is to be attracted. Economic rent is the difference between that price and the actual earnings of the factor in question. In the case of land, the supply price is equivalent to the return which would be earned by a unit of land if it were taken from one use and assigned to that which was the most rewarding alternative. The economic rent for a unit of land is thus the difference between the return which it is earning and the necessary supply price. If there is only one feasible use for a unit of land, then the supply price is zero, and the total return is economic rent.<sup>1.</sup>

Ricardo is credited with originating the concept of economic rent as it applies to land. In doing so, he considered an area in which the quality of the soil varied and only wheat was grown. Wheat yields and economic rent depended on soil quality.<sup>2.</sup> Von Thünen modified this scheme by holding soil fertility constant and examining, instead, the effect of distance from the market.<sup>3.</sup> In this context, the net revenue of the farmer depends upon the proximity of his farm to the market. Hence, the supply price and economic rent of units of land vary with distance from the market, since it is worthwhile to pay more for land if

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1. I.e. the only alternative is to take the land out of production.
  2. See Chisholm, op.cit., pp.20-26; and William Alonso, Location and Land Use : Toward a General Theory of Land Rent, Cambridge, Massachusetts, 1964, pp.2-5.
  3. Loc.cit.; and Andreas Grotewohl, "Von Thünen in Retrospect", Economic Geography, Vol.34 (1959), pp.346-55.

transport costs can thereby be reduced.

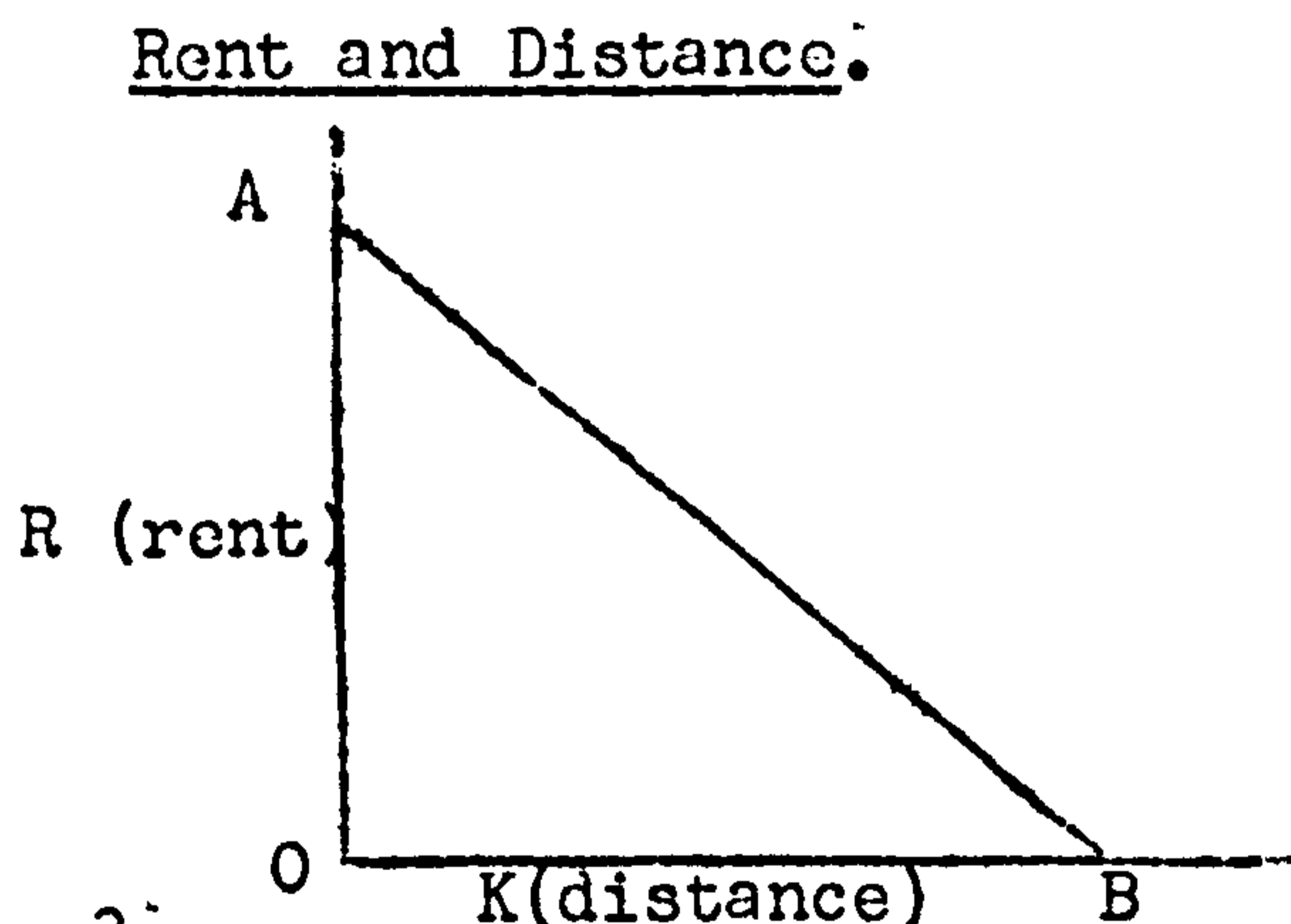
Dunn has expressed these relationships mathematically<sup>1</sup>. In an area where one crop is grown, and von Thünen's conditions apply,

$$R = E (p - a) - Efk,$$

where R = rent per unit of land,  
k = distance from the market,  
E = yield per unit of land,  
p = market price per unit of a given commodity,  
a = production cost per unit of the above commodity,  
and f = transport rate per unit of distance for the commodity.

The relationship between rent and distance from the market can also be depicted graphically, as in Figure 7.1 below. The sloping line AB is the marginal rent line, or

Figure 7.1<sup>2</sup>.



rather surface<sup>3</sup>, and is an indication of the rent potential of units of land at successive distances from the central market. Rent is at a maximum on the edge of the market

1. Dunn, op.cit., p.7.
2. From Dunn, op.cit., p.7.
3. The term 'surface' is more accurate because AOB is a partial cross-section of a cone centred on the market.

point (0), where transport costs are lowest. Beyond B, rent is no longer received because transport costs are so high that farming is unprofitable.

A location close to the market would not, however, guarantee abnormally high profits. Other than in the very short term, no single producer receives more than a normal profit in a fully competitive economy. In the case of agriculture, this is because the economic rent becomes the ordinary rent paid by the farmer to the landlord. At a location near to the market, savings in transport costs are matched by increases in the payment to land. If part of the surplus revenue resulting from low transport costs were withheld by the farmer, then rivals would be able to displace him by bidding higher for his land. In the equilibrium position, therefore, all farmers earn the same profit<sup>1</sup>, though some do so by making large transport outlays, while others pay a higher price for land.

With the introduction of a second crop to the model, spatial competition arises between industries as well as firms. This may lead to the formation of concentric zones of land use around the market. Both crops, or industries, will have rent surfaces that slope downwards with distance, but these are almost certain to differ. The rent potential of units of land at various distances from the market depends upon the interplay of those two surfaces, as is

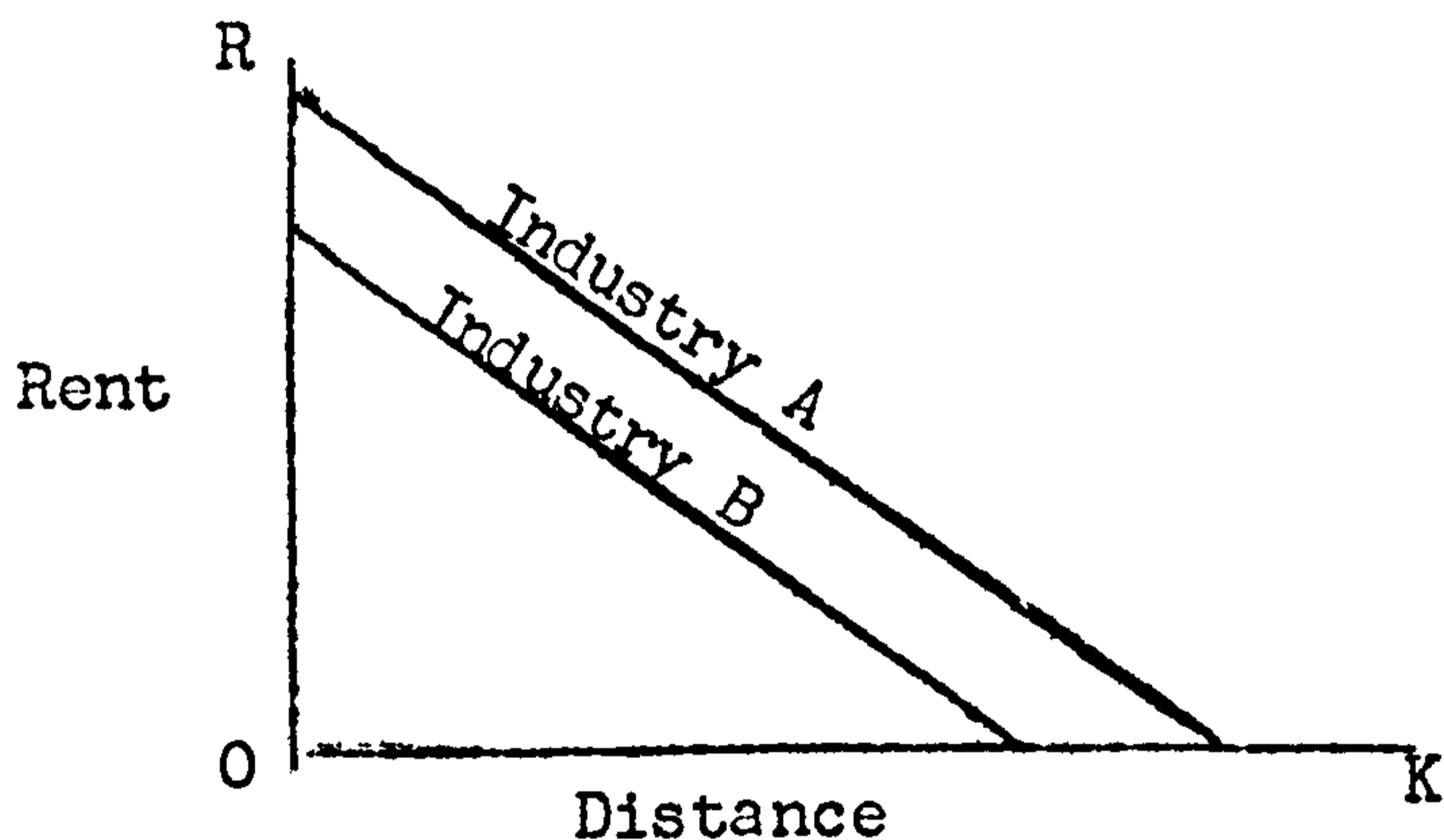
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1. I.e. a 'normal' profit.

indicated in Figures 7.2 and 7.3. Each unit of land will be assigned to that use which affords it the higher rent potential, since the industry concerned will be able to outbid its rival at that point.<sup>1</sup>

Figure 7.2.

The Distance-Rent Relationship for Two Crops.



The marginal rent surfaces for two industries, A and B, are shown in Figure 7.2. Both industries have a rent potential, but at every point where B could function profitably, A has a higher potential and is consequently in a position to outbid its rival for the land. The equilibrium solution is therefore one in which monoculture prevails throughout the area, with A the only industry in existence.

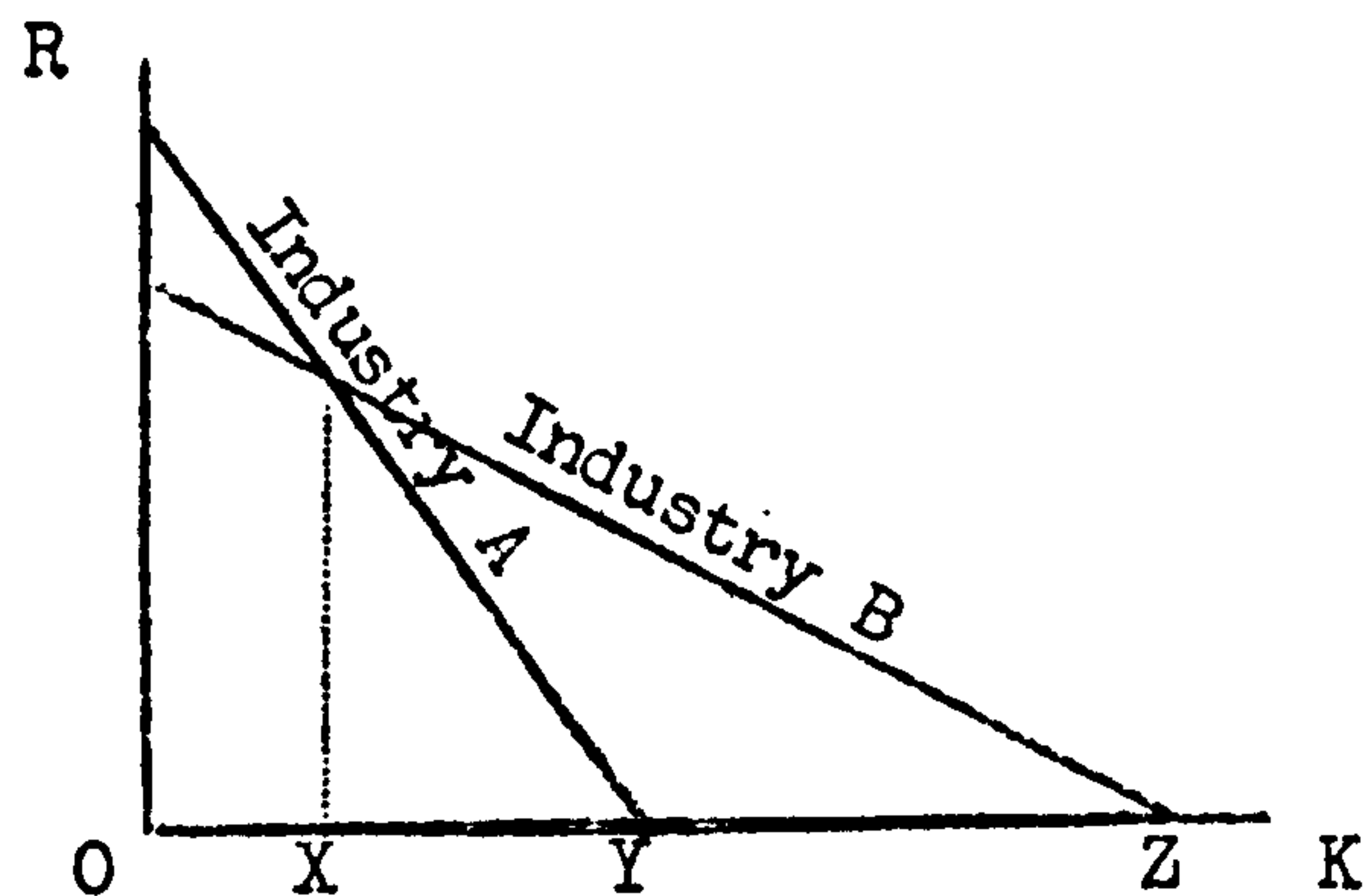
Figure 7.3 depicts a rather different situation. Here, industry A has the higher rent potential up to distance X. Beyond that point, it is B which has the higher potential. The zone OX will therefore be occupied by A, and XZ by B. These zones are in fact concentric rings about the market at O. It may be noted that zoning on this pattern will

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1. Dunn, op.cit., pp.9-11.

occur only if intercept R, in Figure 7.3, is greater for A than for B while intercept K is smaller for A than for B, or vice-versa.<sup>1</sup> Otherwise, one industry will have a higher rent potential at all points, and only one crop will be grown in the region. Multiple zoning may emerge when a number of industries are represented, with each crop or land-use type occupying that ring in which it is capable of obtaining a higher economic rent than any other crop.

Figure 7.3.  
Two-Crop Zoning.



With distance from the market, changes in land use will tend to appear even when only one crop is grown.<sup>2</sup> These will result from differences in farming methods. To achieve the optimum level of output, a farmer in a particular industry will make use of an input package in which land bears a certain relationship to the other factors of production. This package will vary in content according to the

1. Ibid., pp.11-13.

2. Ibid., chap.3;  
Isard, op.cit., pp.188-99;  
and Chisholm, op.cit., p.26.



distance of the farm from the market. Close to the market, the farmer is faced with relatively high land charges. To compensate, he must use his land intensively, substituting labour and other inputs for land. Near the agricultural margin, however, land will be plentiful and cheap, and the farming system must take advantage of that by incorporating extensive methods of production.

The von Thünen model can be brought closer to reality, and made more complex, by modifying it in ways suggested by its originator. For example, the assumption that transport rates are constant with distance can readily be relaxed without fundamentally disturbing the orderly arrangement of the model. Generally, transport rates decline with distance, due to the decreasing significance of terminal charges and other fixed costs unrelated to the length of the journey. As a result, marginal rent functions are not linear in their relationship with distance, but curvilinear and concave.<sup>1</sup> This, however, does not require any alteration in the essentials of the model.

Similarly, the presence of more than one market centre can be accommodated satisfactorily.<sup>2</sup> If there is a sufficient distance between the various centres, then each will acquire its own supply area and set of land-use zones, unaffected by the existence of the others. Alternatively, and

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1. Dunn, op.cit., pp.39-43 and 56-57.

2. Ibid., pp.57-63.

more probably, there may be competition between the centres, with supply areas overlapping and each market centre striving to extend its influence at the expense of its neighbours. The equilibrium pattern must therefore reflect not only the rent potential of different industries at a given point with respect to distance from one market, but also their potential at that point with reference to all markets.

A very simple solution may be envisaged in which two centres of equal status share an agricultural district equally, each having a truncated supply area, with the two areas separated by a straight-line boundary. The addition of more centres of equivalent stature would further distort the symmetry of the supply areas, but the resulting pattern would depend on the relative positions of the various centres. If the various market centres in an area were unequal in economic stature, then a hierarchial system could emerge in which the small centres and their tributary areas appeared as holes in the fabric formed by the zones surrounding the large market centres.

Another type of distortion could be created by the development of unequal transport facilities on the otherwise homogeneous plain. Railways, trunk roads, canals and major transportation arteries have the effect of lowering transport costs in the immediate areas through which they pass.<sup>1</sup> In turn, this leads to the warping of the concen-

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1. See ibid., pp.64-65; and Isard, op.cit., p.276.

tric zones of land use around a central market, with the various belts being extended outwards in the directions taken by the routeways concerned. Despite losing their circular form, however, the zones remain intact. A similar effect can be had by differences in soil quality, or other aspects of the physical environment,<sup>1</sup> the land-use zones being drawn outwards in areas with relatively low production costs and compressed where conditions dictate that costs should be high.

#### The Effects of Economic Growth.

Whether as a cause or affect, rising productivity in agriculture is a normal concomitant of economic growth, and historically it has figured prominently during industrialization. An increasingly prosperous and numerous population requires ever larger supplies of agricultural produce, and thus provides the farming sector with the incentive and opportunity to expand its output. At the same time, however, labour tends to be drawn from the rural-farming populace to meet the rising demand for it in the secondary and tertiary sectors. Agriculture is therefore encouraged to expand production while its labour force is static or, more probably, declining. The almost inevitable result is widespread mechanization and productivity improvements by this and other means.

On the other hand, much of the stimulus to economic growth may actually emanate from the agricultural sector.

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1. Dunn, op.cit., pp.66-70.

Rising productivity in farming, especially if mechanization is partially responsible for it, releases labour for other employment. It also tends to lower the costs of various industries by reducing the prices of some of their materials. By expanding its output sufficiently to produce surpluses of certain commodities, agriculture may also promote economic growth through the expansion of external trade. During industrialization, at least, progress in the agricultural sector tends to be both a cause and an effect of economic growth, and it is usually very difficult to establish which aspect of the relationship developed first.

The significance of industrialization and economic growth for the theoretical model of agricultural location can be examined by assuming that the system, once disturbed, will move towards a new state of equilibrium which will take account of the changed conditions. Following Dunn,<sup>1</sup> the components of locational equilibrium for agriculture may be grouped into two categories - the determinants of demand and the determinants of supply. Economic growth may be expected to affect and involve them both to some extent.

#### The Determinants of Demand.

Population size is one of the most critical elements in this category, and population expansion has generally been closely associated with economic growth, especially

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1. The following discussion draws heavily upon Dunn, op.cit., chap.6, but also see : Richard J. Peet, "The Spatial Expansion of Commercial Agriculture in the Nineteenth Century : A Von Thünen Interpretation", Economic Geography, Vol. 45 (1969), pp.283-301; and Martin Beckmann, Location Theory, New York, 1968, chap.7.

in the industrialization phase. The immediate effect of population increase is to raise the overall demand for agricultural commodities, which in turn leads to higher price levels for them. These raise the marginal rent functions of the various agricultural industries, so that each unit of land can command a higher economic rent, and each industry can operate at a greater distance from the market than was possible originally. The radius of the agricultural area supplying a particular market centre is therefore enlarged.

If these effects are constant for all industries, then each individual land-use zone will expand in size. The industry occupying the area nearest to the market will extend its zone of dominance outwards. In turn, the industry in the adjacent zone will surrender part of its original territory, but will more than compensate for this by annexing an even larger part of the next zone. The overall result will be that each zone becomes larger than it was initially, though it will cover a rather different area.

More realistically, however, it is improbable that each industry will be affected to the same extent by population growth. This is partly because population expansion tends to alter the aggregate pattern of demand. Natural increase can give the population a quite different age-structure, and immigration may also affect its social structure and cultural balance. In turn, these changes mean that the demand for some agricultural commodities rises faster than

that for others, that some industries benefit more than others, and that land-use zones expand at differential rates.

Income is the other major determinant of aggregate demand. Generally, an increase in per capita real income, like population growth, raises the demand and price levels for agricultural goods and consequently leads to the radial expansion of land-use zones and of the agricultural supply area as a whole. Again, however, the effects tend to be disproportionate between industries and between zones, as an increase in consumer incomes alters the overall structure of demand and thereby benefits some industries more than others.

In this case, it is variations in demand elasticity which cause the re-shaping of the demand structure. One important influence is the principle underlying 'Engle's Law'. That is the empirically-verified observation that above a certain level, further increases in personal incomes do not occasion a proportionate rise in expenditure on foodstuffs. Hence, "for agricultural products as a group, the income elasticity is relatively low."<sup>1</sup> More durable goods become increasingly prominent in household budgets as the standard of living rises above subsistence level, and these generally owe more to manufacturing than to farming.

Even between agricultural commodities there are variations of a similar nature. Foodstuffs in the 'starchy-staple' category have relatively low demand elasticities,

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1. Dunn, op.cit., p.74.

and they become less important items in the household budget as personal incomes rise. Conversely, meat, fruit, fresh vegetables and dairy produce are subject to a more elastic demand, and expenditure on them tends to increase faster than income. It is thus to be expected that economic growth - providing that it is reflected in the level of per capita income - will create more additional demand for some commodities than for others, and that this will be manifested in the adjustments made to the various land-use zones.

A third important determinant of demand is the structure of consumer preferences. This affects the composition rather than the size of aggregate demand. Independently of both population and income change, there may be alterations in the pattern of taste or preference that lower and raise the demand for different commodities, and thereby contribute to the expansion and contraction of land-use zones.

#### The Determinants of Supply.

The locational equilibrium of agriculture can also be disturbed by changes affecting supply conditions. These may appear most dramatic in the form of technological innovations such as the introduction of machinery to aid farming processes, but the discovery and use of new crops or better methods of cultivation may be of greater significance. Innovation in agriculture generally leads to a reduction of real unit costs, to an increase in yields per unit of land, or to some combination of the two. In the short run, the

net result is the same whichever direction innovation takes. There is an upward shift of marginal rent lines and, hence, an extension of the agricultural area and of the individual zones affected.

The long-run adjustment, however, depends upon whether there has been an increase in yields or a decrease in costs<sup>1</sup>. In the latter case, the expansion of the zones occupied by the industries concerned is followed by an increase in production. As a result, output becomes inconsistent with the existing price levels, which must fall. Lower prices, will, in turn, cause some contraction of the areas being farmed. Unless the demand elasticity of the commodities affected is zero, however, demand will remain higher than it was at the original price levels. The areas under production will therefore still be somewhat larger.

In contrast, an increase in the yield per acre may have the long-term effect of causing a contraction of the productive area. In the short run, output will rise, both because the initial area of production can yield more and because land previously beyond the margin can be farmed as a result of the upward movement of rent functions. The price level must fall, however, to restore the balance between supply and demand, and this will force part of the farming area out of production again. If the increase in yield is greater than the increase in demand occasioned by the new and lower price, then the total productive area may

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1. Ibid., pp. 76-77.



remain smaller than it was originally. Dunn avers that this outcome is highly probable, since it can only be avoided if the demand elasticity is very high. Thus, whereas a reduction in the cost of production will cause an extension of the agricultural areas, an increase in yield is likely to result in its diminution.<sup>1</sup>

Innovation in the transport sector tends to lower the cost of transportation, and hence of agricultural production too. It therefore operates in the same manner as cost-reducing improvements within the agricultural sector, and permits the extension of agricultural supply areas. It is likely that the effects will vary between industries and land-use zones; for an innovation in transport may benefit one industry in particular, as the introduction of refrigerated railway trucks did dairying. More generally, the construction of a railway would be relatively more advantageous for industries with locations further away from the market, since railway charges tend to decline with distance. Hence, although marginal rent lines shift upwards with transport innovations, they do not do so to the same extent. As a result, the consequences for demand and the size of productive areas vary between industries.

Finally, innovation in the manufacturing sector may also disturb the locational equilibrium of agriculture. If the immediate market for a particular branch of farming is provided by a manufacturing industry, then any change in the

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1. Loc. cit.

optimum location of the latter will be reflected in that of the former. For example, a manufacturing industry bound to the source of a certain agricultural commodity may also be limited to areas within a given distance of the market. An innovation, perhaps in the transport sector, which allowed such an industry to locate further away from its market would also give greater locational freedom to that branch of agriculture associated with it.<sup>1</sup>

#### Summary.

The relative significance of the types of change which have been discussed varies both temporally and spatially. During industrialization, however, all of them are normally present, each contributing to the movement towards a new state of equilibrium. Population growth, rising living standards, and falling costs of production and transportation all encourage the expansion of agricultural production and of the productive area. Rising yields, on the other hand, tend to restrict the extension of the farming area, since they make possible greater production from the same area.

Changes in the structure of demand, which are occasioned by higher personal incomes, alterations to the population composition and adjustments to the pattern of consumer tastes, cause expansion to differentiate between agricultural industries. While some industries experience a greater upsurge of demand than normal, and their zones of occupance are considerably enlarged, others may be faced

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1. Ibid., p.79.

with a declining market. Similarly, innovation tends to vary in its effect, being greater for some than for other industries, but in detail this is a matter for empirical investigation.

### Agriculture in the Teesside Region.

#### The Physical Framework.

The physical and economic heartland of Teesside is an undulating lowland plain which is bisected, in an approximate east-west direction, by the Tees itself. This plain, which may be defined as the area less than 250 feet above sea-level, flares outwards and declines in elevation with distance from the western boundary of the region towards the coast. In the west it meets, or merges with, the foothills of the Pennines. In the north it rises steadily in elevation and provides a gentle slope leading on to the limestone plateau of east Durham. To the southwest it adjoins the lowlands of the Northallerton Gate, which separate the Pennines from the North York Moors, and in the south east it is checked abruptly by the Cleveland Hills.

The greater part of the region consists of land less than 250 feet in altitude. A number of parishes, however, are situated on the Durham plateau, at elevations of up to 500 feet above sea-level, and a few are located in the Pennine foothills. A substantial part of the region also consists of parishes in the moorland district formed by the Cleveland Hills and North York Moors. There, altitudes between 1,000 and 1,500 feet are attained, but settlement

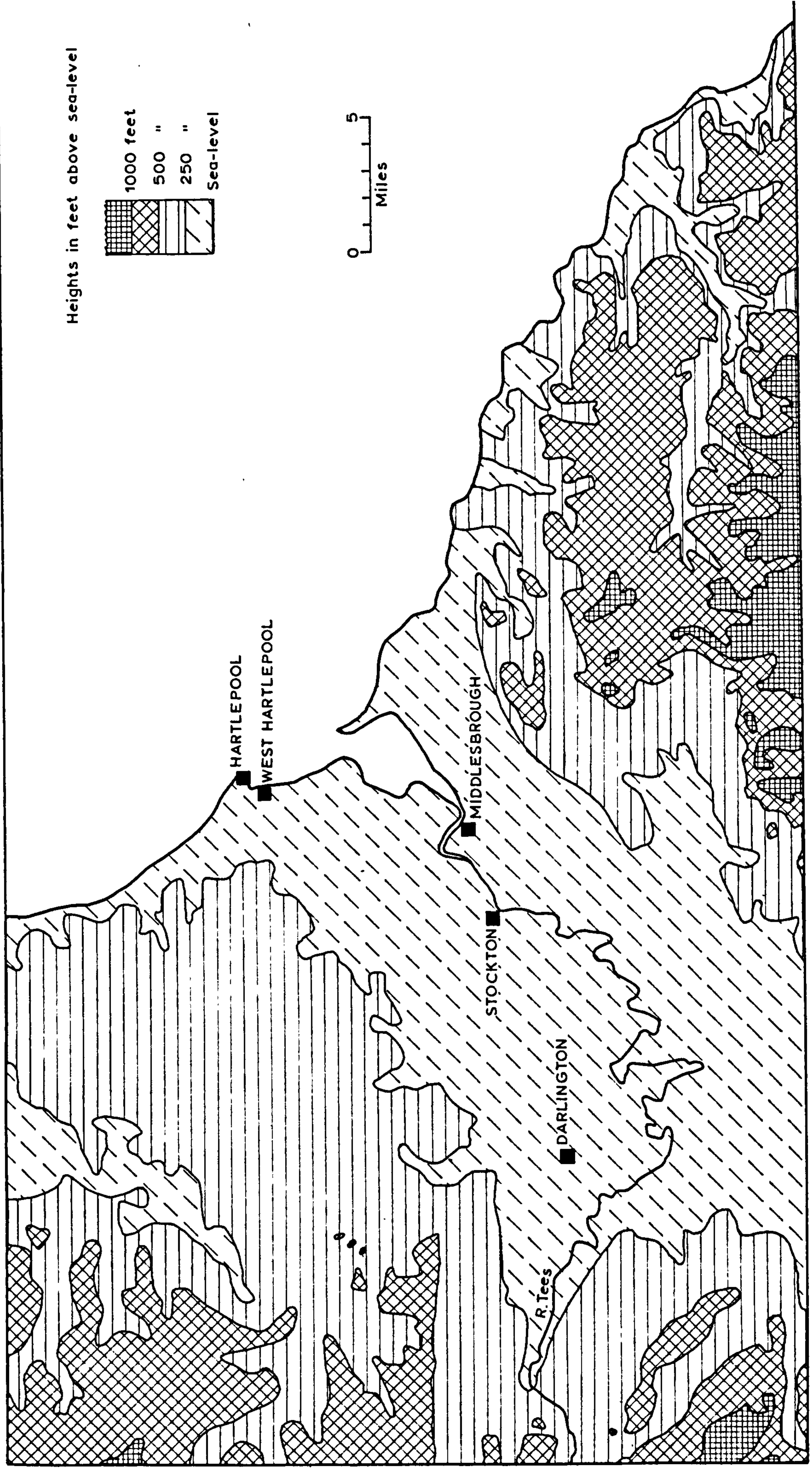


Figure 7.4 Physiography of Teesside

and farming have long been concentrated in the dales which are deeply incised in the moorland plateau.

### Climate.<sup>1.</sup>

In North East England as a whole, the mean monthly temperature ranges from slightly below 40°F. in January to a little under 60°F. in July. Within the Teesside region, there are only relatively small deviations from this general pattern. In the lowlands, temperatures sink a little lower in winter and rise a little higher in summer at inland locations than they do at the coast. In the upland areas, temperatures tend to be rather lower throughout the year, and the growing season is about 10 days shorter than

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1. Details of climatic conditions have been taken from:  
I.J. Jackson, Pressure Types and Precipitation over North-East England, Department of Geography Research Series, No.5 (1969), University of Newcastle upon Tyne, 81 pp.;  
S.W. Wooldridge, Yorkshire (North Riding), pt. 51 of The Land of Britain : The Final Report of the Land Utilisation Survey of Britain, ed. L. Dudley Stamp, London, 1945, pp.375-78;  
North East Development Association, A Physical Land Classification of Northumberland, Durham and Part of the North Riding of Yorkshire, Newcastle, 1950, chap.3;  
J.W. House and B. Fullerton, Tees-Side at Mid-Century : An Industrial and Economic Survey, London, 1960, pp.53-57;  
  
E.May Watson, "Climate", in Scientific Survey of North-Eastern England, British Association, Newcastle 1949, pp.31-37.

at sea-level, where 35 weeks is the norm.

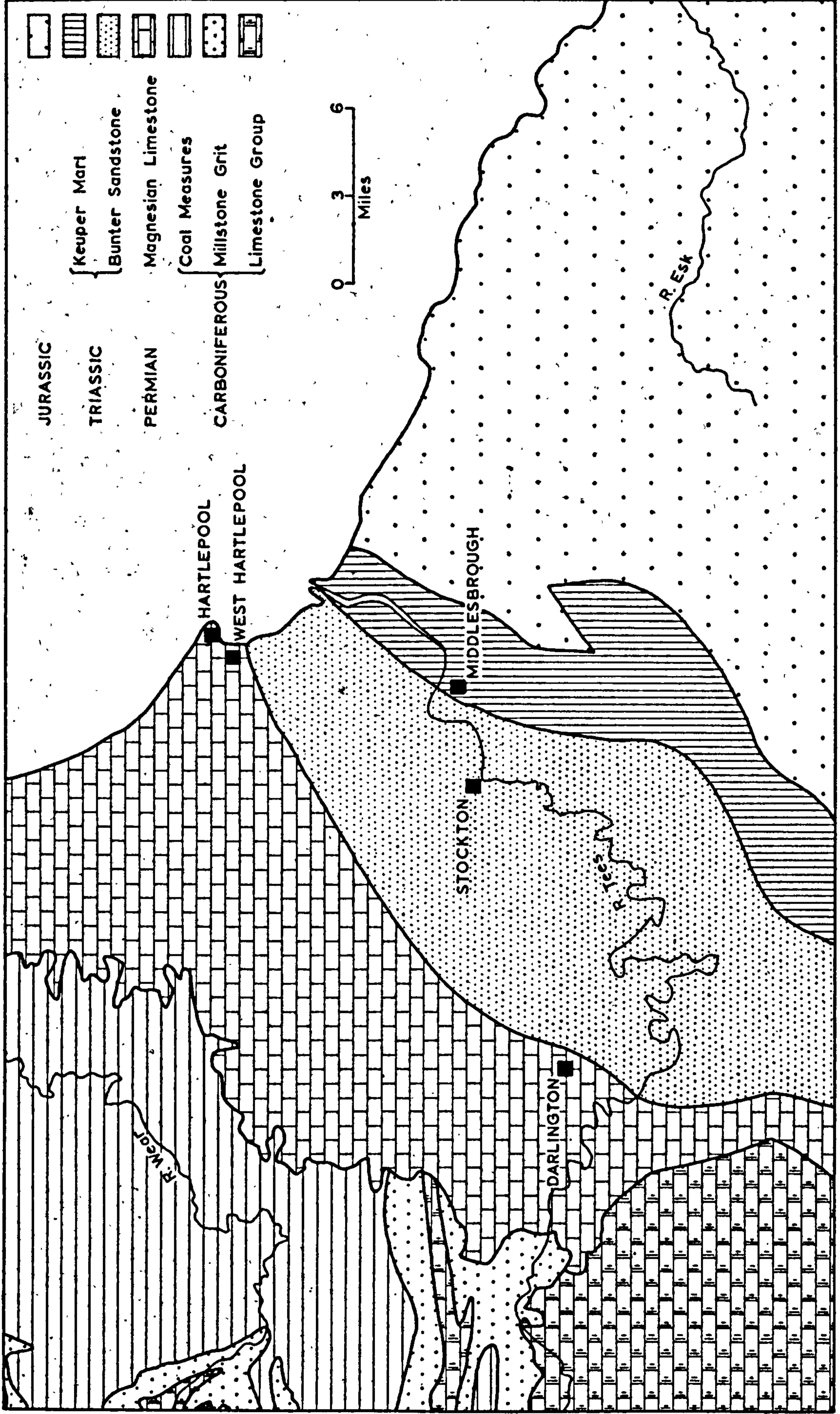
The amount of precipitation received varies spatially, but it is generally typical of areas in eastern Britain. Westerly airstreams are dominant in all seasons throughout the North East as a whole, and precipitation consequently decreases eastwards from the Pennines. On Teesside, the presence of the North York Moors, which gives rise to an area of comparatively high precipitation near the coast, disturbs the regularity of this trend. To the west of Darlington, places within the Teesside region receive up to 30 inches of precipitation per year, whereas less than 25 inches is normal to the east. The driest part of the region is the area around the Tees estuary, where less than 18 inches is common. In contrast, the higher parts of the North York Moors receive up to 40 inches annually. Throughout the region, summer is the season of maximum precipitation and spring is the driest period of the year.

#### Soils:

Over most of the Teesside region soils have developed not on bed-rock but upon a variety of Pleistocene and more recent superficial deposits. As a result, "... the solid geology has but the broadest of influences upon the present-day soil ...."<sup>1</sup>. It is only towards the southern extremities of the region, on the summit areas of the Cleveland Hills and the North York Moors, that there are large tracts of land free from drift and clad with soils generated on solid

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1. North East Development Association, op.cit., p.27.



Source: N.E.D.A., 1964.

Figure 7.5 Geology of Teesside

rock. Elsewhere, till is the normal soil parent material, though it is augmented by glacial sands and gravels and by deposits of alluvium which have been laid down more recently.

The Pleistocene glaciation was a complex process in North East England, with major ice-sheets from southern Scotland, the Lake District and Scandinavia, and minor ones from the Pennines and the Cheviots, all converging upon the area and leaving their distinctive marks behind them.<sup>1</sup> None of the ice-bodies concerned, however, appears to have exceeded 1,000 feet in thickness upon reaching the vicinity of Teesside;<sup>2</sup> drift has not been found within the region at altitudes in excess of 850 feet.<sup>3</sup> Even at 600 feet above sea-level, such deposits are rather tenuous.<sup>4</sup>

The geological evidence suggests that the progress of the various ice-sheets was halted by the Cleveland Hills and their outliers at Eston and Upleatham, which diverted them into the Vale of York and a corridor along the coast.<sup>5</sup>

1. For the glacial history of the area see: George Barrow, The Geology of North Cleveland, "Memoirs of the Geological Survey", London, 1888, chap. 6; D.B. Smith and E.A. Francis, Geology of the County Between Durham and West Hartlepool, "Memoirs of the Geological Survey of Great Britain", London, 1967, chap. 6; R. Agar, "Glacial and Post-Glacial Geology of Middlesbrough and the Tees Estuary", Proceedings of the Yorkshire Geological Society, Vol.29 (1953-54), pp.237-53; Vernon Wilson, British Regional Geology: East Yorkshire and Lincolnshire, Geological Survey and Museum, London, 1948, chap.8; H.G.A. Hickling and T. Robertson, "Geology", in Scientific Survey of North-Eastern England, op.cit., pp.10-30.; G.W. Radge, "The Glaciation of North Cleveland", Proceedings of the Yorkshire Geological Society, Vol.24 (1939), pp.180-205.
2. A.E. Smailes, North England, London, 1960, p.36.
3. Barrow, op.cit., p.66.
4. Loc.cit.
5. Hickling and Robertson, op.cit., p.23.



In East Cleveland, however, the glaciers overcame the obstacle posed by hills ranging up to 500 or 600 feet in elevation and left a mantle of drift over much of the moorland in that area.<sup>1</sup> Tongues of ice also penetrated the vale of Guisborough and other accessible lowland avenues into the hills, but the higher districts were not touched by the encroachment. Eston Moor, the Uplcatham Hills, and the north west - south east oriented ridge to the north of Kildale and Eskdale (which encompasses the Guisborough, Commandale and Danby Moors) are all free from drift.

The areas without a cover of glacial drift consist of the highest parts of the region, and are in the south east. There, the surface rocks are almost entirely the sandstones and thin shales of the Estuarine Series of the Oolitic Formation,<sup>2</sup> which have given the more easily-erodible shales of the Lias a protective overlay. The Estuarine rocks provide a very poor parent material for soils.<sup>3</sup> Their base-content is relatively low, and the soils formed on them have been much diminished in agricultural value by long and continuous weathering and leaching. Anderson refers to these soils as 'senile'; their original stocks of plant nutrients have largely been lost through leaching, and the possibility

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1. Details of the patterns of deposition can be obtained from the one-inch maps of the Geological Survey.
  2. For a general description see Wooldridge, op.cit., pp.359-64 and 372-75.
  3. Moorland soils have been described and classified by G.A. Anderson in his "A Preliminary Investigation of the Soils of the North-East Yorkshire Moors", unpublished Ph.D. Thesis, University of Durham. 1958, 556.pp.

of recovery is slight, as very little new material remains in the upper profiles.<sup>1.</sup>

Even so, orthodox Brown Earth soils could probably develop under deciduous woodland, which is regarded as the climax vegetation for the area.<sup>2.</sup> There is strong evidence that such soils were once widespread, and that it was man - with his tools, grazing stock, and methods of farming - who was responsible for the deforestation of the moorlands and the resultant degeneration of the Brown Earths.<sup>3.</sup> With the clearing of the woodland came the encroachment of heath vegetation, the development of layers of acid peat, intensified leaching, and podzolisation of the soils.

Now, Peaty Podzols are typical of the high moorlands, and gleying is common on shales where the surface is relatively level. In texture, the soils range from coarse-grained sands, developed on gritstone, to the clay loams of the shales. Agriculturally, their value has been very low for many centuries past, and the land they cover has been used for little other than rough grazing for free-ranging sheep.

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1. Ibid., pp.27-31.

2. Ibid., pp.42-47 and 49-51.

3. For example, G.W. Dimbleby found orthodox Brown Earths, surrounded by podzols, under prehistoric tumuli. These were taken to be fossilized relics which had been protected from degeneration by the presence of human structures. See Dimbleby's "Historical Status of Moorland in North East Yorkshire", New Phytologist, Vol.51 (1952), pp.349-58.

On the steeper valley sides and scarp slopes of the moors there are soil complexes of a superior type.<sup>1</sup> These owe their origin partly to creep action, which rejuvenates the soil cycle by continually exposing fresh rock to weathering, and thereby maintains the 'juvenile' status of the soil profiles. An additional influence is the presence of outcrops of Liassic rocks, which have a higher base-content than those of the Oolitic, on these slopes. Finally, drainage is very free and this factor prevents the occurrence of gleying, which is a widespread problem on the valley floors. The soils in this superior category are not, however, extensive, but they do have a localized importance for farming.

Glacial and inter-glacial drift deposits provide the parent materials for soils throughout most of the region. The former consist mainly of boulder clay, and the latter of sands and gravels. The depth of the drift varies considerably. It is 300 feet thick at Wolviston, only 10 feet thick at Lackenby, and even less elsewhere.<sup>2</sup> Generally, the drift is thickest in the centre of the Tees lowland and tends to thin towards the Durham plateau in the north, the Cleveland in the south, and the coast in the east. There are unusually thick localized deposits, however, wherever pre-glacial valleys have been infilled. At the other extr-

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1. Designated 'Creep Complexes' by Anderson, op.cit., p.11.
  2. See Agar, op.cit., p.239; and R. Simpson, "Some Geographical Aspects of the Agriculture of the Hartlepool's Region", unpublished M.Sc. thesis, University of Durham. 1964, p.1.

eme, there are places on the slopes leading up to the Durham plateau - in the vicinity of Bishop Middleham, Kelloe and Trimdon Grange, for example<sup>1</sup> - where bed-rock comes within inches of the surface.

Most of the drift material is in fact boulder clay, which generally gives rise to strong, clay-like soils but does vary somewhat in character.<sup>2</sup> In east Cleveland the till consists of a mixture of Triassic and Jurassic materials, with a leavening of erratics from distant sources, and the soils in that area, which tend to be lighter than is normal on boulder clay, are shallow, fine sandy loams. Podzolisation is widespread in east Cleveland, since much of the area has long been covered by heath vegetation, but the relatively high base-content of the drift has meant that it is less severe than on the higher moors.

In the central Tees lowland, on both sides of the river, the boulder clay is composed of Triassic materials, which give it a reddish hue. The soils which have developed on it vary in texture locally, but loams are general and they have a comparatively satisfactory level of fertility. There is a deficiency of lime and potash,<sup>3</sup> but these soils are otherwise adequate in their chemical content for farm-

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1. Simpson, op.cit., p.1.

2. See North East Development Association, op.cit., chap.5; and Wooldridge, op.cit., pp.372-75.

3. See P.K. Mitchell, "West Cleveland Land Use, circa 1550 to 1850", unpublished Ph.D. thesis, University of Durham, 1965, chap.2.

ing. The main difficulty for farmers has always been the problem of drainage. Where the land is low lying and flat, the soil tends to be stiff and 'cold', and gleying is not uncommon. These are not, perhaps, serious handicaps today, but they were very troublesome in the nineteenth century, especially when artificial drainage was the exception rather than the norm.<sup>1</sup> Further north, on the slopes leading up to the Durham plateau, the drainage problem diminishes in significance and soils also have a higher content of calcareous material, which comes from the underlying magnesian limestone.

Skirting the lower reaches of the Tees and its estuary, there is a band of laminated clay which extends eastwards from Egglecliffe to Cowpen Bewley, on the northern side of the river, and Rodcar, on the southern bank. This is a late-Pleistocene deposit, overlying the boulder clay, and is believed to have accumulated in a temporary body of quiet water, the outlet from which was blocked by ice standing off the coast.<sup>2</sup> The clay is of a very fine texture and the surface of the deposit, which is everywhere below 50 feet in altitude, is more level than that of the till plain. These factors mean that the drainage problem is particularly acute in this zone.<sup>3</sup>

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1. Ibid., p.59.

2. Agar, op.cit., pp.240-42; and Smith and Francis, op.cit., p.241.

3. See Wooldridge, op.cit., p.367.

Much of the area covered by the laminated clay is, or has been, marshy, as was formerly true of the site of Middlesbrough and is still true of land in the vicinity of Cowpen Bewley. Similarly, the tracts of marine alluvium around the Tees estuary and of riverine deposits along the larger waterways in the region have suffered from this condition, which is a defect from the point of view of the farmer. Urbanization and modern agricultural methods have improved drainage conditions in such areas, but their propensity for flooding and waterlogging have strictly limited their value for farming purposes. Historically, their most important use was as watermeadows.

Finally, there are several relatively extensive lowland areas where sands and gravels predominate. One of these is in the Stokesley-Seamer district, and another lies between Acklam and Eston. The soils which have formed on these parent materials belong to the category of loamy sands.

They are inherently poorer than the boulder-clay soils, but locally they may be superior because of their excellent natural drainage.<sup>1</sup>

#### Land Classification.

The value of land for agricultural purposes depends not on one factor, such as soil type, alone but on a complex of interrelated conditions. While the value is dependent partly on the nature of the local economic system, the physical character of a given area - which may have been modified by

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1. North East Development Association, op.cit., p.30.

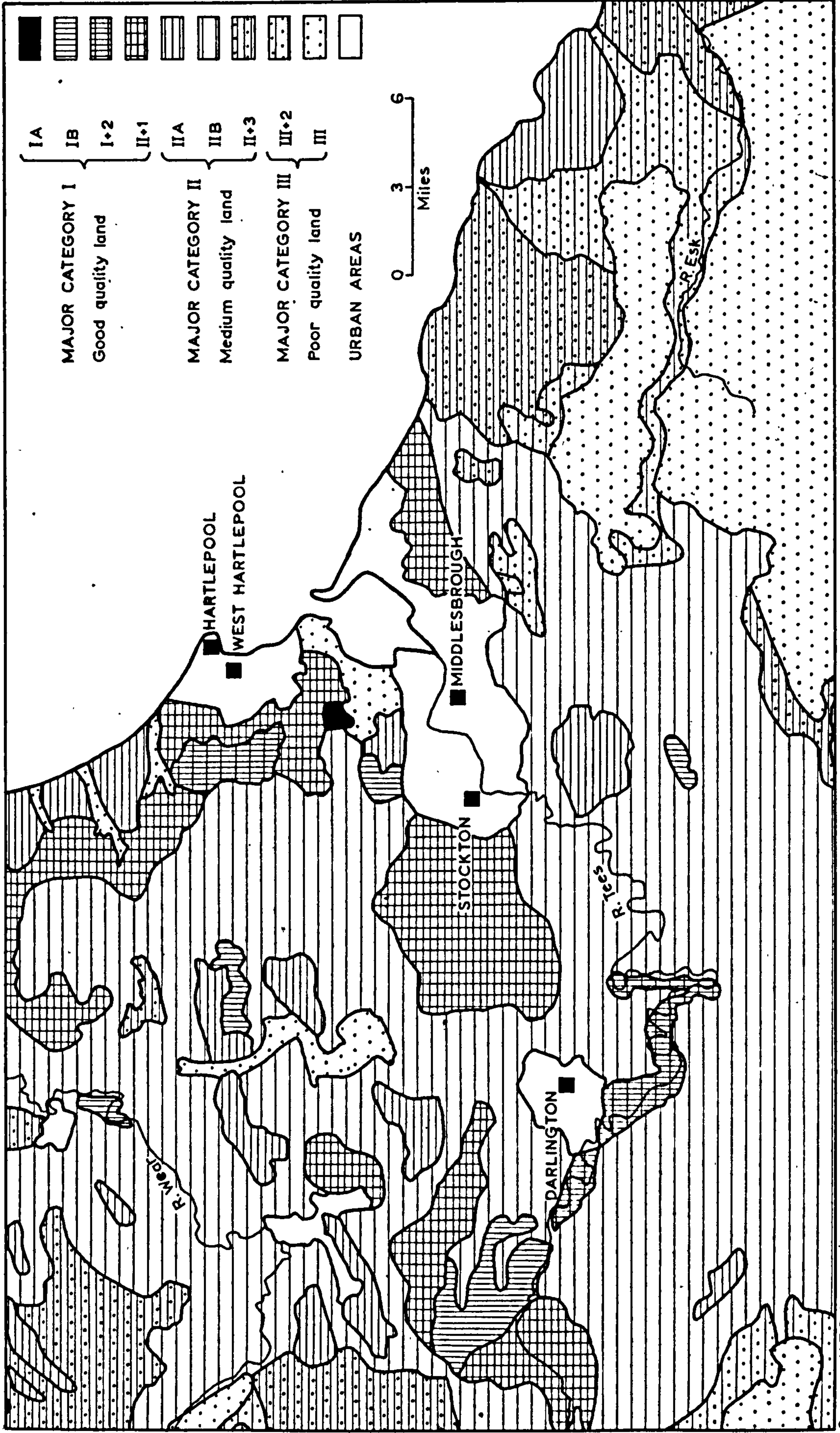
human activity - broadly determines the economic potential of the land within it. Almost twenty years ago, a study was made of the physical quality of agricultural land in the North East as a whole by the North East Development Association.<sup>1</sup> This provided an interesting, though very generalized, classification of land in an area which includes the Teesside region. The classification, which has been drawn upon in the present study, was based on the physical and chemical properties of soils, site characteristics local climatic conditions and other factors.

As the accompanying map reveals, most of the land in the Teesside region was found to be of medium quality. The only area with IA land, which owes its superior character to careful and intensive methods of cultivation rather than an inherently high level of fertility, is a small pocket between the villages of Greatham and Newton Bewley. There are several small areas of IB land. One such lies between Gainford and Staindrop, where the surface is not so flat as normal and the land is consequently better drained, and where the parent materials of the soil are of Carboniferous origin.

Another is at Wolviston, a third at Middleton upon Leven, and the last near Bishop Middleham. All of these are very small. There is an area of I + 2 land around Elwick and another to the south of Darlington, where the alluvial dep-

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1. North East Development Association, op.cit.  
The Agricultural Land Service of the Ministry of Agriculture, Fisheries and Food is currently undertaking a national survey of agricultural land, but at the time of writing work in the Teesside area was incomplete.



Source: N.E.D.A., 1981.

Figure 7.6 Classification of Land on Teesside



osits skirting the Tees are comparatively well drained. Land in the category II + 1 is more plentiful.

All of the categories discussed so far contain farmland of a relatively good quality, but that is not so much a result of soil type as of drainage and climatic conditions. In the lowlands, where there is less exposure and more warmth for plant life, drainage very largely determines whether land is of a first- or second-class quality. Most of the area has land in the medium-grade type, because drainage is restricted. In upland districts the land is uniformly poor for agriculture, due to the combination of inferior soil types, a harsher climate and poor drainage.

#### The Development of Teesside Agriculture to the Mid-Nineteenth Century.

Contemporary observers of the agricultural scene were not impressed by the state of affairs on Teesside in the middle of the nineteenth century. In the harsh moorland environment of North Yorkshire farming had changed little for many years, and was as poor as it had ever been, while in the once prosperous lowlands conditions were bad and were believed to be deteriorating. The prosperity which lowland farmers had known at the turn of the century had disappeared and their methods were commonly thought to be primitive. To a large extent, however, these conditions were typical of clay lowlands throughout the country, rather than characteristic of those on Teesside alone. Basically, they reflected the economic changes, especially price move-

ments, which had been undermining the strength of British agriculture since the end of the Napoleonic Wars.

To place these remarks in their historical perspective, it is useful to trace the antecedents of nineteenth-century Teesside agriculture. In a very detailed study of lowland parishes in West Cleveland,<sup>1</sup> between the Tees and the Cleveland Hills, Mitchell has shown that under the medieval open-field system the area approximated the norm for the English Midlands. Arable farming dominated the system, usually occupying nearly half of the improved land,<sup>2</sup> The main wave of enclosure, in the area studied by Mitchell, occurred between 1620 and 1670, long before the period of Parliamentary Enclosure. By 1750, and perhaps as early as 1700, there were few remnants left of the open fields.<sup>3</sup> This was probably true of lowland Teesside as a whole.

With enclosure, there was a marked shift towards pastoralism. In West Cleveland, again according to Mitchell, the proportion of improved land under an arable regime was as low as 25 per cent on the typical enclosed farm of the mid-seventeenth century.<sup>4</sup> In another study, Long has shown that later in the seventeenth century horses constituted a greater proportion of the total value of farm assets in Cleveland than in any other part of Yorkshire, and that cattle were more important than in other lowland districts.<sup>5</sup>

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1. Mitchell, op.cit., 539 pp.

2. Ibid., p.138.

3. Ibid., pp.23-24.

4. Ibid., p.189.

5. W. Harwood Long, "Regional Farming in Seventeenth-Century Yorkshire", Agricultural History Review, Vol.8 (1960), pp.103-115.

These are signs that the breeding and rearing of horses and cattle; for which Cleveland later became famous, were already local specialties.

Conditions varied locally, largely with land quality, but in 1716 there was a farm at Crathorne with only 10 per cent of its land under arable, and others at Acklam and Ingleby Barwick with 16 per cent.<sup>1</sup> Arable farming was very much of secondary importance, and landlords inserted covenants in their tenancy agreements to protect the permanent grassland by limiting the amount which could be put to the plough.<sup>2</sup> Stock-raising (the Teeswater Shorthorn cattle and the Cleveland Bay horse) and dairy production were the main pursuits.<sup>3</sup> There was little demand, of course, for liquid milk but the region, like many others,<sup>4</sup> found London an apparently inexhaustible market for butter and cheese.<sup>5</sup>

From the middle of the eighteenth century, however, there was a revival of interest in arable farming, and crop acreages began to increase. In this respect, Teesside was by no means unique; the causes and effects were national

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1. Mitchell, op.cit., p.262.

2. Ibid., p.265.

3. Ibid., p.264. Also see: James Sinclair, History of Shorthorn Cattle, London, 1907, 895 pp.; North of England Farmer Office, The History of Improved Short-Horn or Durham Cattle and of the Kirklevington Herd, Newcastle, 1871, 371 pp.; and John Cadwallader Bates, Thomas Bates and the Kirklevington Shorthorns, Newcastle, 1897, 495 pp.

4. See Robert Trow-Smith, A History of British Livestock Husbandry, 1700-1900, London, 1959, pp.19-22; and G.E. Fussell, The English Dairy Farmer, 1500-1900, London, 1966, chap.6.

5. Mitchell, op.cit.; p.264.

in extent, being associated with general price trends. Chambers and Mingay regard the mid-eighteenth century as a critical turning-point for agricultural prices. Thus :

Before 1750 prices of both grain and animal products tended to rule low, mainly because of lengthy runs of good seasons, but also because the growth of the cultivated acreage and the gradual improvements in land-use, fodder supplies and rotations raised output beyond the increase in consumption. After about 1750 there set in a long period of some sixty years in which prices generally tended upwards as output trailed after the rising consumption of a rapidly increasing non-agricultural population.<sup>1</sup>

In short, industrialization created an increasingly favourable economic climate for agriculture in the second half of the eighteenth century. Prices continued to rise during the Napoleonic Wars, when an unusually high incidence of bad harvests conspired with the disruption of foreign trade to put even greater demands on British farmers.<sup>2</sup>

Significantly, however, grain prices rose more rapidly than the prices of animal products. As a result, cereal growing became increasingly more profitable than livestock husbandry, precipitating a general shift towards arable farming wherever possible. The prices of grains were about 50 to 75 per cent higher in 1790 than in 1750, while those of beef and mutton were only 25 per cent higher.<sup>3</sup> Following the outbreak of war in 1793, agricultural prices rose still higher, though they became more erratic too. Wheat,

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1. J.D. Chambers, and G.E. Mingay; The Agricultural Revolution, 1750-1880, London, 1966, p.109.

2. Ibid., p.109 and pp.112-115.

3. Ibid., p.111.

one of the most important indices of farming's fortunes, sold at 90s. per quarter in 1795, 119s.6d. in 1801, and 126s.6d. in 1812. During most of the eighteenth century the price of wheat had rarely exceeded 50s.<sup>1</sup>.

Much of the increment in prices inevitably went to middlemen rather than farmers, but the latter still benefited appreciably. The received price for wheat in Cleveland, where it was the main cash crop, rose from 42s. per quarter in 1793 to 78s. in 1817.<sup>2</sup> As a result, wheat acreages, and crop acreages generally, expanded under the influence of the higher prices. Churley's analysis of the Home Office returns for Yorkshire in 1801 indicates that wheat was then the leading crop in Cleveland.<sup>3</sup> In his contemporary survey of farming in the North Riding, John Tuke declared that wheat was the staple produce of Cleveland, and said further that

no other district in the Riding, or perhaps in the north of England, produces so much wheat in proportion to its size, or of so good a quality, as Cleveland.<sup>4</sup>

Tuke was perhaps indulging his imagination a little with those words, but certainly wheat was of great importance to the district. There was, by the early nineteenth

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1. Ibid., pp.112-13; and Lord Ernle, English Farming : Past and Present, 6th ed., London, 1961, Appendix III.

2. Mitchell, op.cit., p.331.

3. P.A. Churley, "The Yorkshire Crop Returns of 1801", Yorkshire Bulletin of Economic and Social Research, Vol.5 (1953), p.180.

4. John Tuke, General Review of the Agriculture of the North Riding of Yorkshire, London, 1800, p.116.

century, not much waste land left in the lowlands of Tees-side which was at all suitable for cropping. Wheat production could, therefore, only be further extended by sacrificing grass, and in many areas permanent grassland was ploughed up as the emphasis continued to shift towards arable farming.<sup>1</sup> London provided the region with its main market for wheat, which, along with other produce, was shipped from wharves at Stockton, Yarm, Cargo Fleet, Newport and Low Worsall.<sup>2</sup>

With the conclusion of the Napoleonic Wars agricultural prices, especially those of wheat and other cereals, fell sharply from their inflated levels, though they remained higher than in the pre-war era.<sup>3</sup> The resumption of foreign trade, a higher frequency of good harvests at home and in Europe, and the much expanded capacity of the arable sector all contributed to this transformation. The price of wheat rarely rose above 65s. per quarter after 1819. In years when the supply was plentiful, it sank below 50s., and even below 40s. on occasion.<sup>4</sup>

The precipitate decline in corn prices immediately placed many farmers in difficulty. The very high prices paid for grains in the previous three decades had attracted producers who could only be marginal cereal growers in more

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1. Mitchell, op.cit., chap.12.

2. Ibid., pp.332-33; and Tuke, op.cit., p.116.

3. Chambers and Mingay, op.cit., pp.124-31.

4. Ibid., p.125.

normal times. This was especially true in clay districts, where the costs of cultivation were relatively high, where the costs of cultivation were relatively high, and where use could not be made of the advanced farming practices introduced on lighter soils. It was consequently areas such as lowland Teesside in which rural distress became widespread, and from which Parliament heard so much protestation against low wheat prices in the succeeding decades.<sup>1.</sup>

Ideally, there should have been a quick return to the pastoral-oriented economy of the eighteenth century, once cereal prices fell from their wartime levels. In the Teesside lowlands, however, as in many similar districts, a number of factors militated against the adoption of this course. Paradoxically, arable acreages continued to grow in many parishes.<sup>2.</sup> One reason was that rents remained at their wartime levels, despite the large fall in prices.<sup>3.</sup> The practice of granting abatements gradually spread, but simple rent reductions were rare. This tended to strengthen the view that the troubles were of a temporary nature, and tenants awaited the recovery of the price of wheat, which alone would enable them to pay the high rents charged by landlords who were also accustomed to a wartime price structure.

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1. Ibid., pp.124-31; and G.E. Fussell and M. Compton, "Agricultural Adjustments after the Napoleonic Wars", Economic History, Vol.3 (1939), pp.184-204.

2. Mitchell, op.cit., pp.414-16.

3. Ibid., p.420.

There were also other difficulties.<sup>1</sup> Much of the best grassland had been put to the plough in the preceding thirty years, to make way for increased cereal production, and this was easier and cheaper to achieve than the re-establishment of pasture, a process which required time, capital and experience. In addition, most of the once-famous local livestock herds had been disbanded during the ascendancy of arable farming, and many farmers were obliged to sell their breeding stock to remain solvent in the immediate post-war years. As a result, time and capital were required to rebuild the herds as well as the pasture. A speedy return to farming with an emphasis on livestock was probably also prevented by the reluctance of farmers, even when they were able, to take such a radical step.

Agriculturally, lowland Teesside stagnated in the post-war years, and the picture of farming drawn about 1800 by Tuke and his contemporaries was not obsolete fifty years later. There was, however, one important change. At the beginning of the nineteenth century crop yields were not very high on Teesside, but the quality of wheat, in particular, was well regarded.<sup>2</sup> In large part, this was because farmers were able to draw on the fertility of land which was well stocked and manured, and much of which had not known arable use for a long time. By mid-century both crop yields and quality were lower.<sup>3</sup> Much of the best land had been

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1. See ibid., chap.14.

2. Tuke, op.cit., p.116.

3. Fussell and Compton, op.cit., p.196; and Mitchell, op.cit., pp.418-419.



under long and continuous cultivation, with less manure from a smaller livestock population to replenish its fertility, and cropping had been extended to very marginal land. Writing of the area south of the Tees, Milburn commented in 1848 :

The vale of Cleveland, once abundant in grass; and famous for its cheese and horses, has witnessed its grazing grounds piecemeal converted into tillage land, cropped as long as it would grow a corn crop.<sup>1</sup>

Conditions were no better in Durham, which was declared to be one of the worst farmed counties in the country by a witness before the Select Committee on Agricultural Customs in 1848.<sup>2</sup> Nor, indeed, were they much better in any other lowland area with clay soils.<sup>3</sup> Moreover, the problems were cumulative, and threatened to become more acute than ever if some means could not be found of breaking what had become a vicious circle.

Continual cereal cropping over a long period of time, with only bare fallows of very short duration to break the sequence, had steadily eroded the fertility accumulated by clay soils under grass and convertible husbandry. Generally,

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1. M.M. Milburn, "On the Farming of the North Riding of Yorkshire", Journal of the Royal Agricultural Society, Vol.9 (1948), p.512.
  2. Testimony of Samuel Crisp - referred to by G.E. Fussell in his "'High Farming' in the North of England, 1840-1880", Economic Geography, Vol.24 (1948), p.299.
  3. See Chambers and Mingay, op.cit., pp.58-59; and G.E. Mingay, "The Agricultural Revolution in English History : A Reconsideration", in Essays in Agrarian History, Vol.2, ed. W.E. Minchinton, Newton Abbot, 1968, p.20.

green fallows could not provide a solution to the problem because drainage was too poor for them to be introduced successfully, and farmers did not have the capital required for artificial drainage projects. Equally, few farmers could afford either to purchase adequate quantities of fertilizers or to restock the much-reduced livestock herds which gave them natural manure. The shortage of capital and the deteriorating quality of the land also made the establishment of leys and permanent pasture more difficult. Ultimately, the solution was to be found in government-financed drainage schemes, but at mid-century it still belonged to the future.

In 1848, according to Milburn, the ancient crop sequence of fallow-wheat-oats still prevailed on the "... cold tenacious clay ..." of Cleveland, though some farmers had replaced oats with either beans or clover.<sup>1</sup> Again, a few farmers had improved their land by using artificial fertilizers and by digging drainage ditches which were filled with stones or tree branches, in traditional style. Even the most progressive cultivators, however, had been unable to dispense entirely with bare fallow on heavy land.<sup>2</sup> This was not because of technical backwardness on their part, but because the heavy clay soils were too wet to give either satisfactory root crops or grass leys.<sup>3</sup> Turnips, the epitome of modernism on lighter soils, did not fill out

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1. Milburn, op.cit., p.512.

2. Ibid., p.513.

3. Chambers and Mingay, op.cit., p.58.

sufficiently to be pulled on clay, and if fed to stock while in the ground they left a field riddled with waterlogged holes.<sup>1</sup> Kerridge has also argued that bare fallows cleaned the soil more effectively than any fallow crop could do, as well as temporarily improving the structure of adhesive soils.<sup>2</sup> Locally, however, where sandier soils were found, clover and turnips were grown in Cleveland.<sup>3</sup>

Writing in 1856 about agriculture in Durham,<sup>4</sup> Bell maintained that the old 'two crop and fallow' system had all but disappeared, and that even on strong soils seeds (clover and grass) were grown between the wheat and oats courses.<sup>5</sup> However, bare fallow was still as common in Durham as it was in North Yorkshire, and for much the same reasons. Green fallows had been tried, sometimes successfully, but they were not popular. Bell, himself, inclined to the view that they would not be adopted generally until much greater progress had been made in improving drainage conditions.<sup>6</sup>

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1. E.L. Jones, "English Farming Before and During the Nineteenth Century", Economic History Review, Vol.15 (1962), p.146; and Eric Kerridge, The Agricultural Revolution, London, 1967, pp.27-29.
  2. Kerridge, op.cit., pp.27-29.
  3. Milburn, op.cit., passim.
  4. Thomas George Bell, "A Report upon the Agriculture of the County of Durham", Journal of the Royal Agricultural Society, Vol.17 (1856), pp.86-123.
  5. Ibid., p.100.
  6. Ibid., p.101.

Little mention has been made so far of moorland farming, which followed a rather different course of development than its lowland counterpart. Although much of the area remained common rough grazing land, as indeed it is still, the open fields had largely disappeared from the North York Moors by the mid-eighteenth century.<sup>1</sup> Livestock were the main support of the moorland economy. The higher land was used for rough grazing, and few attempts were made to improve it. Crops were grown in the valleys, but they were intended mainly for fodder and for domestic consumption.

Even before the end of the seventeenth century, cattle accounted for nearly one-half of the value of farm assets in the North York Moors, and sheep constituted a further quarter.<sup>2</sup> The area was mainly concerned with breeding and rearing stock. The cattle were the shorthorns generally favoured in North East England.<sup>3</sup> Tuke thought them to be of a quite high standard, but they were smaller than those raised on lowland pastures.<sup>4</sup> The breeding stock were kept in the valleys, but beef animals were left to roam the moors for much of the year. Most farms had a dairy, and the production of cheese and butter was an important activity.<sup>5</sup>

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1. See John Chapman, "Changing Agriculture and the Moorland Edge in the North York Moors, 1750-1960", unpublished M.A. thesis, University of London, 1961, chaps. 2 and 3.

2. Long, op.cit., p.105.

3. Kerridge, op.cit., p.170.

4. Tuke, op.cit., p.256.

5. Chapman, op.cit., p.79.

The moorland sheep were the hardy Blackfaces, which gave a mutton of medium quality but a poor coarse wool.<sup>1</sup> They were preferred more because of their ability to subsist on a diet of little but heather and their capacity to withstand severe weather than for any other reason.<sup>2</sup> Even in the depths of winter, the sheep were left to fend for themselves on the open moors. Fodder from the arable land in the valleys was too scarce and valuable to be fed to sheep, other than in the lambing season.<sup>3</sup>

Some wheat was grown in the moorland dales, but oats was the major cereal crop by the end of the eighteenth century. Rye, the traditional staple, had become comparatively rare.<sup>4</sup> More root crops, notably turnips and potatoes, were grown by then than in earlier times, but the acreages were small.<sup>5</sup> Indeed, crop acreages as a whole were still small; for the sheltered land in the valleys had also to be used for growing hay and as improved pasture. Price movements in the early part of the nineteenth century gave some benefit to the moorland farmer, since the demand for meat and wool expanded steadily during the Napoleonic Wars. This advance was not, however, so spectacular, or so erratic, as that for cereals,<sup>6</sup> and the moorland farmer consequently found the post-war situation much easier to weather

1. Kerridge, op.cit., p.170.

2. See Trow-Smith, op.cit., pp.138-41.

3. Tuke, op.cit., pp.260-73.

4. Chapman, op.cit., pp.77-78.

5. Loc.cit.

6. Chambers and Mingay, op.cit., chap.5.

than did his lowland counterpart,<sup>1</sup> since he had not altered his fundamental mode of operations and livestock prices had less far to fall.

The Pattern of Farming Prior to the Mid-Nineteenth Century

It is possible to compile a partial picture of the pattern of farming on Teesside immediately prior to the middle of the nineteenth century by making use of a set of documents relating to the commutation of tithes. Under a very ancient arrangement, which was initially a moral and later a legal obligation, farmers were required to pay a toll amounting to one-tenth of their annual output to the rector of their parish.<sup>2</sup> After the dissolution of the monasteries, rectories and tithes belonging to the houses concerned were vested in the Crown and later sold to lay improPRIATORS, so that the position became more complicated. By the nineteenth century, nearly one-quarter of all tithes were in the hands of laymen, and were regarded simply as a form of property.<sup>3</sup>

By then, too, the system of tithe collection had become very complex - monetary payments often having replaced the traditional tithes in kind - and was a source of annoyance, and some claimed worse, to farmers. The Tithe Commutation

1. Chapman, op.cit., pp.147-49.

2. See : P.W. Millard, Law Relating to Tithes and Payments in Lieu Thereof, 3rd.ed., London, 1938; Christabel S. Orwin and Edith H. Whotham, History of British Agriculture, 1846-1914; H.C. Prince, "The Tithe Surveys of the Mid-Nineteenth Century", Agricultural History Review, Vol.7 (1959), pp.14-26.

3. Orwin and Whetham, op.cit., p.184.

Act of 1836 resulted from a desire to simplify matters and to remove a popular grievance. Under its provisions, Tithe Commissioners were appointed and charged with the responsibility for ratifying those voluntary agreements which had already been made for substituting monetary payments for tithes in kind, and with arranging for commutation where such agreements did not exist.

From the work of the Commission, two classes of documents emerged : Tithe Maps and Apportionments, and Tithe Files. The former resulted from a field-by-field survey of England and Wales, and it contains a wealth of detailed information relating to land ownership, boundaries and occupance, as well as summaries of the land acreages under arable, grass and other categories of use.<sup>1</sup> In many parts of the country, the Tithe Maps were the first maps to be based on accurate surveys.

In the present study, however, use has been made of the Tithe Files.<sup>2</sup> One of these was compiled for each of the 11,800 tithe districts surveyed by the Commission, a

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1. See : Prince, op.cit.; D.B. Grigg, "The Changing Agricultural Geography of England : A Commentary on the Sources Available for the Reconstruction of the Agricultural Geography of England, 1770-1850", Transactions of the Institute of British Geographers, Vol.41 (1967), pp.73-96; and G.H. Tupling, "Searching the Parish Records ; 6, Terriers and Tithe and Enclosure Awards", Amateur Historian, Vol.1 (1954).

2. For a discussion of them see Grigg, op.cit.; and E.A. Cox and B.R. Dittmer, "The Tithe Files of the Mid-Nineteenth Century", Agricultural History Review, Vol.13 (1965), pp.1-16.  
The Tithe Files are now kept at Ashridge House, an annex of the Public Records Office, in Hertfordshire, where they are catalogued under the Group and Class numbers IR/18.

district usually being a parish. The contents of the Files vary according to the complexity of the commutation negotiations, and to the extent that damage has been avoided since they were collected. Usually, the Files contain reports of the various meetings held, and correspondence relating to the negotiations, as well as drafts of the awards subsequently made. In the interests of standardization, and to save time, the Assistant Commissioner responsible for proceedings in a particular district was required to complete one of two types of questionnaire as a record. The longer version of this document had provision for estimates of the acreages of the various crops grown. These estimates give a valuable impression of farming at the local scale, though allowance must be made for a degree of inaccuracy, and they have been used in the present study.

In von Thünen's land-use model horticulture and dairying shared the inner-most zone, these being the activities best suited to, and hence most able to afford, locations near to the market. The adjacent zone was occupied by silviculture, and the area beyond that by belts of arable and then mixed farming. Extensive grazing was located in the zone furthest from the market. Apart from the position of silviculture, which was not a very significant activity on Teesside, this arrangement ought to bear a resemblance to that on Teesside in the nineteenth century. The data obtained from the Tithe Files have been examined to determine whether or not this was the case. The analysis was somewhat bedevilled, however, by the fact that Files do not



exist for all parishes in the region, and that those which are available are not all fully comparable.

The first of the surveys undertaken in the Teesside region by the Tithe Commission were made in 1837, and virtually all of them had been completed by 1845. Most of the data from the Tithe Files therefore relate to the period about 1840, when neither industrialization nor urbanization was properly under way in the region. Consequently, it is not surprising that horticulture, which von Thünen placed in the inner-most zone of land use, appears to have been of little importance. It is a branch of agriculture which depends on the proximity of a substantial urban population, and in 1840 the Teesside towns were still very small.

The Assistant Commissioners responsible for the local tithe surveys reported 5 acres of market gardens in the parish of Haughton le Skerne, 8 acres in Blackwell and an unspecified number in Hurworth, all of which were very close to the town of Darlington, then the largest settlement in the region. Sadberge, about four miles from Darlington, had a further 9 acres. Stockton parish, which contained the second most important town, had 15 acres of market gardens. Hartlepool had 3 acres of land under potatoes, and that was the only agricultural land in the parish not given to grass. Thus, the acreage devoted to horticulture was small, but it was located in areas close to the main towns. This is as much as would be expected since horticulture is a highly intensive form of cultivation.<sup>1</sup>

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1. See Chisholem, op.cit., chap.2.

Because of the limitations of the data available, it was possible to obtain only a very broad picture of the location patterns of the other types of agriculture. This is based on a comparison of arable and pastoral acreages in 168 parishes. More than half the parishes for which there were data had between 30 and 50 per cent of their improved land - which excludes rough grazing - under meadow and pasture, and a further quarter had more than 50 per cent of their land devoted to those uses. The proportion of land under grass in each of the 168 parishes is plotted in Figure 7.7. If parishes in which grassland exceeded 60 per cent of the total area are regarded as having high pastoral components, then that category may be sub-divided into two groups : one consisting of urban parishes and the other of marginal parishes, the latter either having poor land or being distant from the market centres.

In the first group were Darlington, Cockerton, Stockton, Hartburn, Norton, Linthorpe, Acklam, Middlesbrough, and Hartlepool, all with very high proportions of their agricultural land under grass. Since they contained the larger settlements and their suburbs, these were also the main urban parishes in the region. They constituted, in effect, the inner-most ring of land use in von Thünen's model. Agricultural land was more expensive in those parishes than anywhere else in the region. In the parish of Hartlepool, for example, the land was poor in quality but the annual rent was still £7 per acre<sup>1</sup>, which was four or five times as

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1. Tithe Files, I.R./18/2005.

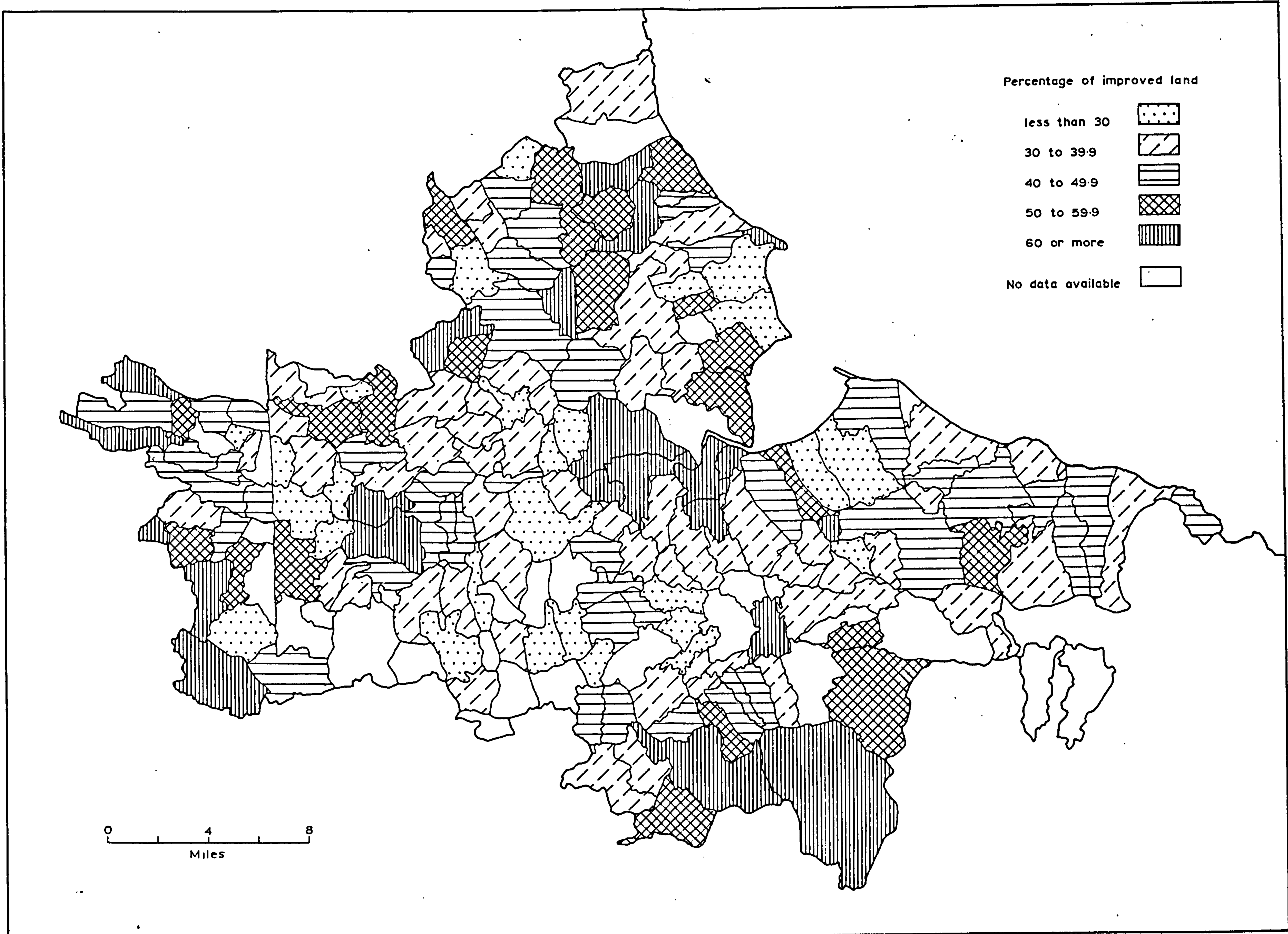


Figure 7.7 Proportion of Improved Land Under Grass, 1840

high as that for even the best land in rural parishes. As a result, agricultural land in the urban parishes was largely restricted to those uses capable of earning the highest returns in such locations.

In practice, two types of use were found in this inner zone, apart from horticulture. One was the growing of hay and the other the provision of pasture. Both were intended primarily for the support of milk cows, to supply townspeople with fresh milk, and horses, which were required for purposes of transportation and were present in large numbers in and around the towns. These twin activities were conducted regardless of the physical characteristics of the land. In the parish of Hartlepool, the land was reported by the Assistant Tithe Commissioners to be of only a 'fair quality'. The soil was very thin and, being on limestone and sand, had a tendency to dry out too quickly during the warmer months.<sup>1</sup> In the parish of Darlington, on the other hand, the soil was said to be a good loam on clay.<sup>2</sup> In both cases, the reports stressed that the value of the farmland was high, but that this was due to the level of demand for pasturage and hay, for milchcattle and horses, and to the possibility of obtaining manure from the nearby towns.

The second group of parishes with high proportions of grassland contained the areas of extensive grazing, where livestock breeding, the rearing of store animals and wool

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1. Loc.cit.

2. Tithe Files, I.R./18/1951.

production were the main preoccupations. According to von Thünen, parishes in this group should have been located at the periphery of the region, and indeed most of them were. However, there were some peripheral parishes which did not have high proportions of their land under grass, and there were some interior parishes, not close to the main towns, which did. The explanation is that the nature of the physical environment was a more important control than distance from the market in this context. Many of the parishes towards the limits of the region were in hill and moorland districts, and therefore concentrated on grazing. Parishes in the lowlands were more concerned with arable farming, which suggests that distance from the market was nowhere great enough on Teesside to secure the displacement of arable and mixed farming systems by pure pastoralism.

Bilsdale provides a typical example of a grazing parish.<sup>1</sup> It had 12,000 acres of bleak moorland, a small part of which was enclosed but unimproved, and they carried 1,000 Blackface sheep. Cattle breeding and rearing were quite important activities, the young stock being sold to lowland farmers at the age of two years, and so too were butter and cheese production. The small area of arable land lay in the valleys, and was used to grow winter feed and some domestic crops, and to provide pasture for stock during the breeding season.

There were estimates of crop acreages in the Tithe

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1. Tithe Files, I.R./18/12001.

Files for only about half the parishes in the region, and some of those were inconsistent or incomplete. The data available do not, therefore, lend themselves to the detailed examination of farming in parishes where the system had a high arable component. In an attempt to determine whether or not land use declined in intensity with distance from the large towns, a question which invites a positive answer on theoretical grounds, the proportion of arable land under bare fallow was calculated for as many parishes as possible. The results have been plotted in Figure 7.8 , but they are too few to permit a firm conclusion on this point.

There is, however, a suggestion that land usage was more intensive than normal close to Darlington and Stockton. A number of the parishes near Darlington had very low proportions of bare fallow - Whessoe (16.89 per cent), Low and High Coniscliffe (11.61 per cent), Manfield (14.33 per cent) and Stapleton (11.61 per cent), for example. Similarly, Norton parish, near Stockton, had only 10.64 per cent of its arable land under bare fallow. Usually, the proportion was nearer 30 per cent.

In those parishes where grassland was not dominant, the farming system was essentially mixed rather than arable. Cereals, wheat and oats in particular, were the main crops. In 37 of the 92 parishes for which data are available, wheat was the leading crop in terms of acreages planted. Oats was the most important crop in 22 parishes, and wheat and oats together in a further 12. Either wheat or oats, usually the

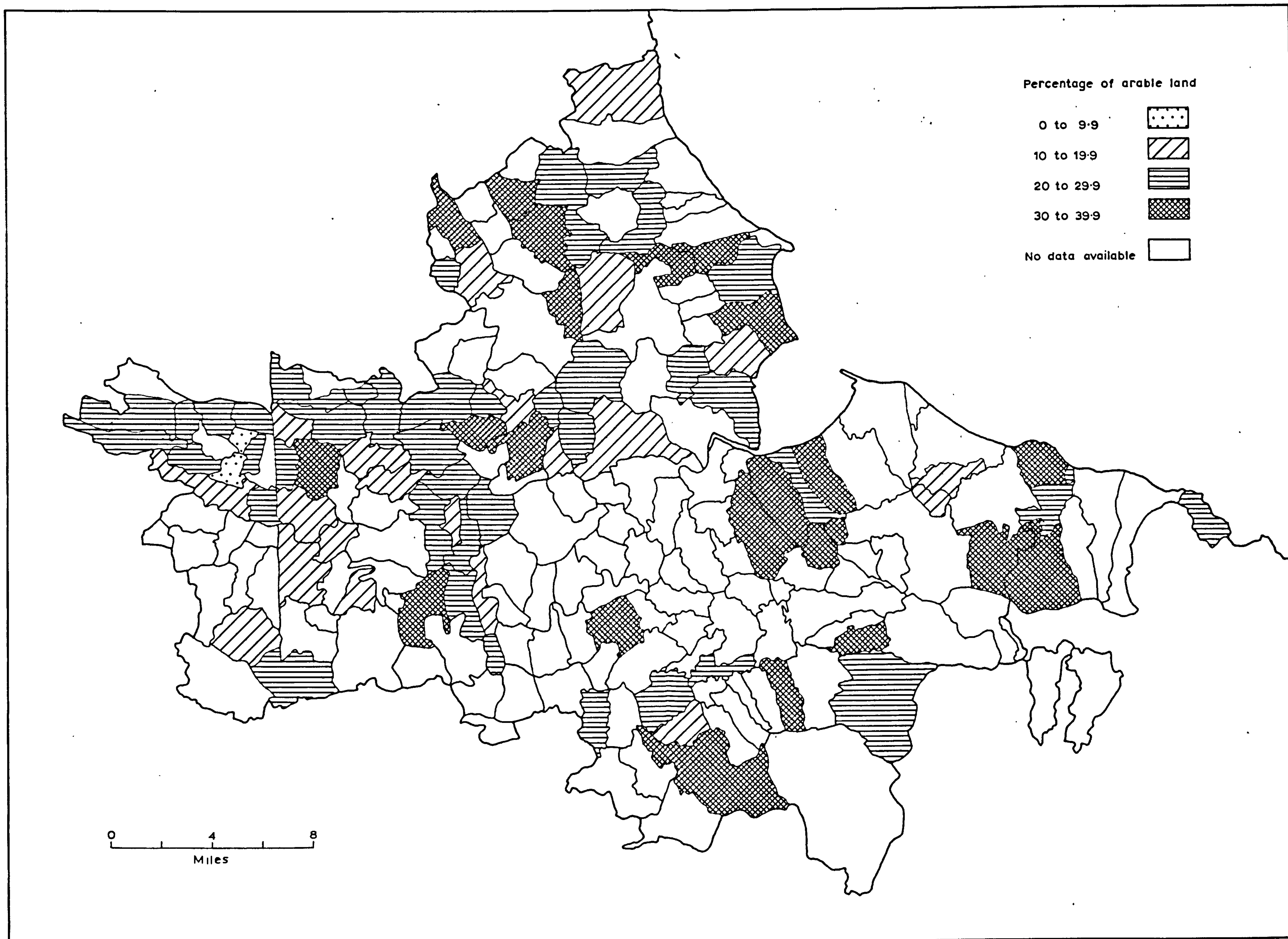


Figure 7.8 Proportion of Arable Land Under Bare Fallow, 1840

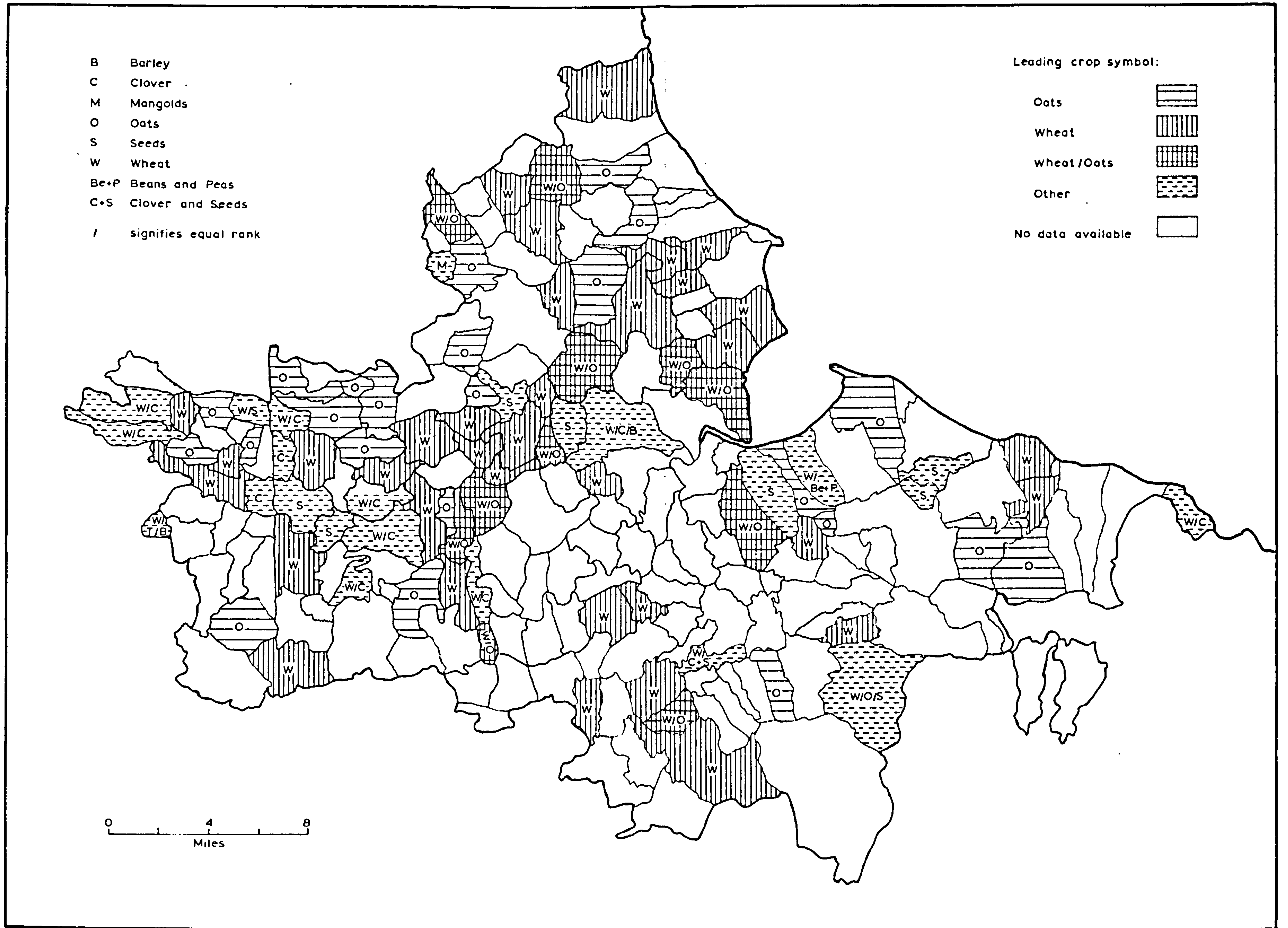


Figure 7.9 Leading Crops, 1840



former, shared first place with other crops in all but one of the remaining 21 parishes. Not surprisingly, oats tended to come to the fore where the land was relatively poor or the climate more severe, and where pastoralism dominated farming. Clover and other fodder crops were also more important in parishes with a high proportion of land under grass, reflecting the interest in livestock in such areas.

As a test of the principles embodied in location theory, the evidence gained from the Tithe Files is not satisfactory. It has been possible to present only a partial and rather generalized picture of Teesside farming in the period about 1840. However, it does seem permissible to conclude that there was some zoning of agriculture. In particular, there was an inner area around the main towns where farmland was largely devoted to the growing of grass, for fodder and for pasturage, in order to support milch cows and horses necessary to the urban population. It was also in this area that horticulture was practised. The land within this inner zone was the most expensive in the region, for locational rather than physical reasons, and it clearly was allocated to those branches of agriculture best able to use and afford it.

Elsewhere, however, physical factors were more important than distance from the market as determinants of the type of farming. At least, the major break in the spatial pattern was attributable to physical circumstances; the mixed farming system gave way to livestock husbandry in the upland

districts. There may have been some fine adjustments to the lowland farming system with distance from the market, but none were revealed by the rather crude data available. It is more probable that the region was not large enough for differential transport costs to exert a significant influence on the pattern of farming, other than in the areas adjacent to the larger towns.

### The Pattern of Farming in 1866.

In 1866 the Board of Trade began publication of the annual Agricultural Returns, which contained statistics pertaining to the counties of the United Kingdom. It was based on the parish summaries of returns obtained from individual farmers by officers of the Board of Customs and Excise, who were stationed throughout the country and hence provided a convenient agency for the task. The individual returns were destroyed after being consolidated into the parish summaries, but the latter were retained, in their manuscript form, and they constitute a valuable source of agricultural data.<sup>1</sup> They have now, however, survived intact. For England and Wales, the summaries are missing entirely for 1868, 1871, 1872, 1892 and 1893, and for parts of the country there are other gaps in the record.<sup>2</sup>

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1. The parish summaries are now stored in the Public Record Office in London, under the Group and Class designation MAF/68.

2. On the subject of the Agricultural Returns see: J.T. Coppock, "The Statistical Assessment of British Agriculture", Agricultural History Review, Vol.4 (1956) pp.4-21 and 66-79; "The Cartographic Representation of British Agricultural Statistics", Geography, Vol.50 (1965), pp.101-114; "The Agricultural Returns as a Source of Local History", Amateur Historian, Vol.4 (1958-59), pp.49-72; and Robin H. Best and J.T. Coppock, The Changing Use of Land in Britain, Faber and Faber, London, 1962, chap.1.

Coppock has studied the parish summaries in considerable depth, and he has pointed to their many limitations as statistical sources. There is doubt concerning the accuracy of the original returns upon which the summaries are based, but opinions on that subject are divided. Certainly, however, there are grounds for doubt. Particularly in the early years of the agricultural census, when the questionnaires were unfamiliar to farmers, and to some extent resented, co-operation was often neither full nor willing. Again, there were problems of definition, such as the distinction between permanent and temporary grass. Some of the returns were actually completed by the Excise officers, who were empowered to do so in the event of farmers refusing or neglecting to deal with them themselves. Another source of error arose from the fact that acreages of crops and grass were sometimes estimated, as few farmers knew the exact areas of their fields before the Ordnance Survey measured them.

There are also problems of comparability between censuses taken in different years. In 1866, crop returns were requested only from occupiers of land greater than five acres in area. This threshold was removed for the censuses of 1867 and 1868, but in 1869 a new lower limit of one-quarter acre was introduced. Changes were also made, from time to time, to the classification system used for crops and livestock, and to some of the working definitions employed. Despite the difficulties such changes may cause,

however, the parish summaries are obviously a very valuable source of data for British farming in the nineteenth century.

In the present study, material from the agricultural census has been used to build a picture of Teesside agriculture in two separate years. One of these is 1881, at the end of the period under review. It is desirable that the other should be as early as possible, and on grounds of statistical comparability 1869 is to be preferred; that was the first year in which a holding of a quarter of an acre of land, a qualification which still stood in 1881, was adopted as the threshold for farmers asked to submit returns. However, a large number of the summaries for 1869, as for 1867, were found to be missing for parishes in the Teesside region. For this reason, and bearing in mind that no summaries at all have survived for 1868, 1866 was selected as the earlier year, despite the data for 1866 not being fully comparable with those for 1881.

By 1866, there were signs that farming in the Teesside lowlands was recovering from its mid-century nadir.<sup>1</sup> As in other heavy clay districts, the immediate solution to the various problems had been found in improved drainage, but it is probable that even by 1850 the long process of agricultural adjustment which had begun after Waterloo had largely run its course and to some extent had brought its own longer-term solution. In partial compensation for the loss of protection previously afforded by the Corn Laws, the

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1. See Mitchell, op.cit., chap.14.

Government announced in 1846 that loans would be made available to landowners wishing to improve their property by means of drainage schemes.<sup>1</sup> Contemporary writers and historians, alike, have accepted this step as a crucial turning-point in the fortunes of British agriculture.

The Government loans were to be repayable over a period of twenty-two years, and they were to bear a modest interest rate of  $3\frac{1}{2}$  per cent.<sup>2</sup> The scheme soon became a success; so much so that a number of private companies were floated for the purpose of making loans to landowners unable to obtain them from the Treasury. The great interest shown in drainage improvement communicated itself to those who were able, though previously unwilling, to finance their own projects. A further incentive was provided by the discovery of a process for manufacturing cheaper and better drainage pipes.<sup>3</sup>

Even in 1850 Caird had been able to point to evidence of a growing interest in Cleveland in drainage schemes.<sup>4</sup> In 1856 Bell described the progress which had been made in draining arable land in Durham, and expressed the hope that it would soon be extended to permanent grassland.<sup>5</sup> By 1861, Wright implied, much of lowland Cleveland had been treated

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1. Orwin and Whetham, op.cit., pp.194-200.
  2. See J.Bailey Denton, "On Land Drainage and Improvement by Loans from Government or Public Companies", Journal of the Royal Agricultural Society, New Series, Vol.4 (1868), pp.123-43.
  3. Chambers and Mingay, op.cit., pp.175-76.
  4. James Caird, English Agriculture in 1850-51, London, 1852, p.327.
  5. Bell, op.cit., pp.105-106.

satisfactorily.<sup>1</sup> The benefits were many. With the laying down of deep drains, and the removal of excessive soil moisture, arable yields rose almost immediately. In part, this was because the quality of the soil was improved, but it was also because land could be used more intensively. Much of the heavy, clay land had previously been cultivated under the ancient ridge-and-furrow system, the ridges carrying the crops and the furrows open ditches.<sup>2</sup> With the introduction of modern field drains, the open ditches could largely be dispensed with, and the area they covered planted. This must have almost doubled the useful acreage of many fields, and hence have raised their output substantially.

Better drainage also made possible the establishment of root breaks in the cropping sequence, which, in turn, provided fodder and permitted the heavier stocking of the land. With more livestock, more manure became available, and arable yields could be increased still further. On heavy land, therefore, the new drainage techniques led to the replacement of a cycle of impoverishment with one of enrichment. The benefits were not confined to the arable land; permanent grassland could be given the manure it required to be kept in a healthy state. Moreover, with the land in better heart, farmers found it easier to establish leys and new permanent grass to replace old pastures in

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1. W. Wright, "On the Improvements in the Farming of Yorkshire Since . . . .1848", Journal of the Royal Agricultural Society, Vol.22 (1861), p.110.

2. Loc.cit.

need of a change in use.

During this period, English farming continued to change in other ways too.<sup>1</sup> In the twenty years after 1850, years of agricultural prosperity on the whole, the price of wheat showed little tendency to rise but the prices of livestock products climbed steadily. In the mixed farming systems which were general throughout most of the country there was consequently a shift in emphasis towards livestock management. At first, this movement was hesitant, and temporary rises in the price of wheat could still make arable farming more profitable, but in the longer term it was decisive. By the 1870's, livestock were the profitable component of mixed farming systems. Mitchell has shown that these trends were experienced in West Cleveland in the 1850's and 1860's,<sup>2</sup> and there is little doubt that they affected Teesside as a whole.

Parish summaries of the 1866 agricultural returns were found to be available for 141 parishes in the Teesside region. Three-quarters of those parishes had between 30 and 50 per cent of their improved land under permanent grass. This was approximately the same proportion as that for the parishes for which data from the Tithe Files were available. However, as it stands, the comparison is not very meaningful, since the two sets of parishes - one for 1840 and the other for 1866 - differ somewhat.

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1. See E.L. Jones, "The Changing Basis of English Agricultural Prosperity, 1853-73", in Essays in Agrarian History, op.cit., pp.219-36.

2. Mitchell, op.cit., chap.14.

Contemporary descriptions of Teesside farming in the years immediately after 1850 stress that there was a transfer of resources, including land, from arable to pastoral farming. To check their accuracy, an examination was made of those parishes for which there are data for both 1840, from the Tithe Files, and 1866, from the parish summaries. This was possible for 121 of the parishes within the region. In 60 of them, there was a decrease in the proportion of land under permanent pasture, and in 61 there was an increase, between 1840 and 1866. Many of the changes were so small as to be insignificant, but 16 parishes registered an increase of more than 10 per cent, and 22 a decrease of similar proportions.

Clearly, therefore, there was no general expansion of permanent grassland between 1840 and 1866, and the total acreage for the region as a whole cannot have changed significantly. Increases and decreases occurred throughout Teesside, without apparent relationship to land quality or other general factors. Judging by the control group, however, an important change seems to have been that fewer parishes had very small proportions of permanent pasture in 1866 than in 1840. Thus, the number with less than 30 per cent of their land under permanent grass decreased by half. This suggests that a more balanced type of mixed farming was being evolved in areas where the arable element had been exceptionally strong, and it may have been such areas that contemporaries had in mind when they wrote of exhausted cropland being returned to grass.



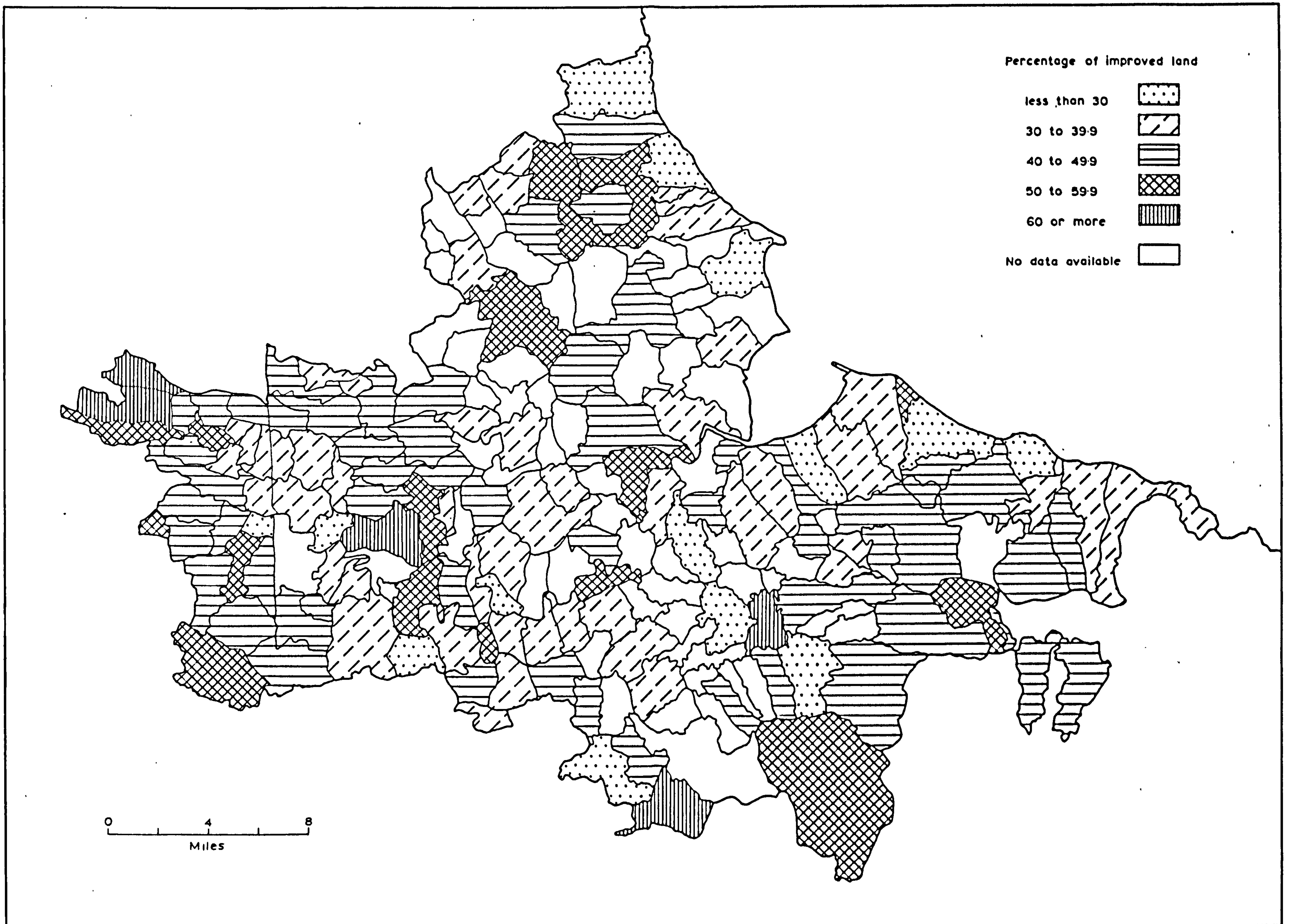


Figure 7.10 Proportion of Improved Land Under Permanent Grass, 1866

Table 7.1

Number of Parishes in the Various Classes  
Defined by the Proportion of Land under  
Permanent Grass.

<u>Percentage of Improved Land</u> <u>Under Permanent Grass</u>	<u>Number of Parishes</u>	
	<u>Circa 1840</u>	<u>1866</u>
Less than 30	19	10
30 - 39.99	41	43
40 - 49.99	34	48
50 - 59.99	12	15
More than 60	15	5
	<u>121</u>	<u>121</u>

It appears, from Table 7.1, that there was also a decrease in the number of parishes with more than 60 per cent of their land under permanent grass. Amongst those in that category in 1840 but not in 1866 were Acklam, Middlesbrough, Norton, Stockton, and Cockerton, which were essentially urban parishes. The reasons for this change are not clear, but it may well have been the case that improved drainage and farming techniques had encouraged a greater interest in growing green fodder crops near to the large towns, where the livestock population must have been increasing to match urban expansion.

Clover and other grasses were sown, as part of the crop rotation, in all the parishes for which data are available for 1866. It can be seen from Figure 7.1 that temporary grass was particularly important in some of the northern parishes on the Durham plateau, such as Coxhoe, Thornley and Kelloe. This would seem to reflect the high proportion of land in arable use in that area; with only small

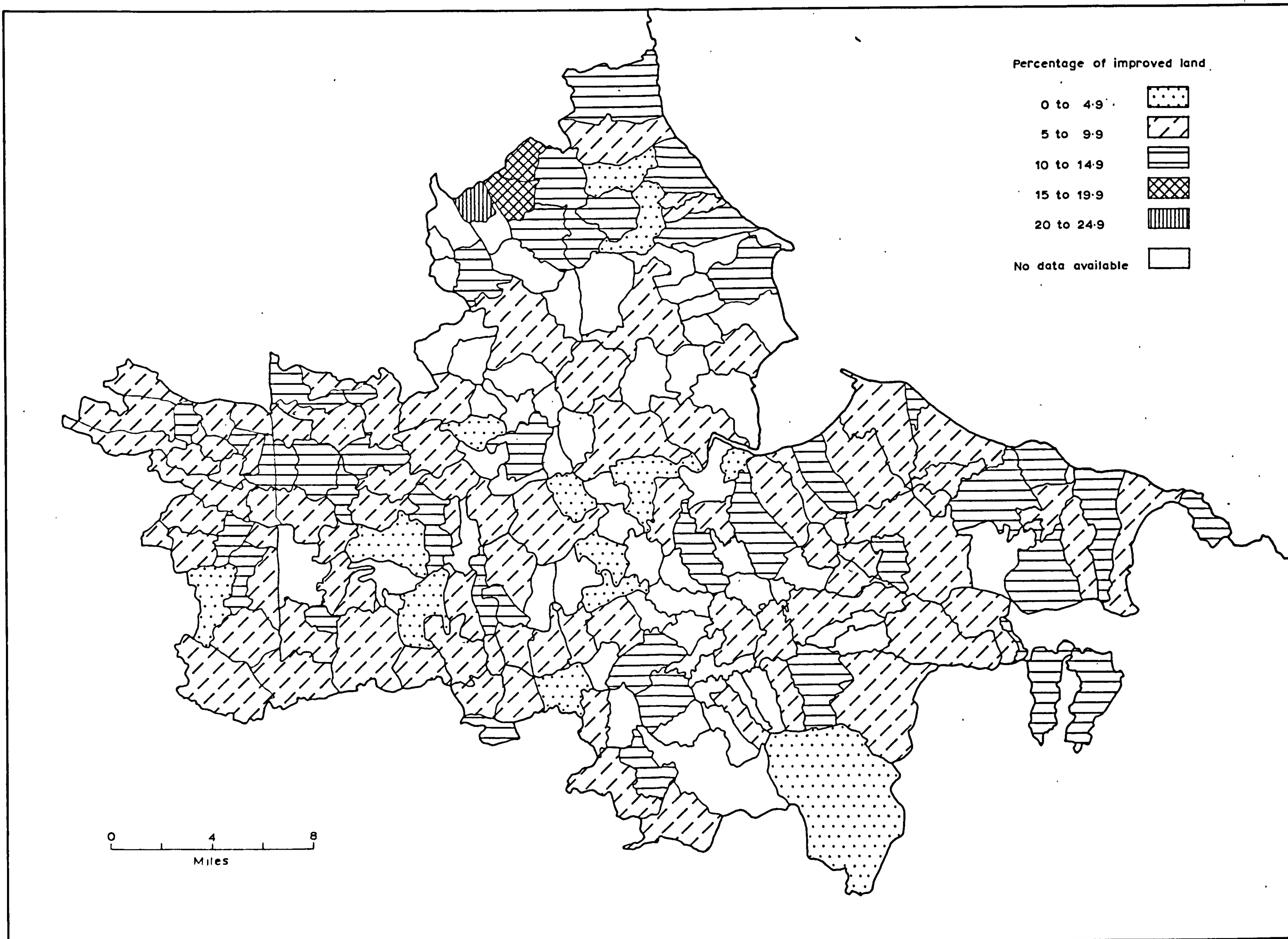


Figure 7.11 Proportion of Improved Land Under Temporary Grass, 1866

areas kept as permanent pasture, grass leys would be correspondingly more important for feeding livestock and resting cropland. It was probably also the case that the thin soils of the plateau favoured grass rather than roots as the green course in the rotation, since the latter require deep soils if they are to give good crops.

With the detailed information available for 1866, an attempt, which proved unsuccessful, was made to establish whether or not there was any evidence of land-use zoning by delineating agricultural sub-regions. First, the proportion of land under each type of crop and the density of livestock in each category were calculated for each parish. Next, the parishes were ranked according to the values exhibited by each variable - that is, for each crop and livestock type. The rank-scores thus derived were then used to rank each variable for each parish. This rather cumbersome procedure overcame the problem of incorporating variables measured in different units (percentages and densities), and it gave each parish an agricultural profile which could be used to compare it with other parishes.

Spearman's rank correlation coefficient was employed to determine the level of similarity between each parish and its contiguous neighbours.<sup>1</sup> This permitted the construction of a similarity matrix. Finally, a variant of Hagood's

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1. Use was made of a computer program written largely by A.D. Sorenson but contributed to by S. Openshaw and P. Taylor, all of the Department of Geography at the University of Newcastle upon Tyne.

regionalization technique was used to group parishes into sub-regions.<sup>1</sup> The results of this analysis were not satisfactory, however, and they have not been presented here. The main reason was that the lack of data for a number of parishes imposed too great a restriction on the interpretation of the findings. In many cases, for example, it was not possible to determine whether a grouping reflected the genuine similarity of parishes or the fact that they all had neighbours for which data were not available. Again, the summaries which have survived for 1866 and 1881 relate to different sets of parishes, which makes comparisons over time difficult.

The distribution of grassland, permanent and temporary combined, in 1866 (Figure 7.12 ) suggests that parishes with more than half their improved land under grass may be placed into the two groups defined for 1840. The first group consists of urban parishes. Stockton, Middlesbrough, Darlington, Haughton le Skerne, Hurworth, Neasham and Cockerton, and almost certainly some of those for which there are no data, belong to it. They all had more than half their land under grass and were close to the main towns. Judging by the earlier examination of land use about 1840, it may be surmised that these parishes were part of an inner zone which was primarily concerned with the provision of fodder and pasture for the urban horse

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1. See M.J. Hagood, "Statistical Methods for Delineation of Regions Applied to Data on Agriculture and Population," Social Forces, Vol.21 (1943), pp.288-97.

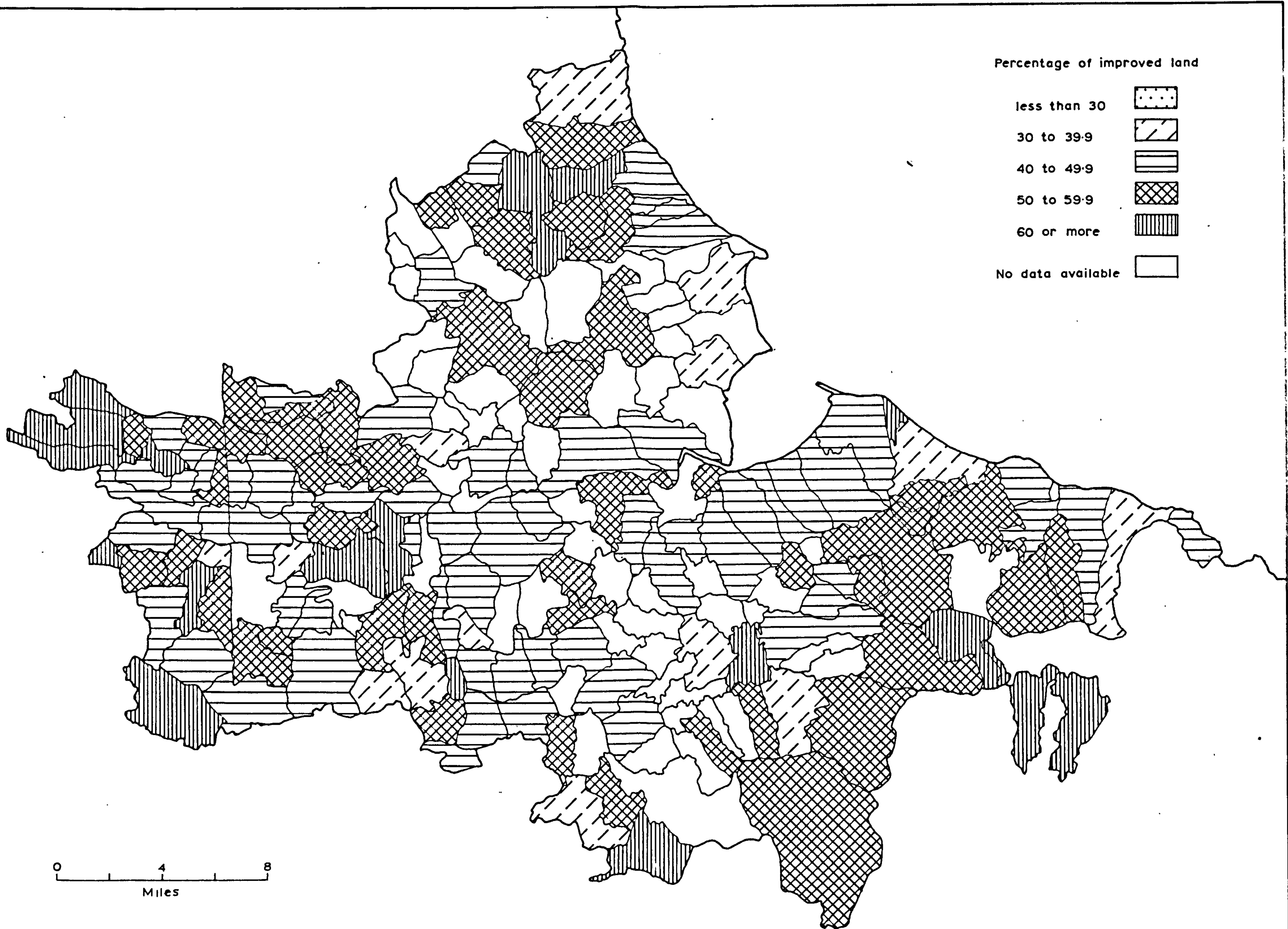


Figure 7.12 Proportion of Improved Land Under Permanent and Temporary Grass, 1866

population and the milch cows supplying fresh milk to the towns.

This view is given partial support by evidence from the livestock returns for 1866, which are extant for most of the parishes listed but not for Cockerton or Hurworth. The returns contain information for milch cows, but in the early years they omitted horses. The average Teesside parish had 4.5 milch cows per 100 acres of agricultural land, excluding rough grazing, in 1866. Stockton, Darlington and Haughton le Skerne all had a higher density than average, which confirms that dairying was relatively important in those parishes. Middlesbrough and Noasham, however, had lower densities, a surprising but perhaps temporary anomaly.

The density pattern of milch cattle (Figure 7.13 ) also suggests that the larger towns had a larger milk-supply zone than appears from the map showing the distribution of grassland. Certainly, there was a number of parishes near Middlesbrough and Stockton (Norton, Thornaby, Stainton, Acklam, Marton, Ormesby and Normanby) which were stocked comparatively heavily with milch cattle but had less than half their land under grass. Similarly, Cleasby, near Darlington, and Stranton, which contained West Hartlepool, were in this position. The most likely explanation is that parishes on the edges of the towns had relatively high proportions of grassland partly because they had to afford grazing for urban-based horses. Further afield, this was not the case, and less grassland would have been needed to sup-

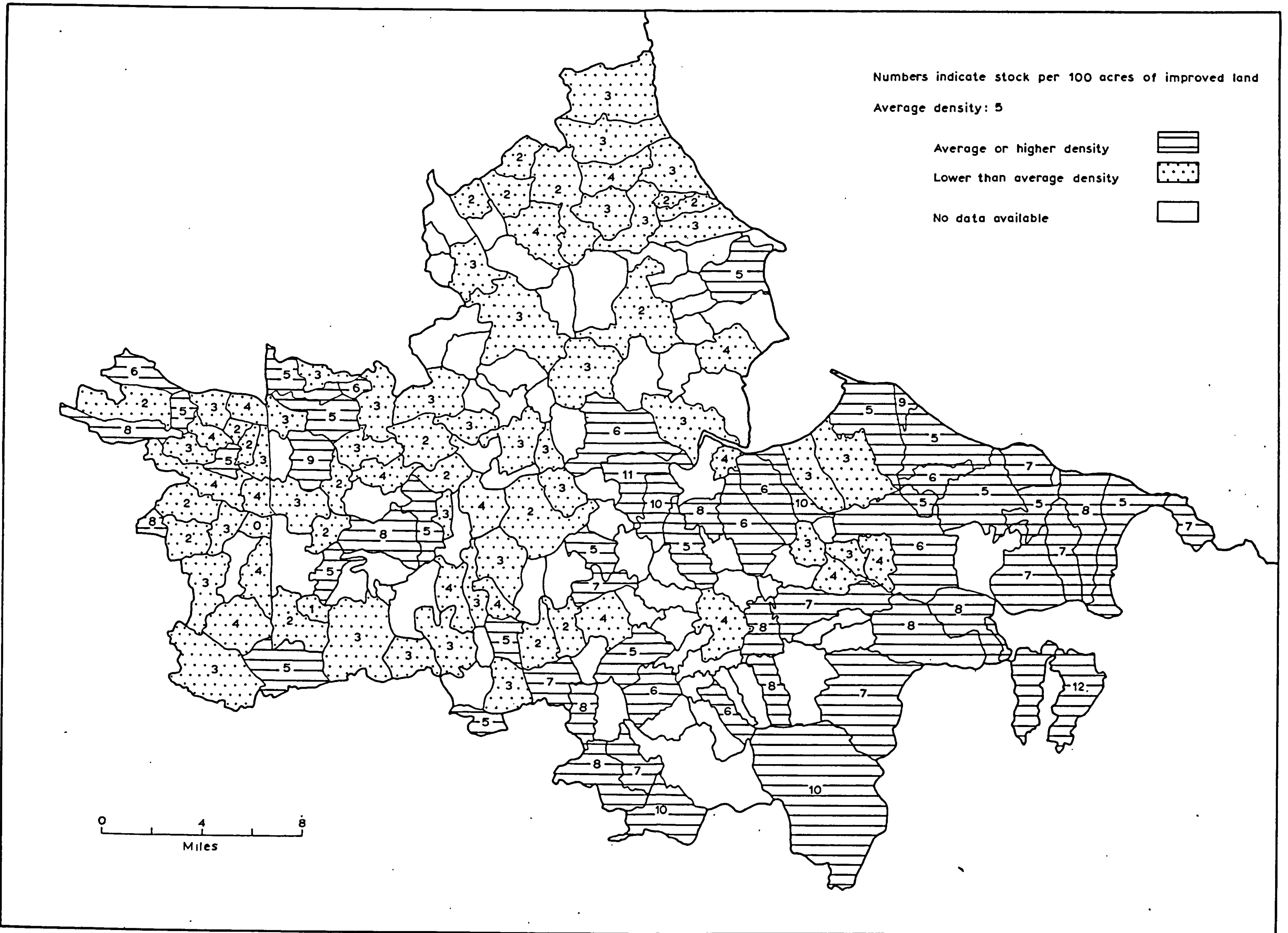


Figure 7.13 Density of Milch Cows, 1866



port milch cattle alone.

Negative evidence of the existence of an inner zone of the type described is provided by the distribution maps for the other categories of livestock shown separately in the returns. Parishes in the vicinity of the main urban centres had, with only the occasional exception, fewer than the average number of stock in all those categories. Thus, neither the breeding and rearing nor the fattening of sheep or cattle was generally of great importance. One interesting point is that Middlesbrough had a higher density of pigs, with 23 per 100 acres, than any other parish in the region. This however, seems to have been a freakish result<sup>1</sup>; in subsequent years in the 1860's, the density was near the average for the region.

On the evidence of the relatively high proportion of grassland and density of milch cows, as well as the relatively low density of other types of livestock, it can be argued that there was a fragmented zone around the main towns in which farming was directly related to the distance from the market. As in 1840, this zone seems to have been predominantly concerned with the production of fodder and the provision of grazing for milch cows and horses. It is also probable that the region's horticultural industry was concentrated in this zone, but the early agricultural returns did not supply information about horticulture and

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1. To some extent it was due to the fact that the crop, or land-use, returns seem to have been incomplete.

this hypothesis cannot be verified.

The second group of parishes with high proportions of grassland - that is, with more than 50 per cent of their land under grass - was largely occupied with livestock breeding and rearing, although cheese and butter production was also important in some areas. Most of the parishes in this group were either in hill districts or had tracts of moorland within their boundaries. The fact that they were also concentrated around the regional periphery, as location theory suggests grazing areas should be, must be attributed to the physical character of the region rather than to the factor of distance from the market. High proportions of grassland were registered in the moorland district in the south-east corner of the region, the Pennine foothills in the west, and on the Durham plateau in the north east.

The density map for milch cows reveals some interesting sub-regional differences. North of Norton, on the approach slopes and summit area of the Durham plateau, Stranton was the only parish with a density of milch cows equal to or greater than the regional norm, despite the generally high proportions of grassland, and Stranton was an urban parish. Staindrop, Cuckfield and a few other parishes in the west had relatively high densities, but it was the south-eastern part of the region which was outstanding in this respect. This was due to the traditional interest in the related activities of cattle breeding and butter and cheese production in the moorlands of north-east Yorkshire.

The density of other cattle over the age of two years was generally high in the area west of Darlington, which was the region's main fattening district. As would be expected, the moorlands of the south east were more heavily stocked with cattle under the age of two years, indicating again the importance there of rearing calves to be sold as stores. The western and south-eastern areas also had the highest sheep densities, and there is a suggestion that the latter was particularly concerned with sheep older than one year, and hence with wool and mutton production. It is noteworthy that despite having high proportions of grassland, the parishes on the limestone plateau of east Durham generally had low densities of all types of livestock. The reasons are uncertain, but they may have included the absence of sheltered valleys and the fact that herds would be restricted in size by the unsuitability of the thin and excessively free-draining soils for root crops, which elsewhere permitted the development of more intensive systems of husbandry.

Wheat, oats and - despite the progress claimed by contemporaries for green fallow crops - bare fallow dominated the arable land in 1866. Of the 141 parishes for which there are adequate data, wheat was the leading crop in 105, oats in 24, and wheat and oats together in a further 3, if temporary grass is excluded from consideration. Bare fallow was the most extensive 'use' in three of the remaining parishes. Oats became the leading crop only in the hill

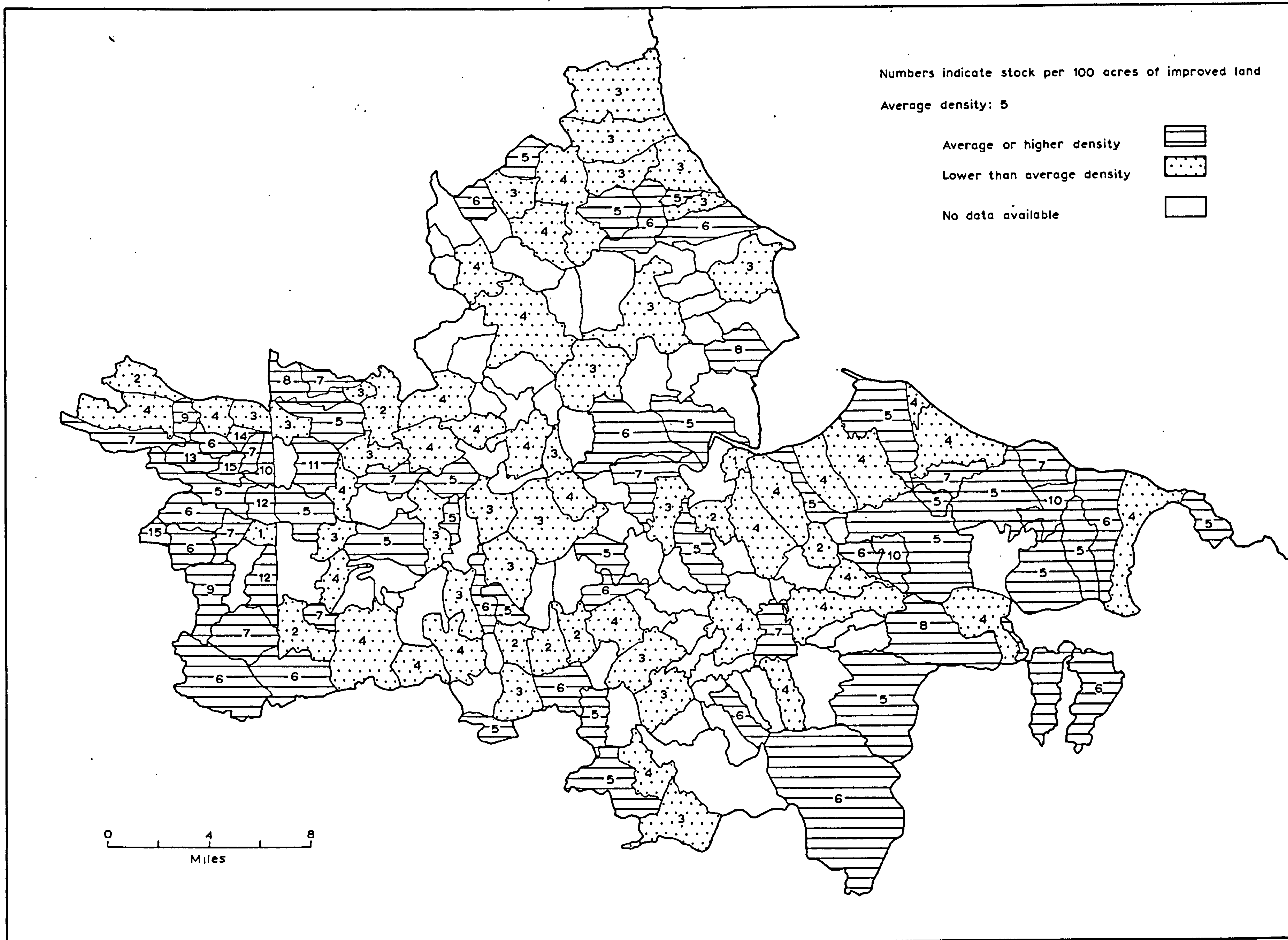


Figure 7.14 Density of Other Cattle Two Years or More of Age, 1866

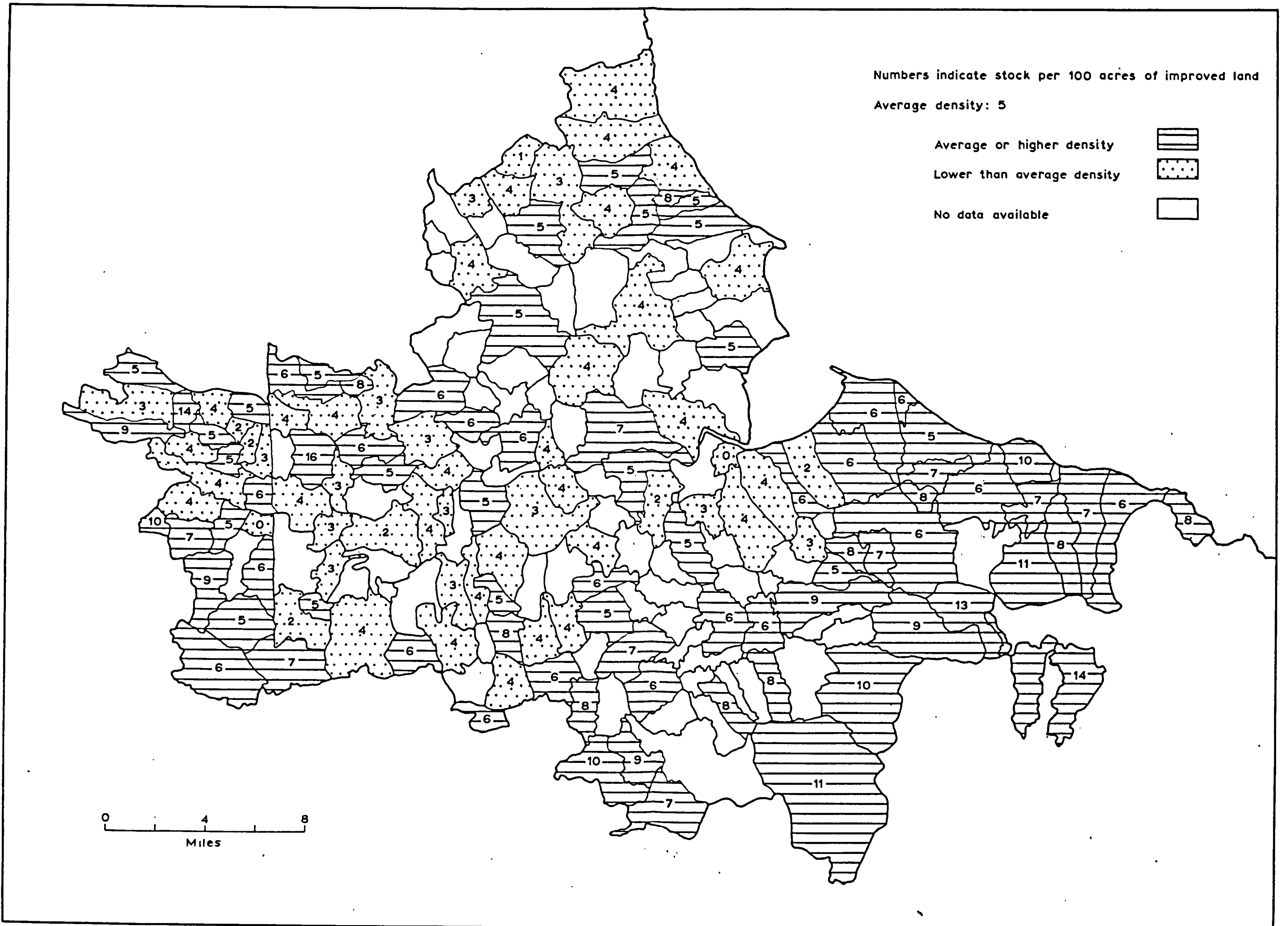


Figure 7.15 Density of Other Cattle Less Than Two Years of Age, 1866

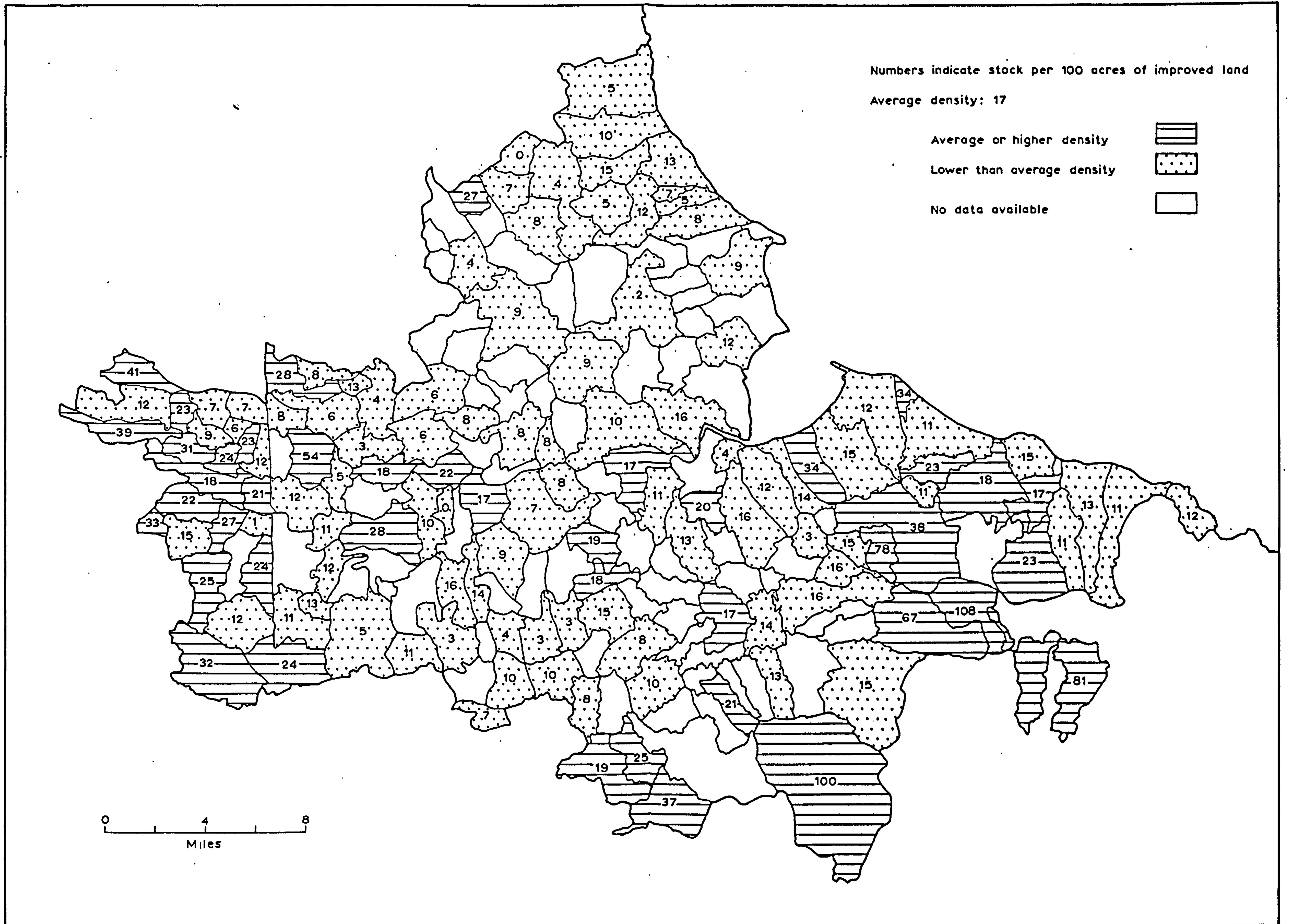


Figure 7.16 Density of Sheep One Year or More of Age, 1866

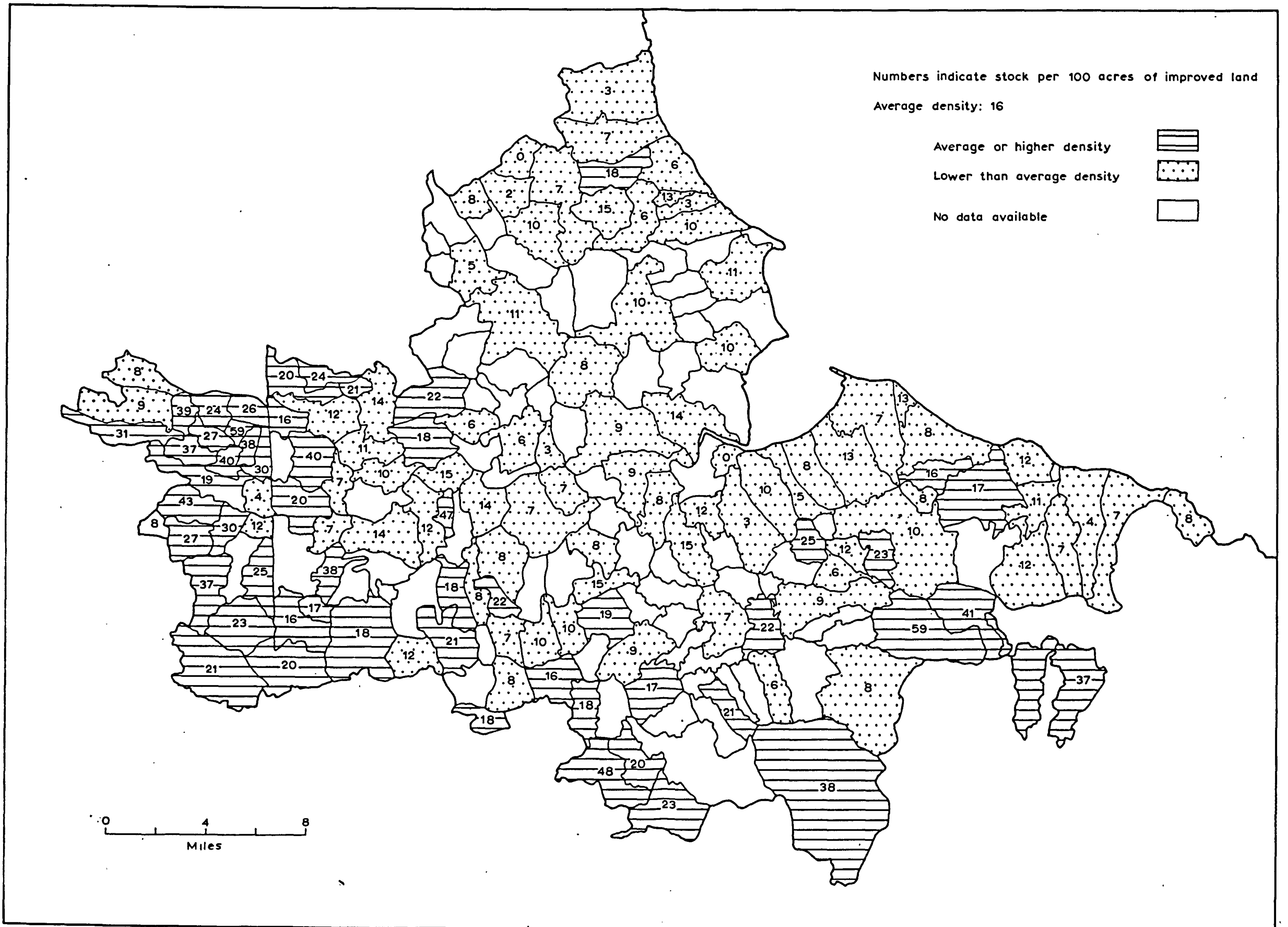


Figure 7.17 Density of Sheep Less Than One Year of Age, 1866

districts in the west, the north and the south east. Its position there was clearly related to soil and climatic conditions, since wheat was dominant in the lowlands even in parishes where animal husbandry was important.

In more than two-thirds of the parishes wheat, oats and bare fallow provided the three leading uses of arable land. Elsewhere, one of these three, but rarely more, was displaced by turnips, barley, beans or vetches. Most of the parishes in which this occurred were located in the grazing district west of Darlington, where turnips were actually the leading crop in five parishes. Rye, peas, potatoes, mangolds, carrots, cabbage, kohlrabi, and rape were all grown in many parishes, but always on a small scale.

There is no evidence that the types of crops grown, or their relative importance, varied with distance from the market. Variation was usually related to land quality, either directly or, through the need to feed livestock, indirectly. Indeed, it is difficult to avoid the conclusion that without the presence of upland areas requiring different farming systems, the region would have produced even smaller quantities of crops other than wheat and oats.

#### The Pattern of Farming in 1881.

Whatever doubts may remain about trends between 1840 and 1866, there is firm evidence that between the latter date and 1881 there was a general expansion of grassland





on Teesside. Summaries of the agricultural returns are available for 84 parishes in the region for both 1866 and 1881. The percentage of agricultural land under permanent grass declined in 9 and rose in 75 of those parishes during the intervening period. Similarly, there was a reduction of the proportion of land under temporary grass in 19 parishes, and an increase in the remainder. Grassland as a whole expanded in 76 of the 84 parishes, which gives support to the view that resources were being shifted from arable to pastoral farming on Teesside.

This change is reflected in the fact that three-quarters of the parishes studied in 1881 had more than 50 per cent of their land under grass, whereas less than one-quarter had been in that position in 1866. Of the parishes with comparatively low proportions of grassland, none had less than 30 per cent, which indicates that the general trend had affected them too. As in the earlier years, the parishes with high proportions of grassland were concentrated in two groups, one consisting of areas on the edge of the main urban centres and the other of upland districts. Very high values were recorded in both groups; in the former, Darlington and Stockton parishes had more than 60 per cent of their land under grass and Middlesbrough nearly 80 per cent, and in the latter Staindrop and Cockfield had higher proportions still.

The average Teesside parish had approximately 6 milch

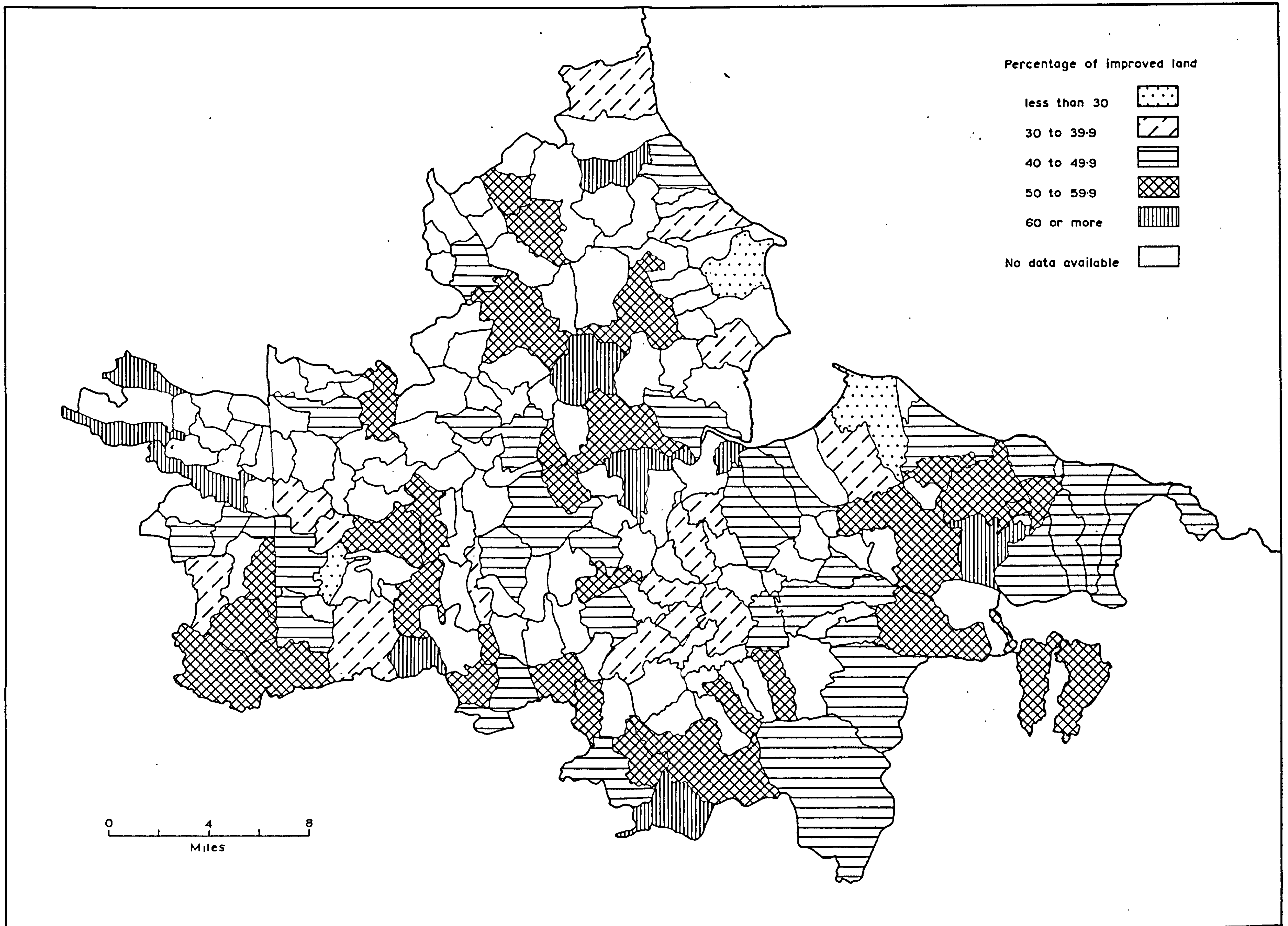


Figure 7.19 Proportion of Improved Land Under Permanent Grass, 1881

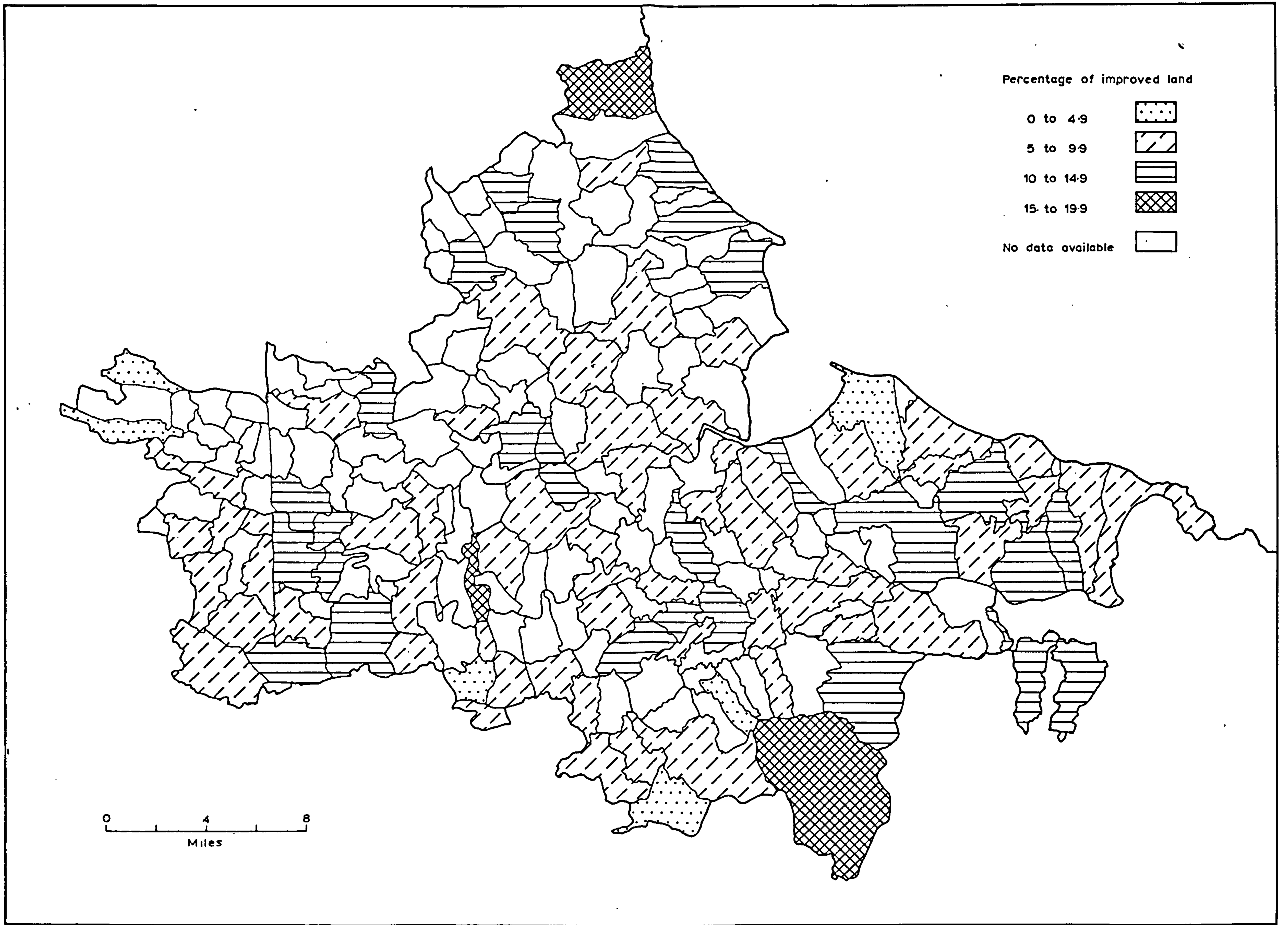


Figure 7.20 Proportion of Improved Land Under Temporary Grass, 1881

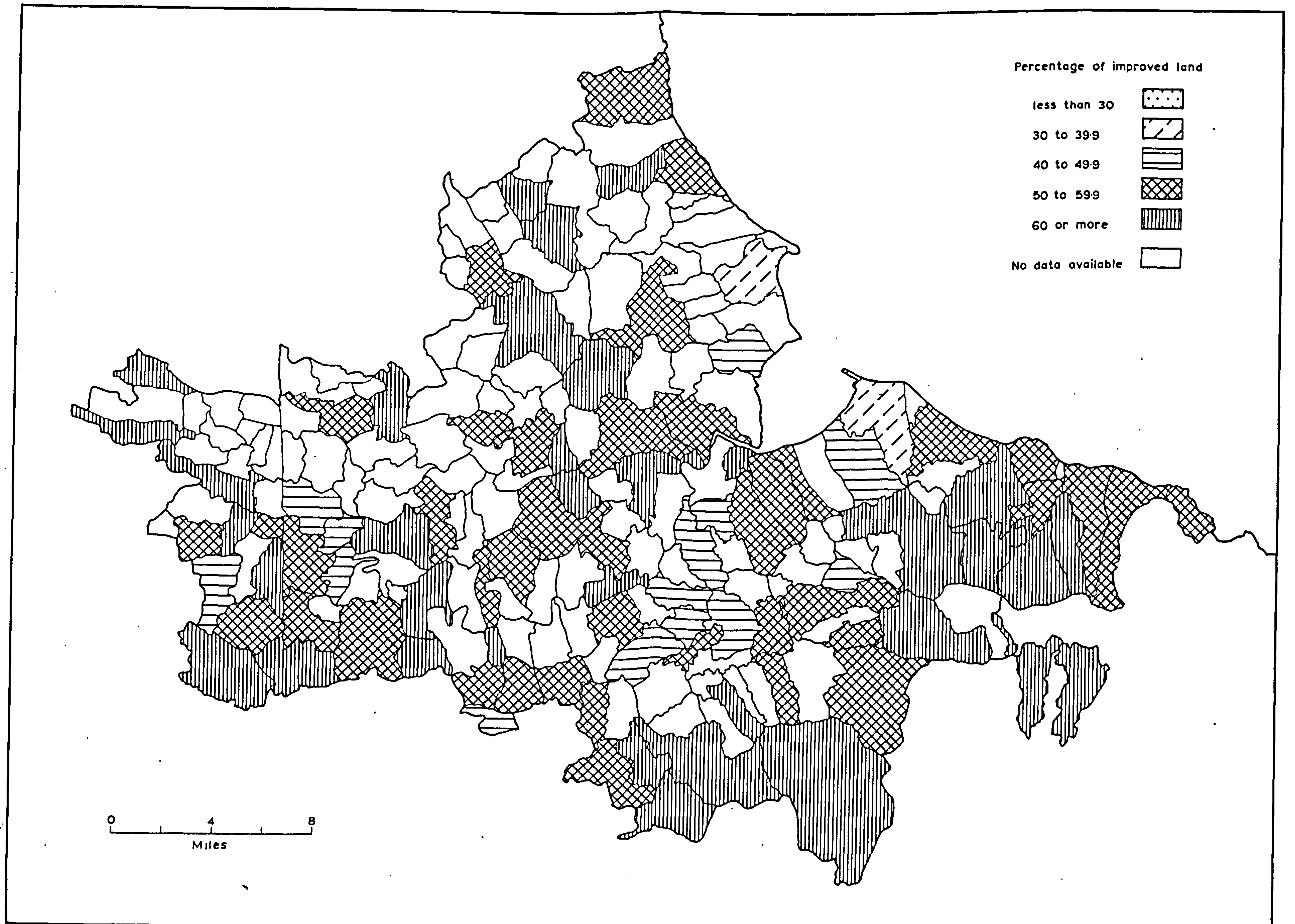


Figure 7.21 Proportion of Improved Land Under Permanent and Temporary Grass, 1881

cows per 100 acres of improved land in 1881. Again as in earlier years, the density was higher than average in the vicinity of the major towns. However, it is not possible to draw any conclusion as to whether or not the urban dairying zone was more extensive than in 1866. To some extent, the need to expand the zone of milk production, with population growth, was mitigated by intensification of production. Thus, Acklam (+1), Norton (+3), Marton (+2), Ormesby (+3) and Middlesbrough (+8) all had more milch cows per 100 acres in 1881 than they had had in 1866.

Relatively high densities of milch cattle were also recorded again in the south-eastern corner of the region, the traditional cattle breeding district, and to a lesser extent in the area west of Darlington. Interestingly, however, while densities in the region as a whole were higher than in 1866, many parishes in the upland districts had lower densities than in the earlier year. Thus, 47 parishes had higher and 15 had lower densities, the latter all being in hill districts. This suggests that a mild transformation of upland farming was taking place, and that cattle breeding and the production of butter and cheese were becoming less important than they had been in the past.

For other cattle over the age of two years, the highest densities occurred in the parishes west of Darlington, in the area which was still the main fattening district. In the moorlands of the south east, densities were generally low, but they were quite high in some of the parishes near

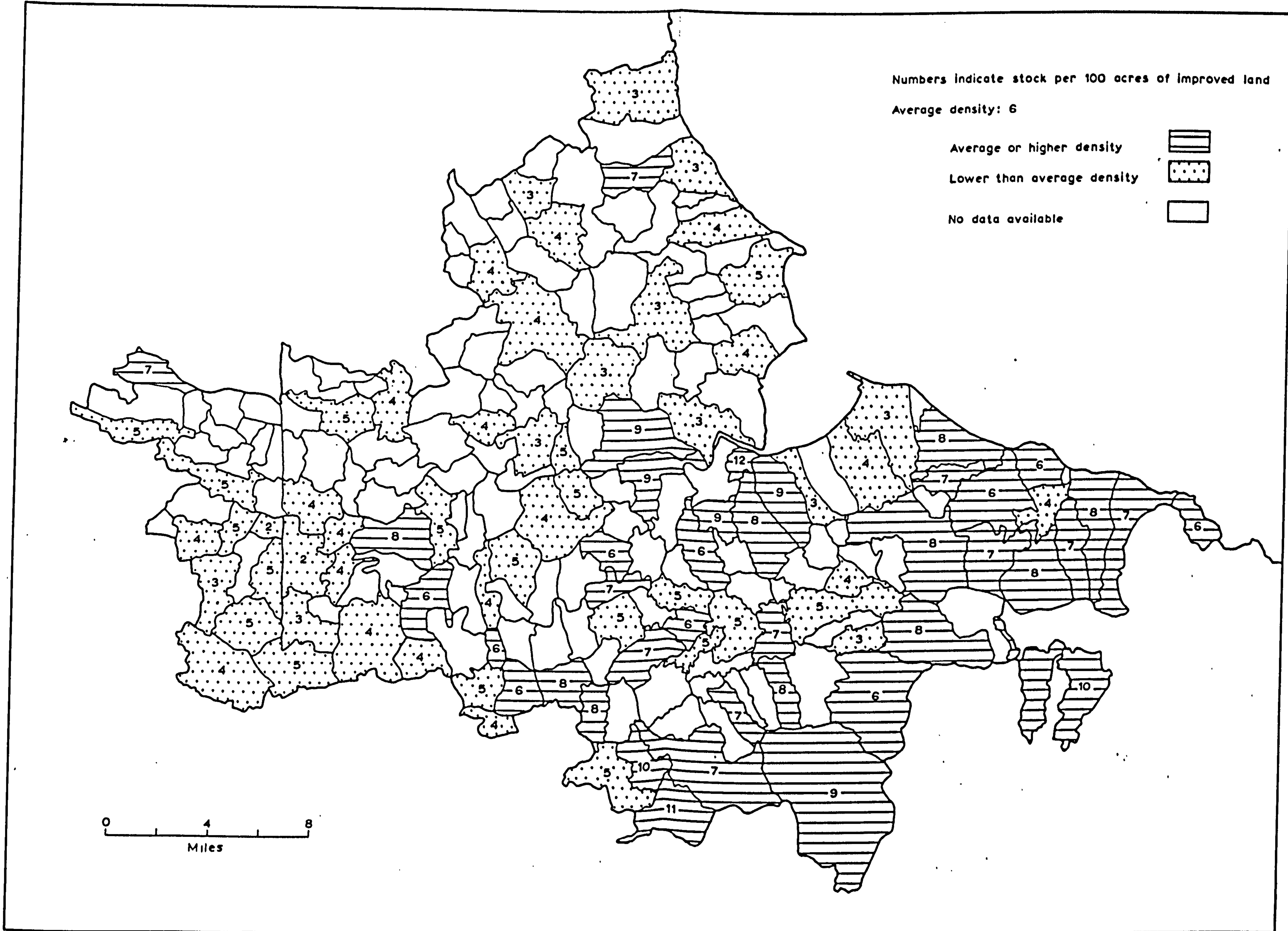


Figure 7.22 Density of Milch Cows, 1881

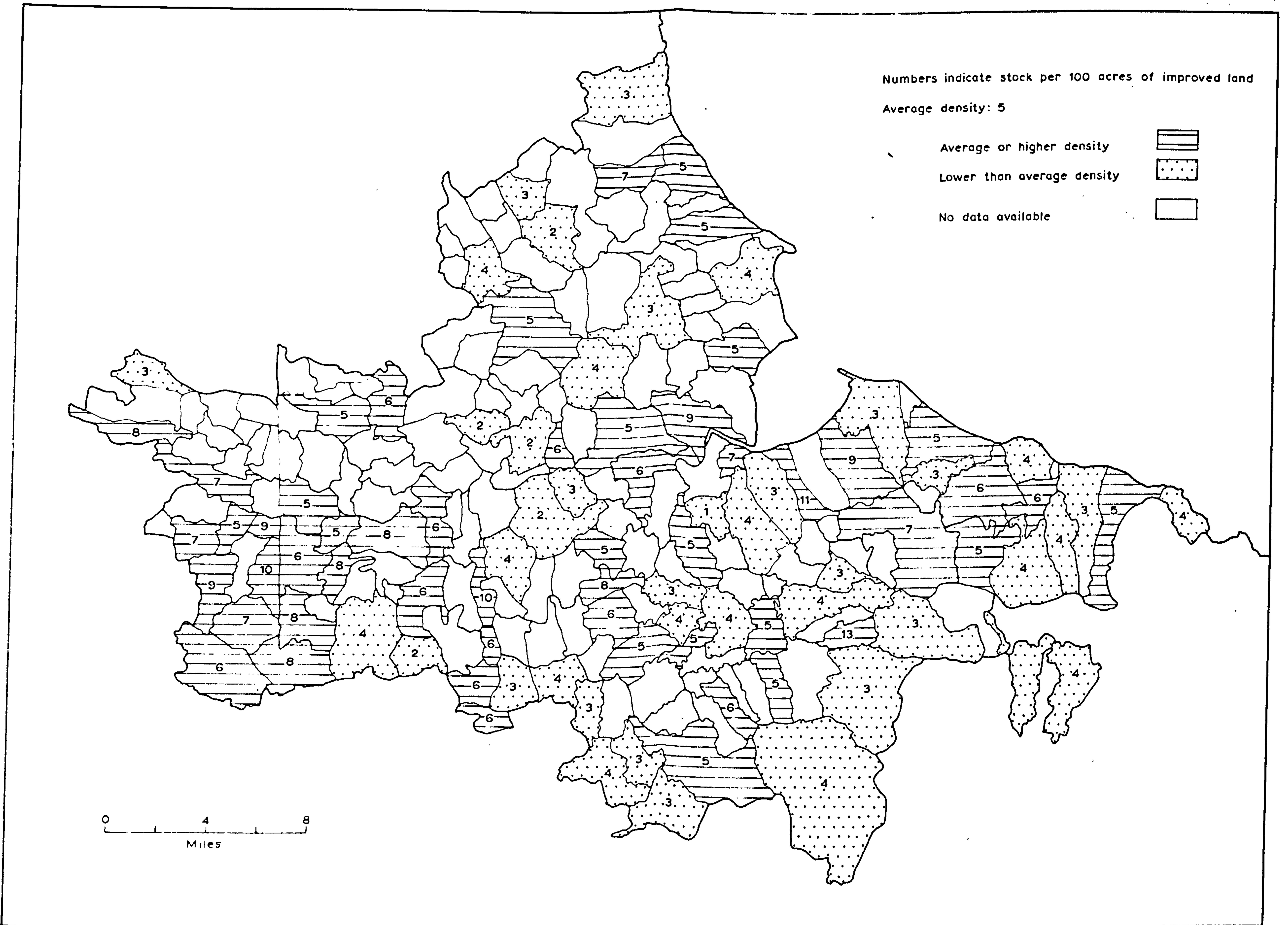


Figure 7.23 Density of Other Cattle Two Years or More of Age, 1881



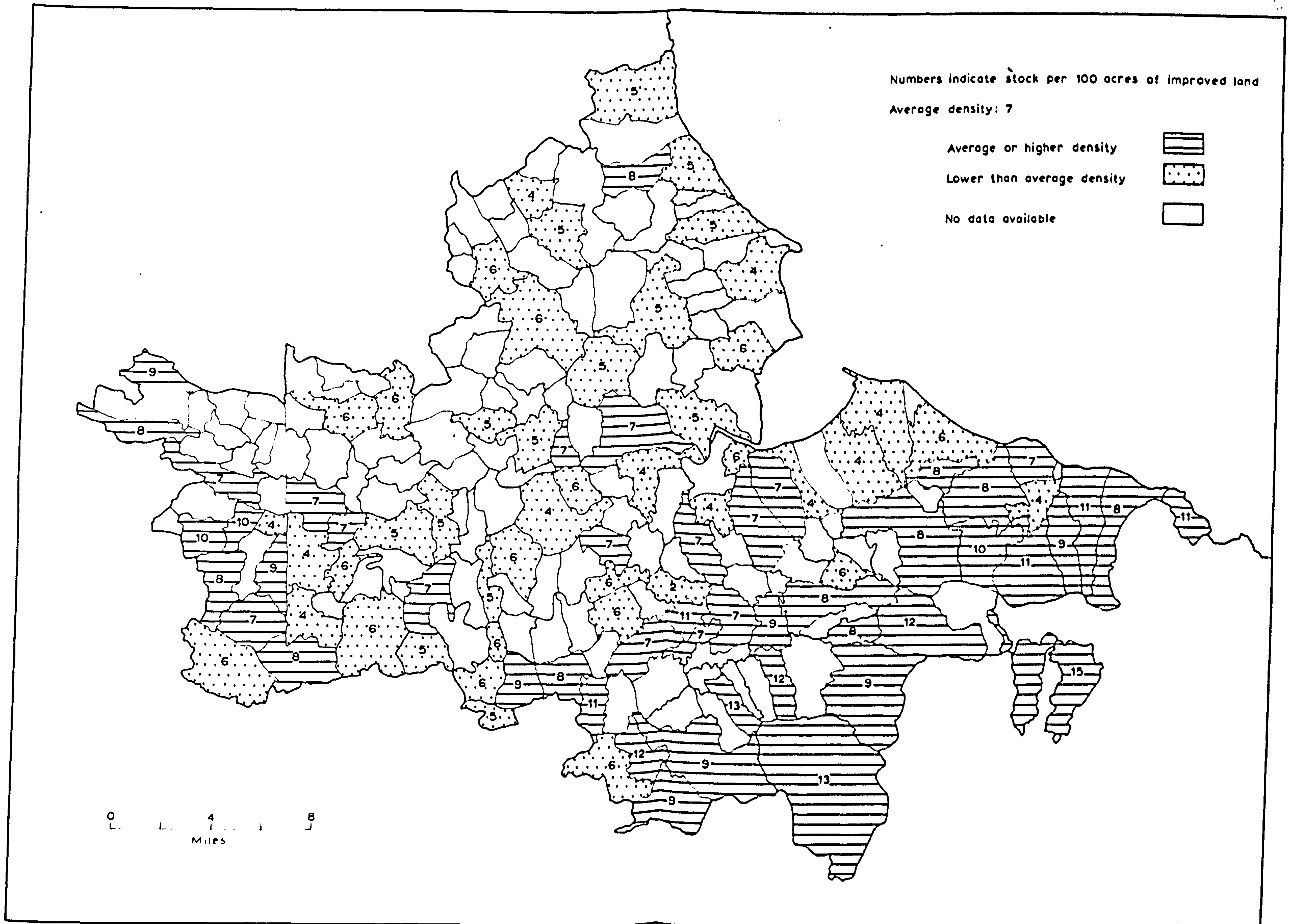


Figure 7.24 Density of Other Cattle Less Than Two Years of Age, 1881

Middlesbrough which had rough grazing. This suggests that the latter were developing as holding areas for beef cattle destined for the urban markets. On the basis of numbers of other cattle under the age of two years, the south-east district again emerges as the chief breeding and rearing area. There, densities were little different to what they had been in 1866. Elsewhere in the region, however, densities were higher in 58 parishes, supporting the general impression that the land was being stocked more heavily and that farming was becoming more intensive.

This impression is further reinforced by the data relating to sheep densities. The relative importance of sheep to the various parts of the region was much the same in 1881 as in 1866, and the densities of sheep in the category of less than one year of age was also little different. Of the sheep over the age of one year, however, 54 parishes had higher densities in 1881, and most of those parishes were in the hill districts. For example, Wilton had 33 and both Kildale and Normanby had 40 more sheep in that category per 100 acres. It would appear, therefore, that in turning away from cattle breeding and butter and cheese production, moorland farmers were turning towards the production of wool and mutton.

There are also indications that tillage land on Tees-side was affected by change. In 1881, wheat was the leading crop in 22, and oats in 43, of the 91 parishes for which data are available. Wheat was thus no longer the normal principal crop; oats had displaced it even on some of the best lowland soils. In examining this question,

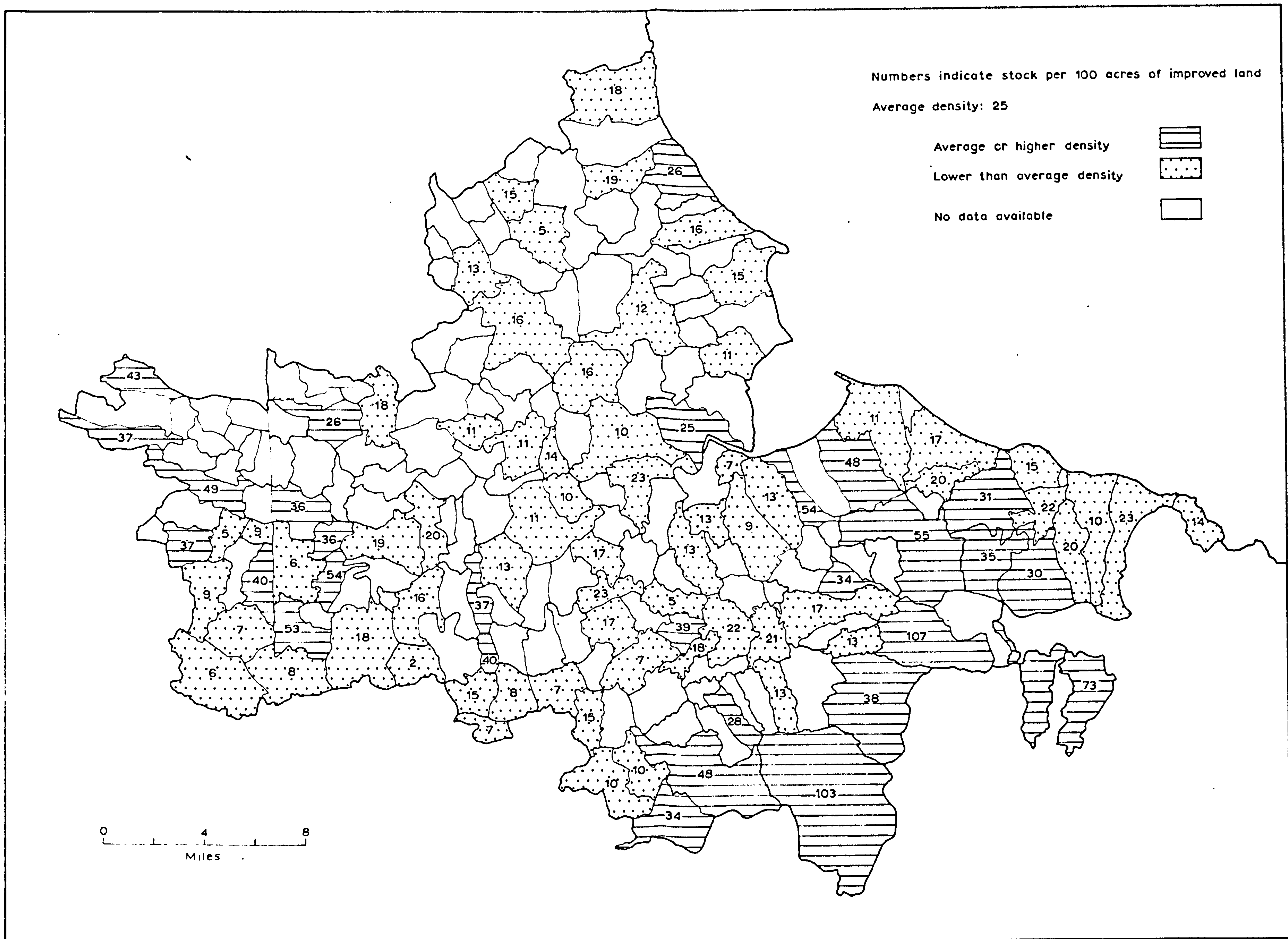


Figure 7.25 Density of Sheep One Year or More of Age, 1881

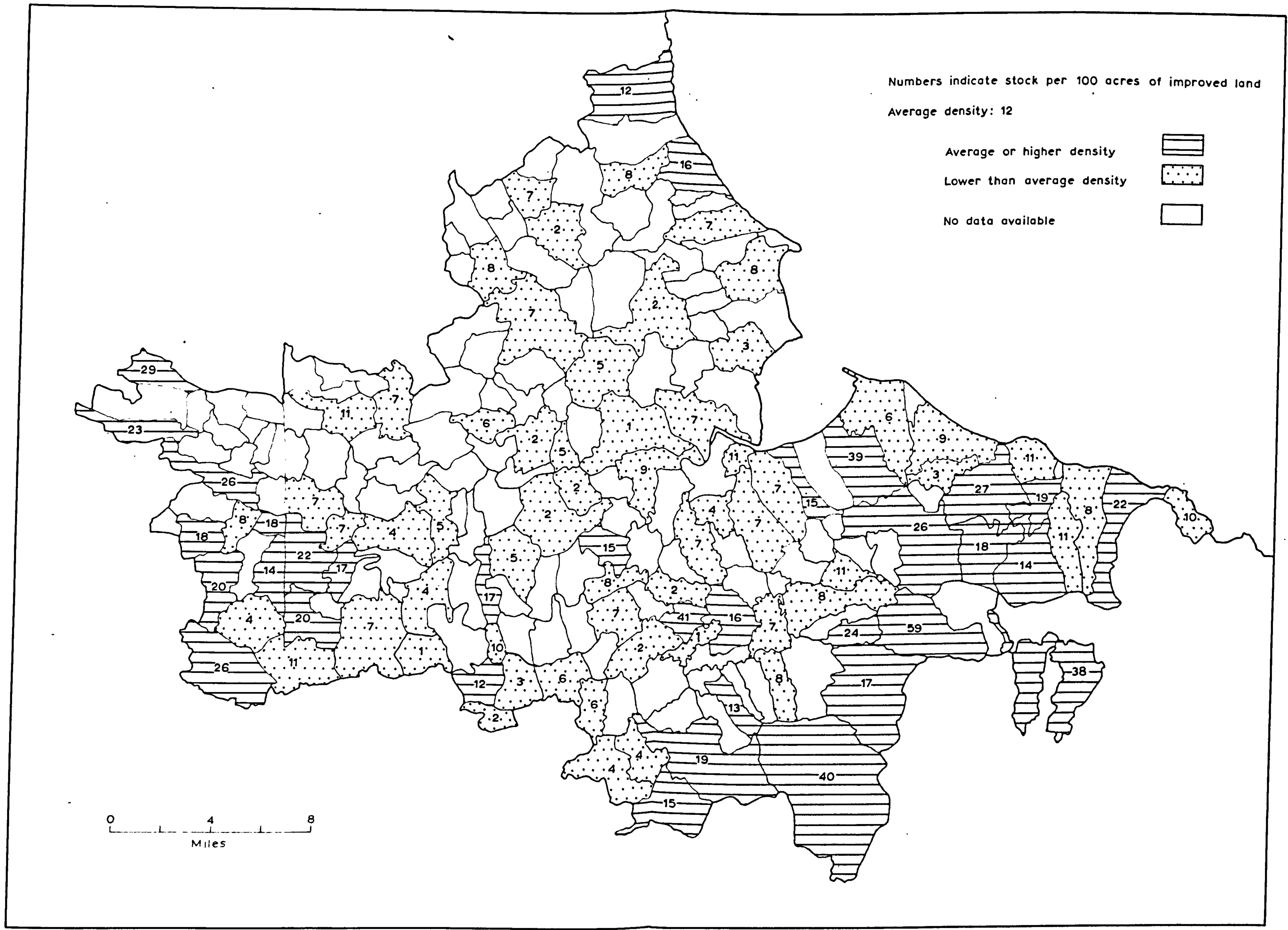


Figure 7.26 Density of Sheep Less Than One Year of Age, 1881



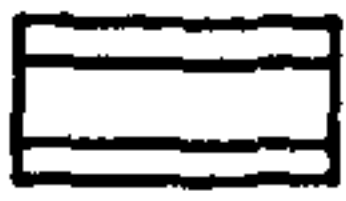




however, it is preferable to consider only the 84 parishes for which there are data for both 1866 and 1881, in order to avoid the problems otherwise created by comparing two slightly different sets of parishes.

In 1866 wheat held first place, in terms of the acreage planted, in 62 of those 84 parishes, but in 1881 it did so only in 21. Oats, in contrast, occupied the leading position in 17 parishes in 1866 and 40 in 1881. The relative decline in the importance of wheat during the intervening period is further evinced by the fact that it was amongst the first three crops in 80 parishes at the beginning and in only 57 at the end. As well as oats, barley and turnips were of much greater significance in 1881, while bare fallow was of considerably less importance. These various changes give substance to the view that Teesside farmers were reducing their commitment to wheat, and to arable farming in general, and transferring their resources into livestock husbandry and the growing of fodder crops.

Generally, as in earlier years, the types of crops grown at a particular location were related not to the distance from the market but to physical conditions. However, by 1881 the agricultural returns had begun to include information relating to market gardening, and it is clear that the location of that activity, at least, was influenced by the distance factor. Market gardening was concentrated in areas close to the main towns : the parishes of Stranton, Great-ham, Norton, Stockton, Eggescliffe, Darlington, Hurworth and

B Barley  
 F Fallow  
 O Oats  
 T Turnips  
 W Wheat  
 B/F Barley/Fallow  
 T/B Turnips/Barley  
 W/F Wheat/Fallow  
 / signifies equal rank

Leading crop symbol:

Barley   
 Fallow   
 Oats   
 Turnips   
 Wheat   
 Turnips/Barley   
 No data available 

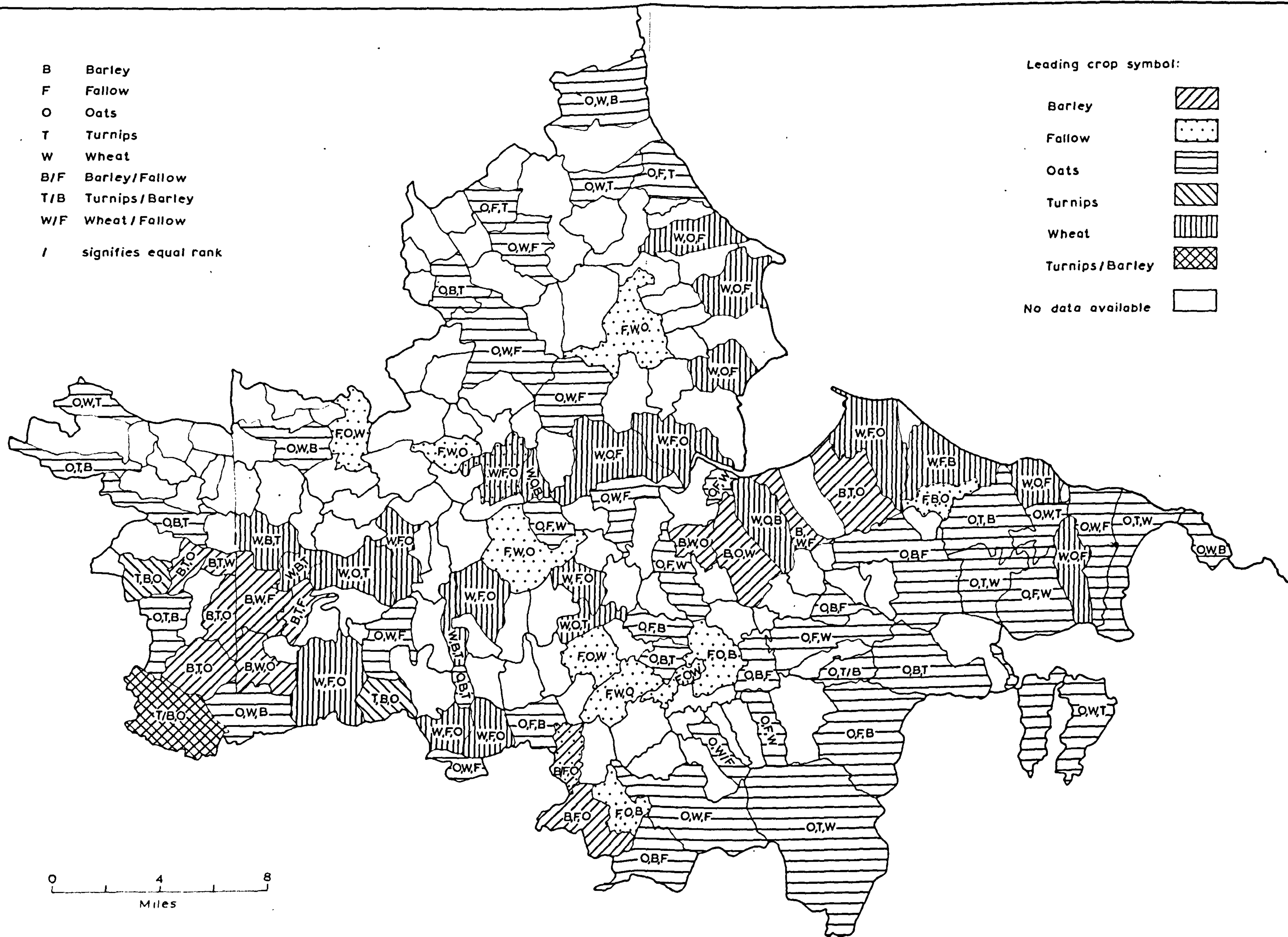


Figure 7.27 Leading Crops, 1881

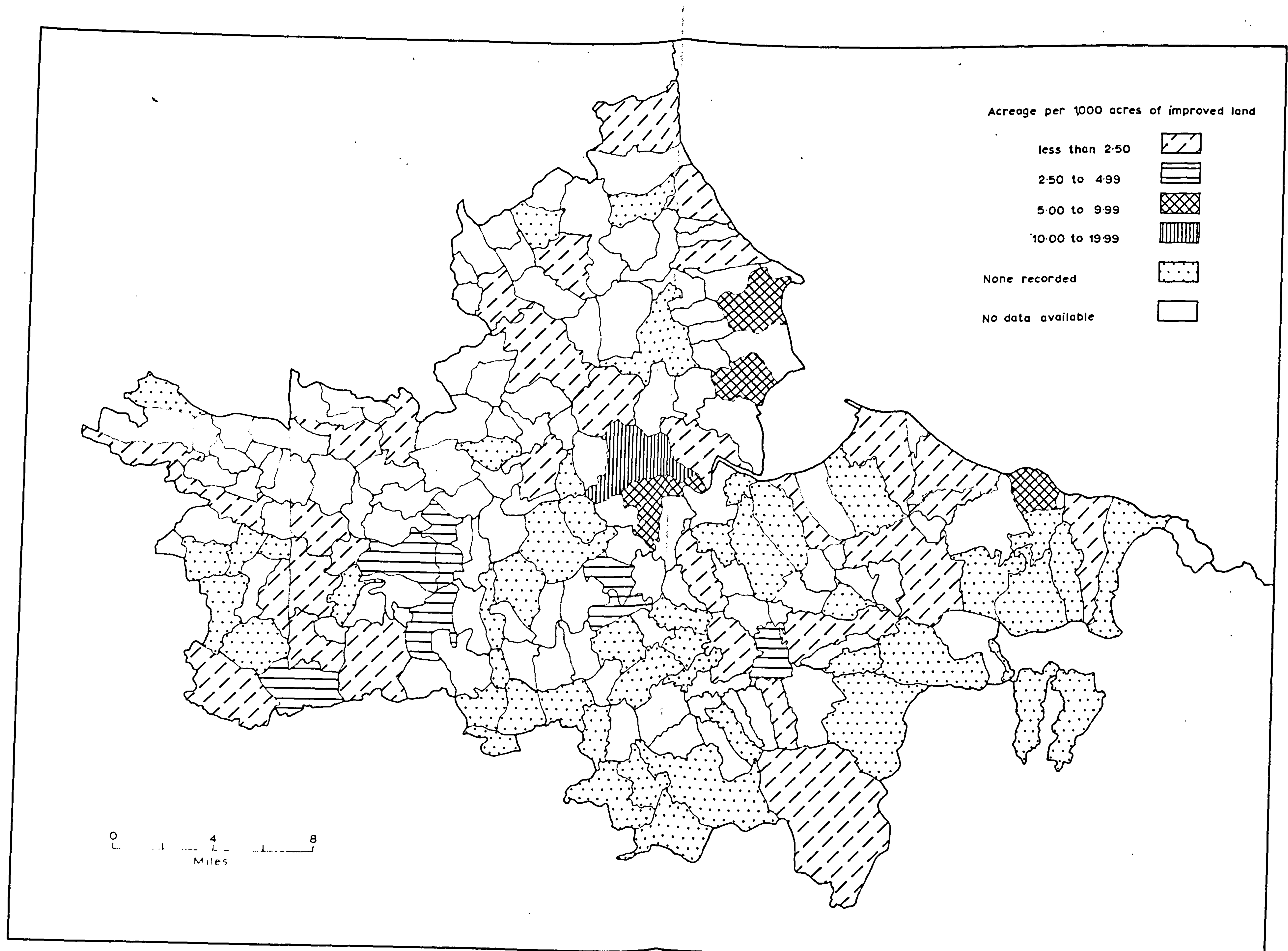


Figure 7.28 Distribution of Market Gardens

Haughton le Skerne are especially noteworthy in this respect.

### Summary

In the Teesside region agricultural trends were governed by national rather than local events throughout the nineteenth century. Broadly, the agricultural sector had two principal components : one lowland and one upland. These fared rather differently. In the lowlands, farming fitted into a pattern common to English districts with heavy clay soils. Such areas were not well equipped to specialise in grain growing, but during the Napoleonic Wars they did just that, attracted by the high prices for cereals in general and for wheat in particular. After the conclusion of hostilities, with the reappearance of more normal economic conditions, it would have been in the best interests of clay districts to return to mixed farming with an emphasis on livestock husbandry. On Teesside, as elsewhere, however, farmers were slow to appreciate this, and even to recognise normal conditions. They preferred to await the recovery of grain prices to the levels which had prevailed during the preceding three decades, regarding the price level of the 1820's and 1830's as abnormal.

This is scarcely surprising. A generation of farmers and landlords had developed and grown old under conditions which in historical perspective appear exceptional, and can be seen to have resulted from the economy being on a wartime



footing, but which then must have seemed quite normal. However, the longer the necessary transition was delayed, the more difficult it became to effect. Costs of production, for cereal farming, were relatively high on clay land, and in the post-war period the much-reduced prices of cereals meant that profit margins in clay lowlands were usually slim, and at times non-existent. To add to the problems, yields were low and falling, the fertility of the land having been sapped by long and continuous arable useage.

The capital accumulated during the prosperous years was soon dissipated, and bankruptcy and rural unemployment became rife. Growing impoverishment made adjustment to post-war conditions even more difficult; for capital was needed to rebuild the depleted livestock herds, to purchase fertilizers and to re-establish grassland which had been put to the plough. In the event, none of these desirable changes came about quickly. Farming in clay districts languished until the middle of the century, when the Government opened the way to improvement by making available capital loans to finance drainage projects.

Improved drainage raised crop yields by giving the soil a better texture and reducing the incidence of water-logging, and by allowing a greater proportion of the land to be cultivated. It also lowered the cost of working stiff clay soils. With better drainage, it also became possible to adopt the root crops long used on lighter soils. In turn, this meant that the traditional bare fallows could to some

extent be replaced by green fallows, which was tantamount to raising the productivity of the land, and that more fodder became available to support larger livestock herds. The keeping of greater numbers of livestock benefited the arable land, in that manure became more plentiful.

In the lowlands of Teesside, there was a slight expansion of grass and a small shift towards pastoralism prior to 1866, but these were negligible in comparison with trends in the following fifteen years. After 1866, both permanent and temporary grassland were extended throughout the region. Simultaneously, root crops became much more evident, wheat was dislodged by oats from the position had long held as leading crop, and there was a general increase in livestock densities. These changes were contemporary with national price movements which, from about 1870, made livestock the more profitable end of mixed farming systems. No doubt, however, they were also encouraged by the proximity of large and growing urban centres, with their rising demand for meat.

Moorland farmers were much less affected by the fluctuations and longer-term shifts in price levels which caused their lowland counterparts to alter their modes of operation. Upland farming was traditionally based on animal husbandry, to which there was no real alternative, and the prices of livestock products were more stable than those of cereals. In the first half of the nineteenth century, as for a long time previously, agriculture in the North York

Moors was predominantly concerned with the breeding and rearing of cattle and sheep - to be sold to lowland farmers for fattening - and with the production of butter and cheese. After 1866, however, cattle seem to have declined somewhat in significance, and sheep to have become correspondingly more important. This was a normal feature of moorland farming in Britain in the later part of the nineteenth century, and was primarily due to the growing demand for wool.<sup>1</sup>

The simple model of land use formulated by von Thünen is clearly of limited relevance to Teesside in the nineteenth century. However, there is evidence that throughout the period studied, the pattern of farming in the areas immediately adjacent to the main urban centres was prescribed by the distance factor. These were areas which had high proportions of their land under grass and high densities of milch cattle. Together, they also held the greater part of the horticultural industry. Collectively, therefore, they constituted the inner-most ring of the von Thünen model, though the limitations of the data available prohibit a precise definition of their spatial extent.

Farming in this zone was largely concerned with the production of fodder and the provision of grazing for the urban horse population and the cows supplying milk to the towns. Like market gardening, these were activities which

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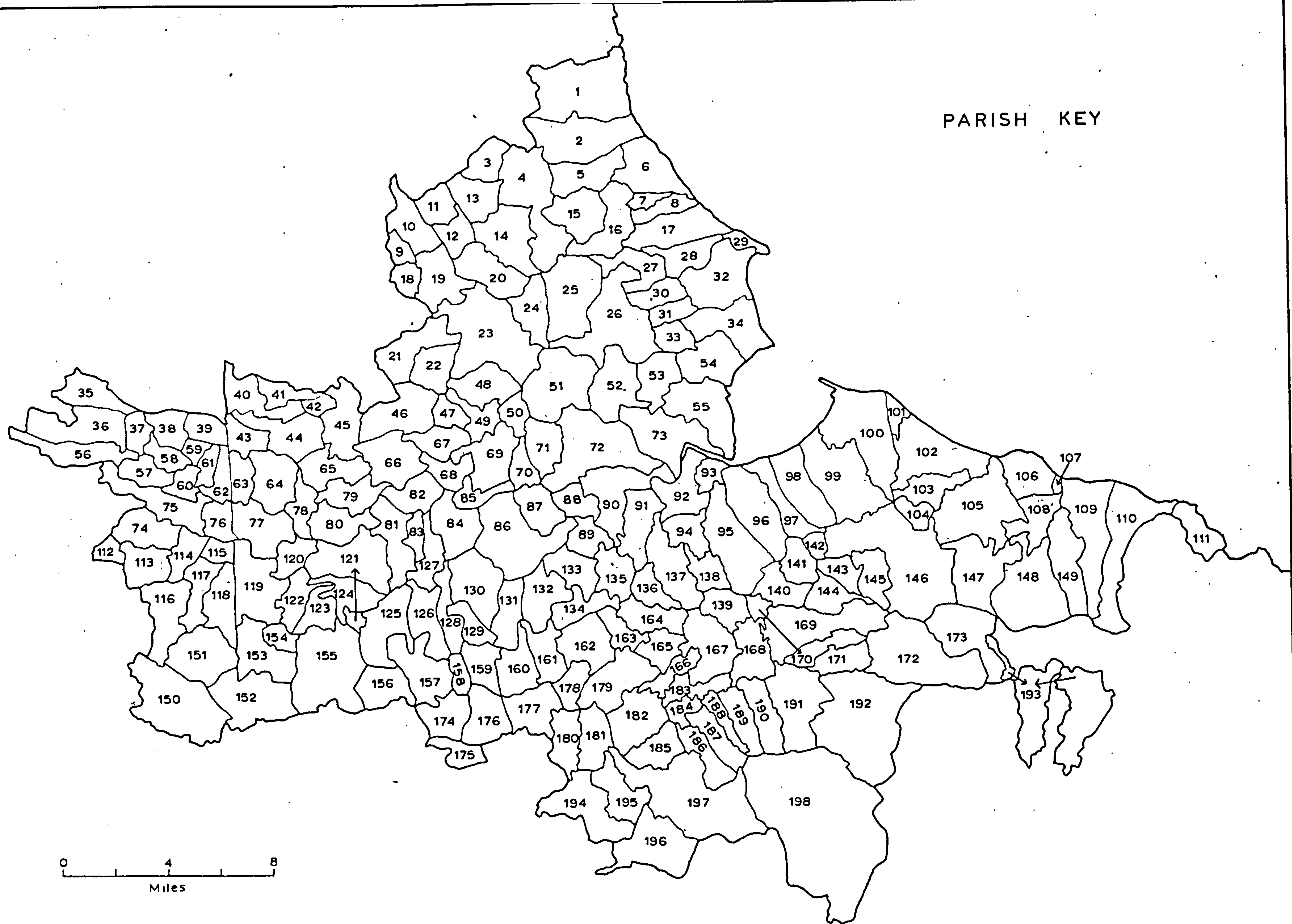
1. See John Fraser Hart, The British Moorlands : A Problem in Land Utilization, University of Georgia Monographs, No.2, Athens, Georgia, 1955, p.26.

PARISH KEY

1. Easington with Thorpe.
2. Shotton.
3. Thornley.
4. Wingate.
5. Castle Eden.
6. Monk Hesleden.
7. Nesbitt.
8. Thorpe Bulmer.
9. Thrylington.
10. Corforth.
11. Conoe.
12. Gamondsway Moor.
13. Killoe.
14. Rimdon.
15. Tutton Henry.
16. Sheraton with Hulam.
17. Hart.
18. Mainsforth.
19. Bishop Middleham.
20. Fishburn.
21. Bradbury and the Isle.
22. Mordon.
23. Sedgfield.
24. Butterwick and Oldacres.
25. Embleton.
26. Elwick Hall.
27. Elwick.
28. Throston.
29. Hartlepool.
30. Dalton Piercy.
31. Brearton.
32. Stranton.
33. Claxton.
34. Seaton Carew.
35. Cockfield.
36. Raby with Keverstone.
37. Wackerfield.
38. Hilton.
39. Bolam.
40. Redworth.
41. Midridge and Grange.
42. School Aycliffe.
43. Houghton le Side.
44. Heighington.
45. Great Aycliffe.
46. Preston le Skerne.
47. Elstob.
48. Fynton and Shotton.
49. Stillington.
50. Whitton.
51. Grindon.
52. Wolviston.
53. Newton Bewley.
54. Greatham.
55. Cowpen.
56. Staindrop.
57. Langton.
58. Ingleton.
59. Morton Tinmouth.
60. Headlam.
61. Killerby.
62. Summerhouse.
63. Denton.
64. Walworth.
65. Coatham Mundeville.
66. Brafferton.
67. Stainton le Street.
68. Little Stainton.
69. Bishopton.
70. Redmarshall.
71. Carlton.
72. Norton.
73. Billingham.
74. Barforth.
75. Gainforth.
76. Piercebridge.
77. High Coniscliffe.
78. Archdeacon Newton.
79. Whessoe.
80. Cockerton.
81. Haughton le Skerne.
82. Barmpton.
83. Great Burdon.
84. Sadberge.
85. East and West Newbiggin.
86. Long Newton.
87. Elton.
88. East Hartburn.
89. Preston upon Tees.
90. Stockton.
91. Thornaby.
92. Linthorpe.
93. Middlesbrough.
94. West Acklam.
95. Marton.
96. Ormesby.
97. Normanby.
98. Eston.
99. Wilton.
100. Kirkleatham.
101. Redcar.
102. Marske.
103. Upleatham.
104. Tocketts.
105. Skelton.
106. Brotton.
107. Skinningrove.
108. Kilton.
109. Lofthouse.
110. Easington.

111. Hinderwell.
112. Ovington.
113. Caldwell.
114. Eppleby.
115. Cliffe.
116. Carkin and Forcett.
117. Stanwick.
118. Aldbrough.
119. Manfield.
120. Low Coniscliffe.
121. Darlington.
122. Cleasby.
123. Stapleton.
124. Blackwell.
125. Hurworth.
126. Neasham.
127. Morton Palms.
128. Low Dinsdale.
129. Over Dinsdale.
130. Middleton St. George.
131. Newsham.
132. Aislaby.
133. Egglecliffe.
134. Yarm.
135. Ingleby Barwick.
136. Maltby.
137. Stainton.
138. Hemlington.
139. Newby.
140. Nunthorpe.
141. Morton.
142. Upsall.
143. Pinchinthorpe.
144. Newton.
145. Hutton Lowcross.
146. Guisborough.
147. Stanghow.
148. Moorsholme.
149. Liverton.
150. Gilling.
151. Melsonby.
152. Middleton Tyas.
153. Barton.
154. Newton Morrell.
155. Croft.
156. Dalton upon Tees.
157. Eryholme.
158. Sockburn<sup>1</sup>/<sub>2</sub>.
159. Girsby.
160. Low Worsall.
161. High Worsall.
162. Kirklevington.
163. Castle Levington.
164. Hilton.
165. Middleton upon Leven.
166. Rudby.
167. Seamer.
168. Stokesley.
169. Great Ayton.
170. Little Ayton.
171. Easby.
172. Kildale.
173. Comondale.
174. Great Smeaton.
175. Little Smeaton.
176. Hornby.
177. Appleton upon Wiske.
178. Pickton.
179. Crathorne.
180. West Rounton.
181. East Rounton.
182. Hutton Rudby.
183. Skutterskelf.
184. Sexhow.
185. Potto.
186. Faceby.
187. Carlton.
188. Little Busby.
189. Great Busby.
190. Kirkby.
191. Broughton.
192. Ingleby Greenhow.
193. Danby.
194. East Harlsey.
195. Ingleby Arncliffe.
196. Osmotherley.
197. Whorlton.
198. Bilsdale Midcable.

PARISH KEY



0 4 8  
Miles