

THE BELGIAN KEMPENLAND

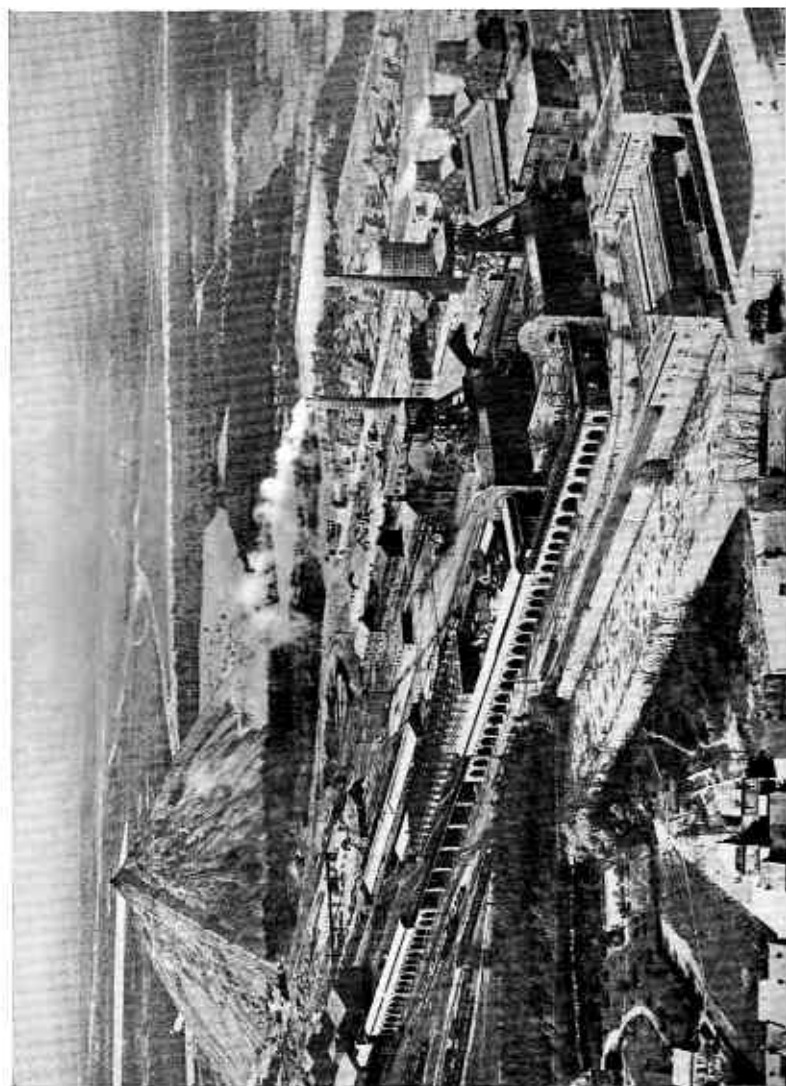
BY

F. J. MONKHOUSE, M.A.

*Lecturer in Geography
in the University of Liverpool*

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PREFACE

IN the north-east of Belgium there is a small region, known to the people of that country as *de Kempen* or *de Kempenland* (in French *la Campine*), both names ultimately derived of course from the Latin *campus*. This book attempts to portray systematically its essential geographical character. There might seem to be little of interest or profit in a study of such a region, which forms just a small part of the sandy heathlands of the North European Plain. On the contrary, the reclamation and improvement of the heathland, the planting of conifers, the laying down of pasture, the exploitation of the deep coalfield which lies beneath the Tertiary sands and gravels, the building of great factories and the housing-estates where live their workers, and the resulting enormous increase of population, proportionally greater during this century than in any other part of Belgium—all these have a singular interest in themselves. What is more, the several topics are inter-dependent and form part of a single theme, that is, the increasingly profitable use by Belgium of an area described in the early nineteenth century as consisting of “sterile wastes even as the sands of the sea-shore.”

The method of treatment is systematic; the physical setting is described first, then the features of the economic life, and finally the distribution of population and of settlement. But the account is not merely a survey of conditions in 1938, the last year for which, in some cases, detailed statistical information is available, nor even of 1947. For it is impossible to survey adequately the characteristics of any chosen area without considering how these have come to be what they are. In other words, it is as important to examine how the Kempenlanders utilized their environment in the past and the changes they produced in so doing, as it is to describe the facts of the present-day physical and economic geography.

Three general points concerning method may be briefly mentioned. In the first place, it will be seen that foot-note references are restricted to a minimum, except where due acknowledgement must necessarily be made. Instead, a detailed Bibliographical Note is appended at the end of the text. The chief sources of information, apart from a number of monographs and articles in both French and Flemish, have been personal observation and interrogation in the field, and the use of statistical material. The last includes not only the very wide range of official Government publications which have appeared since the production of the first massive *Recensement Général de la Population* of 1846, but also much unpublished material readily made available by the Belgian Government, by various commune administrations, particularly that of Genk, and by many industrial companies. Due acknowledgement of these sources of information is made in the Bibliographical Note. It was felt, therefore, that to give the exact reference to every figure quoted would be unduly tedious.

The second point concerns a problem which commonly faces a geographer when the country in which he is interested has alternative forms of its place-names. Should he use the official form sanctioned by the particular country, or should it be a form familiar to the English readers for whom his work is primarily intended, sometimes very different from the first? This problem is considered in the "Note on Place-Names in the Kempen" on p. xiii. Briefly, the policy adopted in this text has been to use the official Flemish form in all cases, with a very few exceptions. Brussels is used instead of either of the two official forms Bruxelles or Brussel, and Antwerp (city) instead of the official Antwerpen or the customary French form of Anvers; it would be pedantic to use other than the anglicized forms for these two world cities. The official form Antwerpen is retained for the name of the province and of the *arrondissement*, thus providing a convenient distinction between the city and the larger administrative units. The anglicized form of Scheldt is used instead of either Schelde or Escaut, and Meuse is used instead of Maas. The alternative non-official but sometimes rather more familiar forms of other place-names are indexed with cross-references to the official forms used in the text.

The third point is that the metric system of measurement is used throughout, even to a metric scale on the maps, and no apology is made for this. Belgian statistical information is of course in the metric form, and frequently the reduction of a round metric figure to its exact equivalent in English measure results in a most misleading appearance of extreme accuracy. For example, the reduction of the important and significant fifty-metre contour to 164·045 feet would be absurd. A series of summary conversion tables is appended for convenience (pp. 240-3).

ACKNOWLEDGEMENTS

I AM happy to express my thanks to numerous friends for help and advice. To Professor H. C. Darby especial gratitude is due for his constant encouragement and stimulus and for his ready counsel. Professor Idris Ll. Foster, of Jesus College, Oxford, who read both typescript and proof, brought to that tedious task his exceptional critical ability. My colleagues in the Department of Geography at Liverpool have throughout contributed suggestions and advice. Mr D. A. Coult, of the Department of Botany at Liverpool, read and criticized Chapters II and IV. Mr W. G. White, Modern Languages master at the Liverpool Collegiate School, rendered timely help with some of the original sources.

During the course of visits to Belgium, I have received much kindness and hospitality. Government departments, communal authorities, industrial firms and private individuals have been most generous in the provision of statistical and other information. Too numerous to include in this Preface, these various sources of assistance are listed in the Appendix, Bibliographical Note. But special mention must be made of the management and technical staff of the *S.A. des Charbonnages de Winterslag*, who, incidentally, supplied the photograph which forms the frontispiece, with permission to reproduce it; of M Léon Dubois, Ingénieur Civil des Mines, on the staff of that colliery; of M Frans Slechten-Feytons, head of the *Technisch Dienst* of the commune of Genk, who provided much detailed local information and manuscript maps; and of M van den Broeck of the *Institut National de Statistique* in Brussels, whose ability to produce statistics, published or unpublished, almost on demand, has been invaluable.

Every student of the geography of western Europe in general and of Belgium in particular must necessarily owe much to the researches of Mlle

M. A. Lefèvre, *Directrice* of the *Institut Géographique Paul Michotte* in the University of Louvain, and Honorary Secretary of the International Geographical Union. I am very grateful to Mlle Lefèvre for permission to base Figures 6 and 66 upon original maps from her books; acknowledgement is made in the caption to each.

The maps were drawn by Mr A. G. Hodgkiss, draughtsman in the Department of Geography at Liverpool, and lettered by my wife, who in addition undertook the onerous tasks of reading the proofs and of compiling the index. Mr R. A. Downie, Secretary of the University Press of Liverpool, apart from seeing the book through the press, gave unstinted help and advice in typographical and other technical matters.

Finally, grateful thanks are due to the University of Liverpool for a generous research grant towards the cost of field-work in Belgium.

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1949

F.J.M.

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NOTE ON PLACE-NAMES IN THE KEMPEN

IN an article entitled "Flemish Names in Belgium" in *The Geographical Journal*, vol. XCII (London, 1938), M. Aurousseau, secretary of the Permanent Committee on Geographical Names, wrote: "The recognition of Flemish involves the eclipse of a number of familiar names, as, for instance, . . . la Campine. . . ." After careful consideration, it has been decided to use in this book the name *Kempen* or *Kempenland*, as the region is known to its predominantly Flemish-speaking inhabitants, rather than the French form of *Campine*, as yet perhaps more familiar to English readers.

In Belgium there are two official languages which have equal status in law; these are *Walloon*, which is a dialect of French, and Flemish or *Vlaams(ch)*, one of the west Germanic group of the Teutonic languages. The linguistic boundary between the two runs more or less across the country to the south of Brussels. To the north of this line, except in the capital itself, more than half of the people habitually speak Flemish. In the two Kempen provinces of Antwerpen and Limburg, ninety-one per cent and eighty-six per cent respectively of the people spoke Flemish in 1930, the date of the last linguistic census.

The famous Language Law of 1932, or the *Loi de Classification*, enunciated the general principle that within the Flemish-speaking areas the official place-names are to be in the Flemish form. Five years later, the final official forms of Flemish commune-names, based on the new simplified orthography recommended by the *Koninklijke Commissie voor Toponymie en Dialectologie*, were published in *Spelling van de namen der Vlaamsche gemeenten, van de Vlaamsche namen der tweetalige gemeenten en gemeenten uit de Brusselsche agglomeratie*. In the following year, *Le Moniteur Belge* (*Belgisch Staatsblad*) for 11 June 1938 published a list of the official names of all communes, and this has since been followed in all official publications, including the annual population estimates.

This list refers only to the names of provinces, *arrondissements* and communes. The Flemish names of many geographical features in the Flemish-speaking areas appear on the very attractive map compiled by A. de Ghellinck, M. A. Lefèvre and P. L. Michotte, on a scale of 1 : 500,000, and published by the *Institut Cartographique Militaire* in 1937.

The differences between the French and Flemish names of many places is small, involving such minor modifications as the change of *ck* to *k*, of *th* to *t*, of *y* to *ij*, of *s* to *z*, of *x* to *ks*, of *ou* to *oe*, of *ss* to *s*, of *heim* to *hem*, of *ae* either to *aa* or just *a*, of the translation of *Grand* to *Groote* and of *Petit* to *Kleine*, and of the elimination of the accent. Such changes are readily recognizable. Examples of these, with the official Flemish form given first, are : Kутtekoven (*Cuttehoven*) ; Rotem (*Rothem*) ; Wilrijk (*Wilryck*) ; Zemst (*Sempst*) ; Eksel (*Exel*) ; Broekom (*Brouckom*) ; Hoeselt (*Hoesselt*) ; Boorseme (*Boorsheim*) ; Lanklaar (*Lanclaer*) ; Balen (*Baelen*) ; Groote-Broegel (*Grand-Broegel*) ; Kleine-Spouwen (*Petit-Spauwen*) ; and Bree (*Brée*). Sometimes the difference is rather more marked ; thus Groot-Gelmen (*Grand-Jamine*) ; Val-Meer (*Fall-et-Mheer*) ; Borgloon (*Looz*) ; Temsche (*Tamise*) ; Goetsenhoven (*Gossoncourt*) ; Zootleeuw (*Léau*) ; Oost-Vlaanderen (*Flandre-Orientale*) ; Scherpenheuvel (*Montaigu*) ; and Zuid-Willems Vaart (canal) (*Canal de Maastricht à Bois-le-Duc*). Wherever the difference between the two forms is at all marked, both are included in the Index, with a cross-reference from the non-official form to the full entry under the official form.

CHAPTER I

THE PHYSICAL BACKGROUND

INTRODUCTION

BELGIUM may be divided into several regions, each of which possesses to a greater or less degree the distinctive characteristics which make such a division justifiable (Fig. 1). The Kempen, in the north-east of the country, forms one of the most individual and clearly defined of these regions. It comprises essentially the most westerly of the heathlands which cover a considerable part of the North European Plain (Fig. 2). Though differing in detail, these heathlands have many features in common: poor soils developed on superficial sheets of coarse sand and gravel; a considerable extent of bare sand, often blown into dunes; a vegetation cover of the characteristic heath associations; and areas of moorland which have developed where water-logging has been caused by an underlying impervious layer or "hard pan" of iron oxide. Reclamation and improvement of these heathlands have proceeded steadily, if slowly; thus some parts carry pine plantations, while other areas now form either arable land on which may be grown rye, potatoes and sugar-beet, or reasonably good pasture. But the extent of almost unproductive heath is still quite considerable. The Kempen, however, is unique among these heathlands in that it is underlain by exploitable deposits of coal, and it is a growing industrial region. Its natural aspect therefore in some places has been considerably modified; these modifications, in fact, are the theme of this survey.

The Kempen region extends for about a hundred kilometres from

west to east and for about fifty kilometres from north to south.¹ In the east, a steep slope marks the change from the Kempen plateau to the Meuse valley. In the west, the region stretches as far as the reclaimed polders of the Scheldt estuary, although the influence of the city of Antwerp upon the surrounding district for about fifteen kilometres justifies the delineation of a separate unit—*la Région anversoise*. The southern boundary is indicated by the line of the rivers Rupel, lower Dyle and Demer (Fig. 16). The heathlands continue northward across the frontier between Belgium and the Netherlands into the provinces of North Brabant and Limburg.

It will be noted that in the quantitative distribution maps, based on Fig. 4, the area depicted is more extensive than this region so defined. This is intentional, for the maps as a result often emphasize with striking clarity the distinctiveness of the Kempen, by reason of its marked contrasts with the marginal Scheldt polderlands to the west, the plateaus of Brabant and Hesbaye to the south, and the Meuse valley to the east.

Administrative Units of the Kempen

The Kempen occupies the greater part of the two north-eastern provinces of Antwerpen and Limburg, together with a small part of northern Brabant (Fig. 3). The *arrondissement* and *commune* boundaries within the Kempen and its border lands are shown on Fig. 4. Most of the communes have been in existence for centuries; a few, however, were created in the nineteenth or even in the twentieth century. In the area covered by Fig. 4, twenty present-day communes were not in existence in 1846; two listed in the 1846 Census have been absorbed by neighbours; and thirty-six others show appreciable changes of

¹In 1866, Professor C. Malaise in *Agriculture: Recensement Général* for that year (p. xix), estimated that the area of the Kempen region was 4,497.52 square kilometres. The method by which he obtained such an apparently remarkable degree of accuracy is not known, but his result agrees well with a figure, estimated in more general terms, of 4,500 square kilometres. This latter estimate is used generally in the text, as, for example, when it is stated that a certain proportion of the Kempen is under heath. More usually, in view of the nature of the statistical returns, it is necessary to express proportions in terms of the areas of the two north-eastern provinces of Antwerpen and Limburg, which total 5,268 square kilometres.

area. Until the middle of the nineteenth century the commune centres were just isolated villages in favoured valley situations. They were separated by tracts of heathland, on which the inhabitants of the respective communes had jealously-preserved pasture and fuel rights.

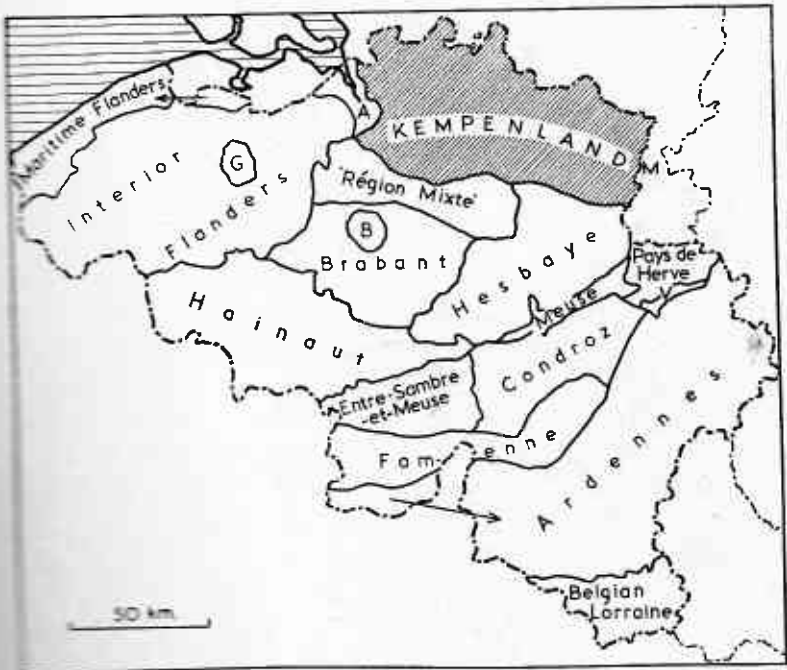
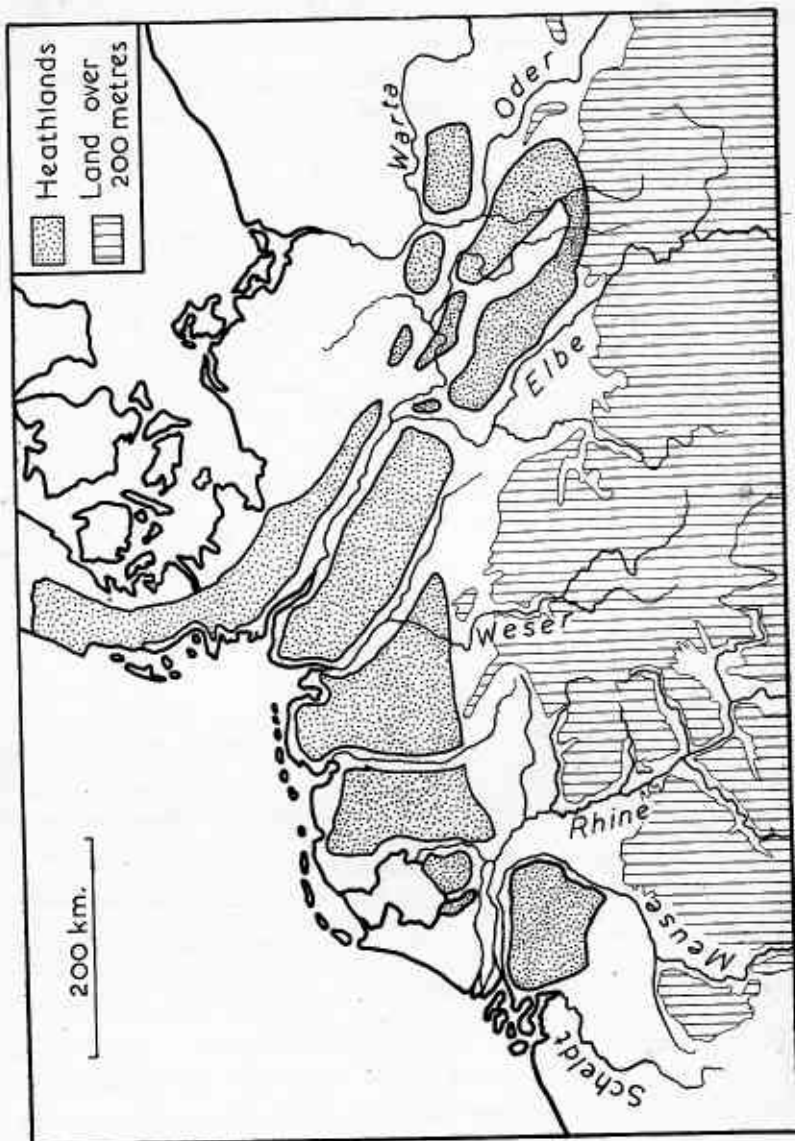


FIG. 1. THE NATURAL REGIONS OF BELGIUM

Based on J. Halkin, *Atlas Classique*, Plate 18 (Namur, 1934).

The abbreviations are as follows: A. Antwerp district; B. Brussels district; G. Ghent district; M. Meuse valley; V. Verviers district. The area denoted as "Région mixte" comprises a number of small districts—in the west "Petit Brabant," in the centre the "Campine brabançonne" (but not a part of the Campine proper), and in the east the Hageland.

When boundaries had to be delineated at the times of the cadastral surveys, they were frequently drawn as straight lines more or less equidistant from two large villages; such, for example, are the boundaries between Lommel and Overpelt, between Houthalen and Melle, and between Houthalen and Genk. Some of these



boundaries, it is true, follow streams or canals, others roads, but many are quite arbitrary. It is of interest to note the shapes of communes in the extreme east. In nearly every case, the eastern boundary follows the international frontier along the Meuse. The chief town lies some five to eight kilometres west of the river, so avoiding those parts of the valley liable to floods, except of course in the case of bridge-towns actually on the banks, as, for example, Maaseik. Each commune is elongated westwards, and so forms a long narrow unit. Vucht, with an area of only 3.95 square kilometres, stretches for nearly four kilometres westward from the Meuse on to the Vuchterbosch Heide, but for much of its length it is less than a kilometre in width. The largest of this group of Meuse valley communes is Mechelen (33.8 square kilometres). (old Meuse)

The areas of the Kempen communes differ considerably. The large ones in the heathlands stretch in a broad band from Esschen and Kalmthout in the north-west to Genk and Zutendaal in the south-east. They include some of the biggest communes in Belgium: Mol (114.2 square kilometres), Geel (108.5), Lommel (102.2) and Genk (87.8). Much of ~~the~~ still consists of sparsely inhabited heathland. The smaller ~~communes~~, notably the group in the north-east of Maaseik ~~communes~~, have only limited areas of heathland. In the western part of Antwerpen province, too, the communes are small, because the ~~large~~ villages which form the commune centres are more numerous, a ~~reflection~~ of the greater density of population in this area.

GEOLOGY AND STRUCTURE

The Basement Rocks

The main features of the solid geology of Belgium are shown in a simplified form on Fig. 5. In late Carboniferous times, ranges of ~~low mountains~~ were uplifted across central Europe by widespread

FIG. 2. THE HEATHLANDS OF THE NORTH EUROPEAN PLAIN

The Kempen, which is continuation into the Netherlands in Limburg and ~~the~~ the most westerly area of heathland in the North European

earth-movements. In Belgium, as in other parts, these Hercynian folds had an approximate west-east trend, forming a series of more or less parallel anticlines and synclines. The most northerly anticline traceable in Belgium is now represented by a core of Cambro-Silurian

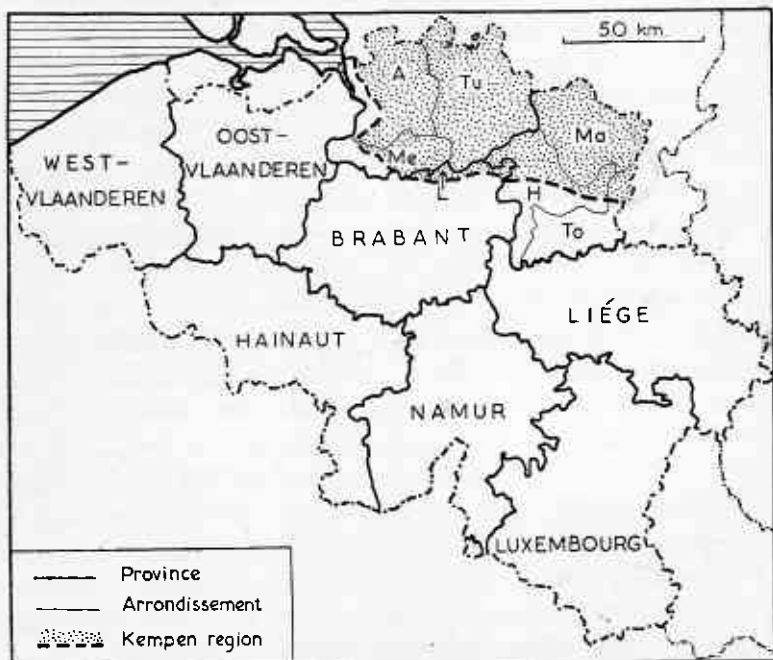


FIG 3. ADMINISTRATIVE DIVISIONS OF BELGIUM

Based on the *Carte de Belgique—1 : 320,000, Comportant la Subdivision Administrative du Territoire* (Bruxelles, 1938).

The *arrondissements* which lie wholly or partly in the Kempen region are indicated by abbreviations, as follows : A. Antwerpen ; H. Hasselt ; L. Leuven ; Ma. Maaseik ; Me. Mechelen ; To. Tongeren ; Tu. Turnhout.

rocks, revealed in places in the valleys of Brabant and Hesbaye, and is known to geomorphologists as the Brabant anticline. To the north of this, the basement rocks dip northward and north-westward to form the Kempen syncline ; they now lie deeply buried beneath a covering of later sedimentary rocks. Much detail is available concerning these

basement rocks in both Belgium and the Netherlands, because numerous deep borings have been put down to prove the existence of coal seams in the Upper Carboniferous strata. They show that the

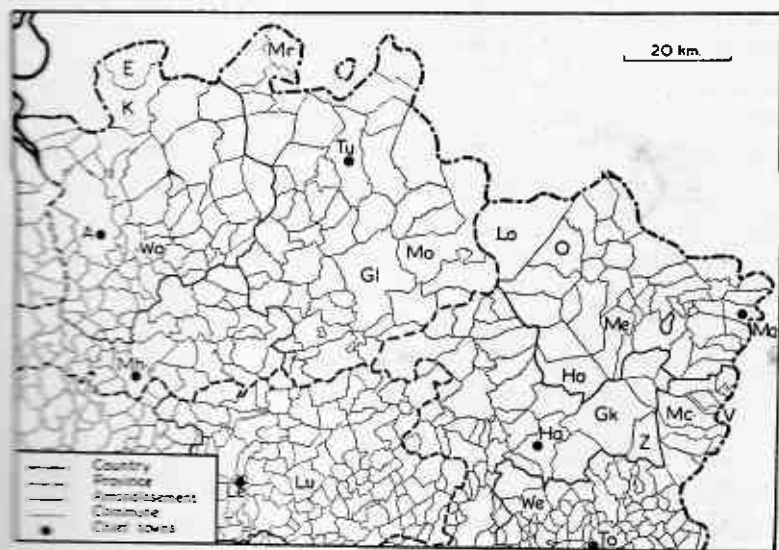


Fig. 4. ADMINISTRATIVE UNITS OF NORTH-EASTERN BELGIUM

Based on the Carte de Belgique—1 : 320,000, Comportant la Subdivision Administrative du Territoire (Bruxelles, 1938).

The chief towns of the arrondissements are indicated by abbreviations, as follows : **E.** Eindhoven ; **Ha.** Hasselt ; **Le.** Leuven ; **Ma.** Maaseik ; **Mh.** Mechelen ; **Tu.** Turnhout. The communes mentioned in the text on pages 10 and 11 of the Table on p. 88 are indicated as follows : **E.** Eindhoven ; **G.** Geel ; **Ho.** Houthalen ; **K.** Kalnhouth ; **Lo.** Lommel ; **Lu.** Luik ; **Me.** Mechelen (Meuse Valley) ; **Me.** Meeuwen ; **Mol.** Mol ; **O.** Overpelt ; **V.** Vucht ; **We.** Wellen ; **Wo.** Wommelgem ;

surface of the basement rocks dips steadily to the north-west; it is at a depth of about 450 to 475 metres below the surface near the eastern edge of the Kempen plateau, at about 500 to 525 metres in the south-west, and at about 600 metres to the west of Turnhout.

The Mesozoic and Older Tertiary Rocks

The North Sea and its adjoining land areas have been a region of depression for long periods in past geological time, and so have been subjected to repeated and widespread marine transgressions. In Cretaceous times, the sea covered much of what is now western Europe, and an extensive cover of chalk rocks was laid down. This was removed from most of Belgium by later erosion, and so the chalk survives only near Mons and in the Hesbaye and Herve regions near Liège. In early Tertiary times (Eocene and Oligocene), another marine transgression covered the Netherlands, most of Belgium and a large part of the Paris Basin. The resultant deposits are to be found over much of central Belgium; those of Eocene age include the Flanders Clay on the Flemish plain and the sands of Brabant and Hesbaye, while Oligocene sands and clays form a narrow interrupted belt along the southern border of the Kempen, and occur more extensively to the east in southern Limburg.

The Newer Tertiary Rocks

In late Tertiary times (Miocene and Pliocene) came the last of the major marine transgressions, and the sea again extended southwards over much of what is now Belgium, and even into northern France. The Lower Pliocene sands and gravels deposited during this period of transgression form a thick continuous mass, covering the whole of the Kempen and its continuation into North Brabant and Limburg in the Netherlands. Usually these Pliocene sands are themselves covered with later drift deposits, but occasionally they do appear on the surface. For example, the Diestian sands, heavily iron-stained, compacted into sandstone, and with pebble-beds among them, form low rounded hills in the neighbourhood of Diest (see p. 23 and Fig. 11). To the south of the Kempen, most of the Pliocene cover has been removed by later erosion, and its former extension is indicated only by the survival of cappings on the low hills in Flanders, Brabant and even as far south as Artois in France.

Towards the end of Pliocene times began the steady shift northward of the coastline, which was primarily the result of a widespread

tilting movement. Areas to the south of a line indicated approximately by the present Netherlands frontier were uplifted, with the result that the Lower Pliocene cappings on the hills of Artois now lie at a height of about 150 metres. To the north of this axis the tilting

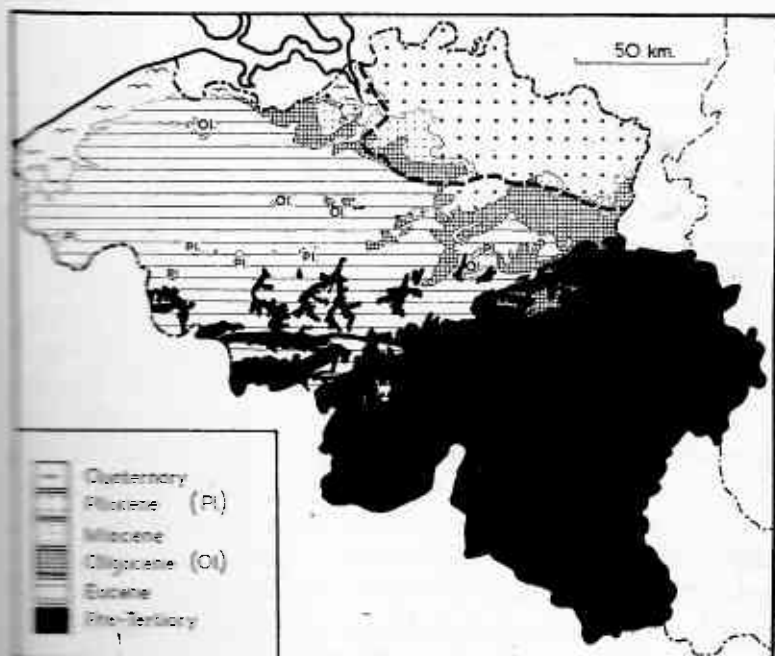


FIG. 5. GENERALIZED GEOLOGICAL MAP OF BELGIUM

Based on J. Halkin, *Atlas Classique*, Plate 16 (Namur, 1934).

The heavy dotted line indicates the approximate southern and western margin of the Kempen.

movement was downwards, so that in the neighbourhood of Utrecht in the Netherlands the Pliocene deposits occur now at some 350 metres or more below present sea-level.

Quaternary and Recent Deposits

Long continued deposition by rivers in Quaternary and Recent times has covered most of the Tertiary sediments with newer Pleistocene and Recent deposits, to considerable depths in the Netherlands, but more

superficially in Belgium. The most important fact about the present physical geography of this part of western Europe is that here converge the Rhine, Meuse (Maas) and Scheldt (Schelde, Escaut), which together drain a large part of west-central Europe. These rivers have jointly built up a great estuarine region, the recent physical history of which is most complex, partly as the result of the Quaternary glaciation.

The Kempen has been more particularly affected by several changes in the course of the Meuse. It is probable that this river once flowed eastwards beyond the position of Liège to the former Rhine, then it was diverted westwards across the Kempen, and later still it developed its present northern course, followed by a great bend westwards near Mook, so flowing parallel and adjacent to the Waal into the Hollandsch Diep and the North Sea. These various changes of the Meuse have not been confined merely to the actual course of the river, but have also involved alterations in base-level. At times, notably when the melting of the ice-sheets at the close of the Quaternary glaciation returned water to the seas and therefore produced a higher base-level, the response of the river to its resultant gentler gradient was extensive deposition, because of the reduction of its load-carrying capacity. At other times, largely as the result of tilting which raised the land areas south of an axis along the Netherlands frontier, the gradient of the river and therefore its erosive capacity were increased. The result has been the formation of a relatively steep-sided valley, marking the eastern edge of the Kempen, along which lies a series of terraces.

The results and inter-relations of these erosional and depositional processes of the Meuse have been analyzed in considerable detail by Mlle M. A. Lefèvre,¹ who distinguishes two main types of river terrace. The terraces which form part of "degradational" or "erosional" flood plains occur where the surface has been progressively lowered by the eroding river, as its channel migrated over the flood plain. This has produced an almost level surface, on which lies only a thin superficial veneer of alluvium. The "aggradational" or

¹ M. A. Lefèvre, "La Basse-Meuse : Etude de morphologie fluviale," in *Société belge d'Etudes géographiques, Mémoire I* (Louvain, 1935).

"depositional" flood plains, on the other hand, were built up where the river was unable to carry its load because of a marked decrease of gradient. Mlle Lefèvre applies these principles to the lower Meuse basin, and distinguishes four "*unités cycliques*" or "fluvial complexes." Cycle IV, the oldest of these, is not represented in the Kempen, but it may be mentioned because of the evidence it affords concerning changes in the course of the Meuse. It is indicated by a series of "flats" at a height of about 180 metres above sea level; they are traceable in the Condroz and Herve regions to the south of the present Meuse valley, in Dutch Limburg, and again strung out along a west-east line to the south of Aachen. Mlle Lefèvre suggests that this 180 metre level represents the valley of a former course of the Meuse, when it flowed eastwards to join the Rhine, incised in an old erosion surface which has a height of about 220 metres.

The Meuse at a later date was diverted northwards, then westwards, and finally again northwards to its present position, producing in the course of these changes three further "fluvial complexes." Each of these is represented by a "degradational flood-plain" upstream, indicated on Fig. 6 by the areas marked IIIe, IIe and Ie (following Mlle Lefèvre's notation), and by an "aggradational" flood-plain further downstream, shown as IIIr, IIr and Ir.

The "degradational flood plain" of Cycle III is represented in Belgium by small areas of terrace cut into the 180 metre level on either side of the Meuse between Liège and Maastricht, in the extreme south of Fig. 6. The corresponding "aggradational flood plain" is the "*plaine de cône alluvial*," or "alluvial fan," which covers most of the central and eastern Kempen (IIIr). This was laid down in Pleistocene times by the Meuse as it left the Ardennes uplands and so suffered an abrupt change of gradient. Its great load of coarse sand and gravel, mainly derived from the Ardennes, was deposited in the form of a "fan" with its apex near Lanaken about seven kilometres north-west of Maastricht, at a height of 103 metres above sea-level. The approximate limits of the eastern part of this "fan" are indicated on Fig. 6; it is bounded distinctly on the east by the Meuse valley and on the south-west by the Demer valley, but slopes very gently northward

into the Netherlands. The word "*cône*," as used by the Belgian geologists, is in some ways misleading, as the form of these deposits is very unlike that of a "cone of deposition," such as is found where a heavily laden, rapidly flowing stream enters the flat or gently sloping floor of a main valley; in this case the cone has a convex surface. By contrast the Meuse "*fan*" consists of an almost horizontal sheet, varying in thickness from ten to fifteen metres at the apex and from five to ten metres at the Dutch frontier, laid down as the Meuse gradually altered its course in a series of slowly moving curves.

Cycle II also was responsible for land-forms which are represented in the Kempen, although not on such a large scale as Cycle III. The "*degradational flood plain*," shown on Fig. 6 as *Ile*, forms a terrace along the Meuse valley between Maastricht and Maaseik, at about 40 to 45 metres above sea-level, and continues north-westward to the neighbourhood of Bocholt. The "*aggradational flood plain*" of this second cycle is shown as *Iir*; it forms a great area of gravel and coarse sand to the north-east of the *Iir* surface of the Kempen plateau. There is little marked change of slope between the *Iir* and *Ile* flood-plains, except from Bocholt to Neeroeteren, where the *Ile* terrace appears. These deposits continue northward across the Netherlands frontier into the Peel, an extensive area of still largely unreclaimed peat bog.

Cycle I represents the modern flood plain of the present Meuse and its tributaries. The "*degradational plain*" (*Ie*) forms the present narrow valley floor, extending from above Maastricht as far down-stream as Neerharen. The present "*aggradational flood plain*" (*Ir*) is represented, as far down-stream as Venlo, by the valley floor

FIG. 6. THE TERRACES OF THE LOWER MEUSE VALLEY

Based on M. A. Lefèvre, "*La Basse-Meuse : Etude de morphologie fluviale*," in *Société belge d'Etudes géographiques, Mémoire I* (Louvain, 1935).

The abbreviations *Ie* to *IIIr* are explained on pp. 11-14. Commune centres are indicated as follows : *Bi.* Bilzen ; *Bo.* Bocholt ; *Ei.* Eigenbilzen ; *G.* Genk ; *He.* Herderen ; *L.* Lanaken ; *Mak.* Maaseik ; *Mat.* Maastricht ; *Ne.* Neeroeteren ; *Nh.* Neerharen ; *Op.* Opitter ; *St.* Stamproy (Netherlands) ; *To.* Tongeren ; *Vr.* Vronhoven.

The international frontier is indicated by a heavy pecked line, except where it follows the river Meuse.

Only the terraces on the left bank (west) of the Meuse are shown.



between the edges of the IIe terrace, but below this it opens out into the joint flood plain of the Meuse-Rhine distributaries, which forms a large part of the surface of the Netherlands. The Ir flood plain is represented in the northern Kempen by the alluvium-covered valley floors of the streams draining northwards and north-eastwards to the Meuse. The alluvial deposits laid down on the Ir flood plain are usually grouped under the names "Holocene," "Recent," or "Modern." These also include in the Kempen the sediments deposited by the tributaries of the Demer and Nethe to the south, the fine silts laid down in numerous small lakes, and the peat which is forming in marshy depressions on the plateau.

Summary

The Kempen area is covered by a superficial deposit of Quaternary and Recent sands, gravels and alluvium, overlying a thick mass of Pliocene and other late Tertiary sands. Below these are Oligocene and Eocene clays, which in turn overlie a varying thickness of Mesozoic rocks, mostly of the Cretaceous series. Below these again are the Upper Carboniferous rocks, containing Coal Measures, then, to a great depth, Lower Carboniferous rocks, equivalent to the Mountain Limestone of Britain, then Devonian slates, and finally the ancient Cambrian-Silurian rocks.

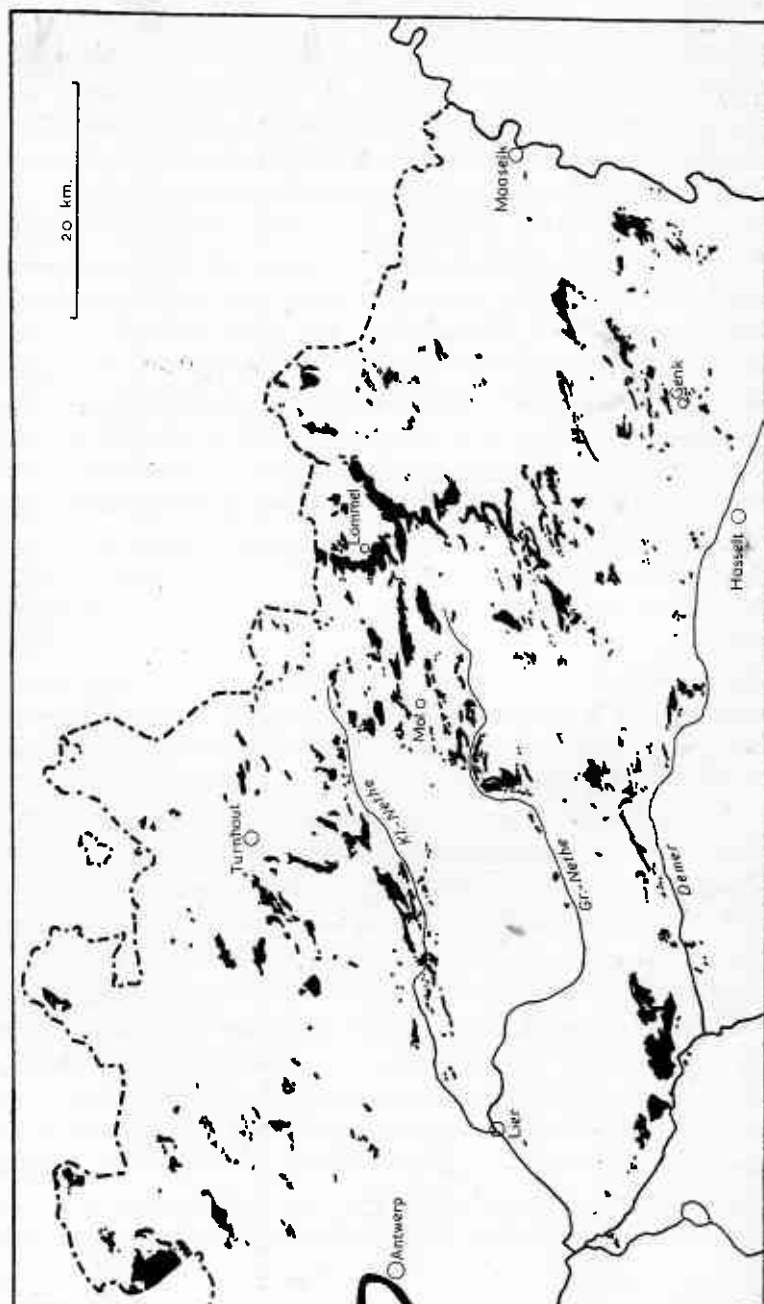
THE SANDS

The surface features of the Kempen are dominated by the great overlying sheet of sand and gravel. From the Meuse valley to the Scheldt polder region, the soil consists almost entirely of sand, except for occasional patches of gravel, a thin layer of alluvium in the valley bottoms, and some peat in the higher depressions. Because of the permeable nature of these sands, there is usually an absence of surface water, and the water-table occurs at some depth, except where an impervious "pan" causes water-logging. The podsol-type soils developed on the sands are dry, partly because of their low water-holding capacity and partly because they are subject to rapid evaporation from the friable surface. They suffer constant leaching by

the swiftly percolating rain-water, and this results in the removal of the soluble bases, especially calcium. The soils are thus deficient in nutrients and lack fertility. Only a small amount of humus forms, derived from the matted fibrous remains of mosses, lichens and woody heath plants, and as this is not neutralized it remains highly acid.

The shallow railway cuttings to the west of Genk show clearly the typical soil profile of the heathland. On the surface there is a layer of dry, compact and rather acid peat, varying in thickness from three to twenty centimetres; in depressions this peat layer may be much thicker. Below it is a layer of sand, often stained a chocolate colour by humus compounds carried down by the acidified rain-water. This passes into yellow or white sand, interrupted occasionally by intercalated layers of grey, brown or white pebbles. Below this leached layer, at depths varying from forty to seventy centimetres, is a hard thin stratum. This impervious "pan" sometimes consists of humus compounds and sometimes of sand-grains or gravel, stained reddish-brown and cemented by the ferric salts deposited from the percolating solutions. Under this again are great thicknesses of unaltered sands and gravels. Near Neerpelt, in the north, the drainage ditches show a much thicker layer, sometimes as much as half a metre, of dark peaty soil, composed of raw acid humus mixed with some silt. Below this is a layer of leached sands, then the "pan," and below that the sands.

The surface sand layer is to be found at all levels, occurring both in form of smooth sheets and as undulating hills and dunes. There are great areas of nearly level heathland, mostly vegetated (see pp. 40-5), but this is interrupted by patches of bare sand, diversified by wind-ripples. Along the line of the Neerpelt-Mol railway, especially near Mol station, there are expanses of yellow, dazzling or greyish sand with an almost desert-like aspect, level but for wind-ripples. Rare tufts of spiky grass each have a tiny hillock of black loam drifted and accumulated around them. Vari-coloured pebbles, sometimes in thin continuous sheets, but more usually in patches. These pebbles are for the most part rounded and smooth, but there are occasional traces of faceting. The exceptional bareness of the heath and the sparsity of the vegetation cover in the Neerpelt-Lommel



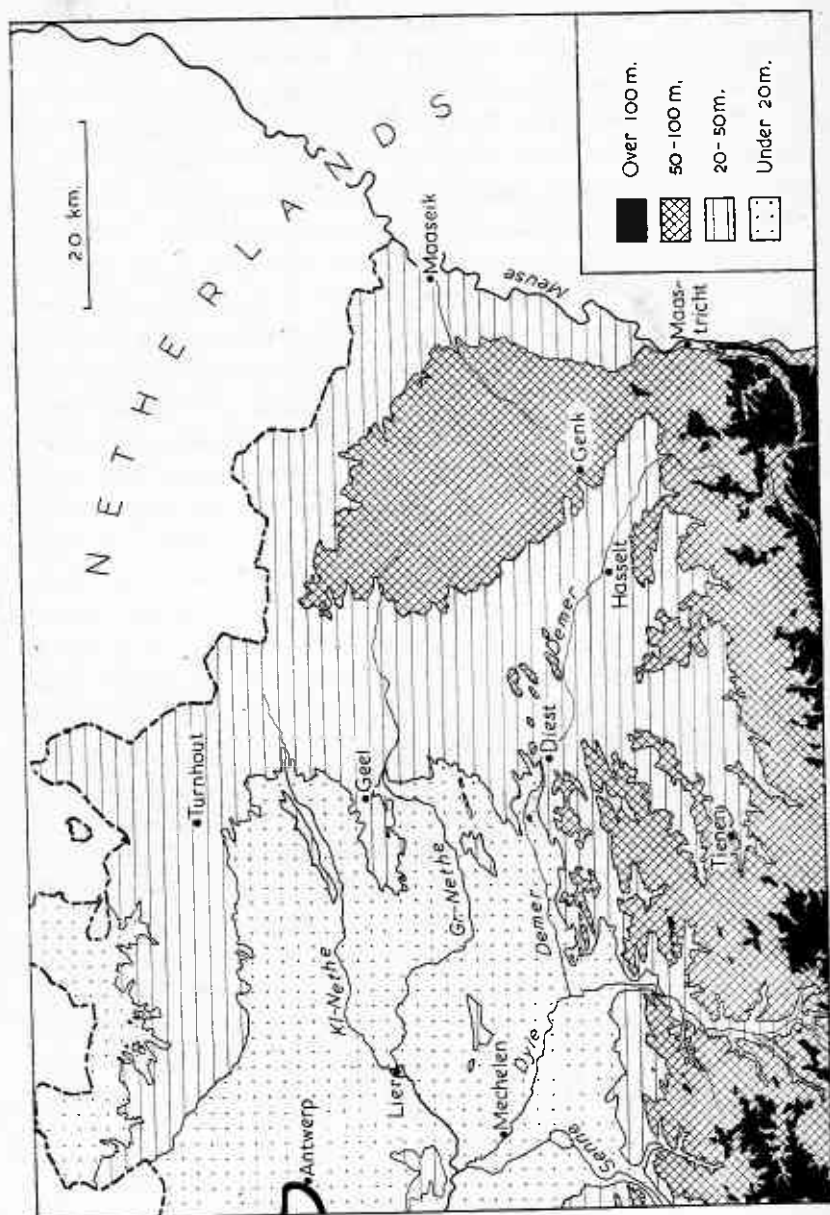
area are due in part to the several large chemical and zinc-refining factories (Fig. 69) ; their chimneys pour out clouds of heavy noxious smoke, which can at times be seen drifting slowly near ground level.

Over many parts of the Kempen, the sand has accumulated in gentle undulations. The distribution of these sand-hills is indicated on Fig. 7, which shows the general tendency of the dune areas to be orientated from south-west to north-east. The northern lines of sand-hills converge in the neighbourhood of Lommel, others are strung out near Genk. Most of the hills are vegetated, and are therefore "fixed" and stationary. Near Genk, for example, the Sint-Martensberg hills form low swelling mounds, separated by hollows, arranged in a confused and chaotic manner, with no specific orientation, and with little trace of the gentle windward slope, crest and steeper slip-face or leeward slope of the typical dune. They are closely vegetated with thick coarse grass and heath flora, and are in places planted with conifers. Surface sand appears only where footpaths wind between the dunes, or where there are rabbit-warrens. Occasionally, however, even the dunes fixed by vegetation have one side of bare sand, sometimes with an overhanging cornice of matted heather and grass roots ; one slope is therefore convex and vegetated, the other concave and of bare sand. These fixed dunes vary in height, from three to ten metres and exceptionally to fifteen or even twenty metres above the intervening hollows.

In places, however, the sand accumulates in forms approaching those of the migratory dunes of the Landes in south-western France, and of the dune-belts in Denmark and along the German Baltic coast, although on a very much smaller scale. Some of these dune areas owe their existence to the direct or indirect influence of man in the past : to the clearance of woodland, to the over-grazing of heath, to the lowering of the water-table as a result of the draining of intervening hollows and valleys, and to the working of sand-pits and gravel-beds. These moving dunes are to be seen to the west and south of Lommel (Fig. 69),

FIG. 7. AREAS OF SAND-DUNES IN NORTH-EASTERN BELGIUM

Based on the *Carte géologique de Belgique*, 1 : 160,000 (Bruxelles, not dated). The generalized areas of the sand-dunes are shown in black.



to the east of Helchteren and Houthalen, and to the north-east of Genk. They are usually some five to fifteen metres in height, and commonly show a grouping in long interconnected trails, with the axis of each dune more or less at right-angles to the prevailing wind, that is, from south-west to north-east, and with curving, almost crescentic, "wings." The horizontal movement is not great, because the unvegetated and therefore "unfixed" areas are small in extent. The movement of sand is within the dune area itself: the wind destroys, piles up, levels and hollows out, producing a chaotic and ever-changing relief.

The Kempen plateau is open and windswept, and where there is no friction by vegetation, the sand is in continual motion. It blows over the hedgeless roads that cross the heathlands to the north of the small town of Genk, so piling up against kerbs, against kilometre-posts, against lamp standards, even against the wheels of stationary cars. The sand moves ceaselessly from the dunes on to the paved surface of the Molenstraat, the road which bounds Genk on the north, and after a strong wind it has to be swept out of doorways. Again, to the north of Neerpelt there are districts which experience almost "Dust-bowl" conditions. In spite of the lines of poplar wind-breaks, which divide the land into squares, clouds of fine sandy dust blow continuously from newly ploughed fields, and the surface movement is arrested only by deep ditches which reach ground-water.

RELIEF FEATURES

The main features of the relief of the Kempen are shown on Fig. 8. The region may be conveniently described under three headings: (1) the Kempen plateau; (2) the plateau edge; and (3) the Kempen plain. The first two divisions, together comprising the plateau and its margins, lie mainly within the eastern or Limburg Kempen, known in Flemish as *de Limburgsche Kempen* and in French as *la Campine limbourgeoise*. The third division, the plain, slopes away northward into the Netherlands and westward to the Scheldt, and lies for the most part

FIG. 8. RELIEF FEATURES

Belgium: Carte oro-hydrographique, 1 : 500,000, produced by M. A. Lefèvre, and P. L. Michotte (Bruxelles, 1937).

in the western or Antwerpen Kempen (*de Antwerpsche Kempen* or *la Campine anversoise*). These two parts of the Kempen, demarcated more or less by the fifty-metre contour, differ appreciably. The Limburg Kempen is characterized by much true heathland, with

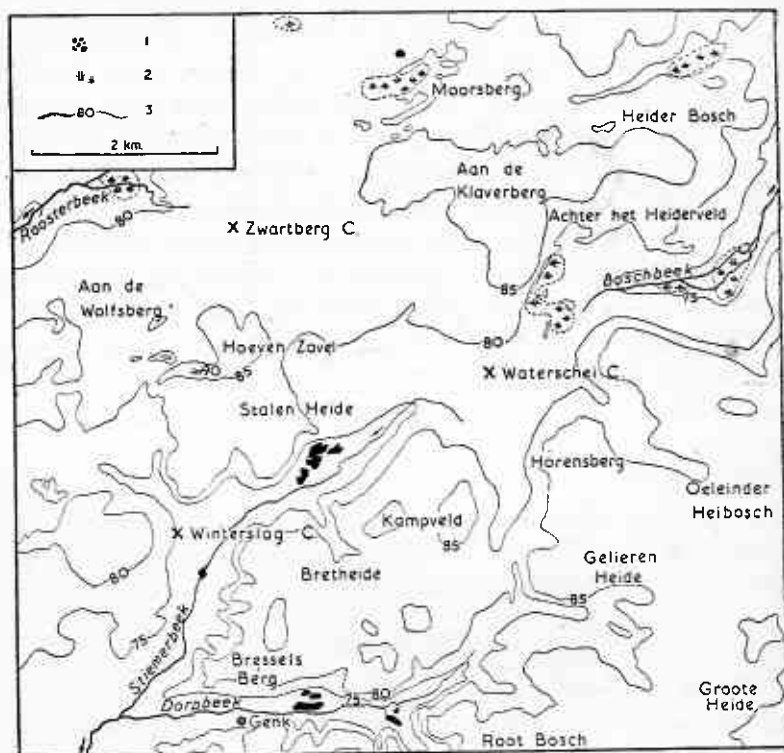


FIG. 9. THE KEMPEN PLATEAU, TO THE NORTH OF GENK

The figures in the key are as follows: 1. lakes; 2. marsh; 3. contour lines. The heights on this and succeeding maps are given in metres, with contours drawn at five metre intervals. The collieries are indicated by a cross and the abbreviation C. The areas of marsh are enclosed by pecked lines. The small shaded circle indicates the centre of the commune of Genk.

The location of this part of the plateau is indicated on Fig. 16.

hungry sandy soils supporting but scanty agriculture, with extensive plantations of conifers, and with a sparse population, except where settlements have grown up near the collieries. The character of the

Antwerpen Kempen changes gradually westward towards the city of Antwerp; there is progressively less heathland, more deciduous trees, more fenced fields, more market-gardening and dairy-farming, and more numerous villages and small towns, indicating the greater density of population.

(2) *The Kempen Plateau*

As already described, the plateau is covered to a depth of ten or fifteen metres with the coarse sands and gravels of the Meuse "fan." Its altitude exceeds that of the plain to the west and north by an amount varying from twenty to sixty metres, so that it cannot be the result of glacial deposition alone. Some Belgian geologists consider that the plateau is partly, at any rate, of tectonic origin, and that it is the result of an anticlinal "wrinkle" trending approximately west to east along a line to the north of Liège. It may be that its eastern and northern edges are outlined by faults, which caused the sinking of the land to the east and north. But the general consensus of opinion is that the plateau represents a deposition surface, surviving between the valley of the Demer and its tributaries to the south-west, and the Meuse valley to the east, both of which have been entrenched not only into the glacial sands and gravels, but also into the underlying Tertiary rocks.

The plateau itself has been subjected only to very slight stream erosion, because of its broad, rather indeterminate watershed, its gentle slopes and low gradients, and its extremely permeable soil and therefore negligible run-off. The only marked feature is the gently inclined cross-belt of the Stiemerbeek and Boschbeek valleys, between which lies the almost level watershed, known as such by its Flemish name of "Waterschei." Two areas, to the north and north-west of the plateau, show the characteristic features of the plateau (Figs. 9, 10). These are the uniformity of the surface, interrupted only by faint rolling mounds, known as *bergen*, rising but a few metres above the general level and alternating with shallow marshy depressions. For the most part, the landscape is one of gently undulating heathlands, with a *monotony* which is only slightly relieved by coniferous

plantations, by shallow reed-covered lakes, and by an extraneous element, the high pyramidal waste-dumps of the collieries.

(2) *The Plateau Edge*

To the west and north, the plateau descends inconspicuously to the plain. To the south-west and east, however, it is more sharply defined

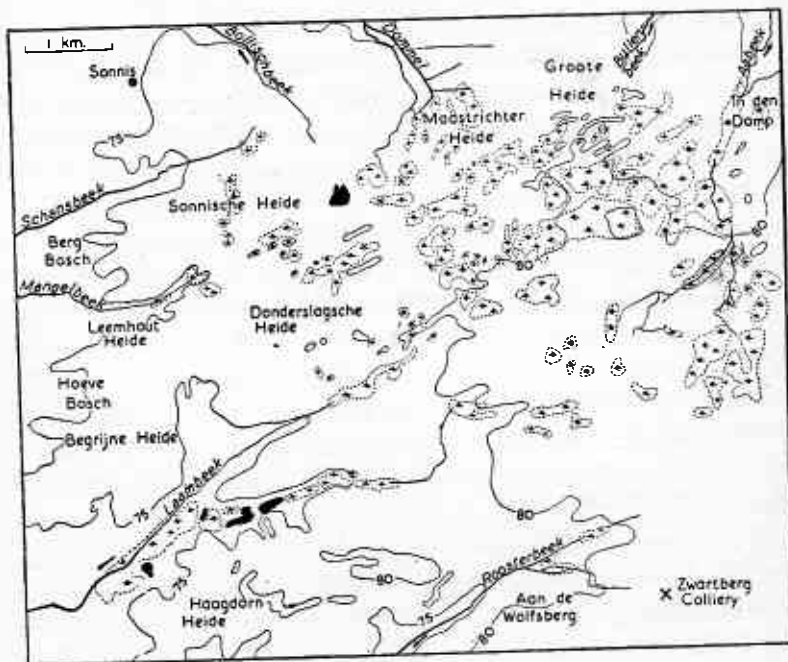


FIG. 10. THE KEMPEN PLATEAU, TO THE NORTH-WEST OF GENK

For key to the symbols, see Fig. 9.

The location of this part of the plateau is indicated on Fig. 16.

by the valleys of the Demer and of the Meuse respectively. The Demer has eroded a "furrow" between the northward sloping surface of the plateaus of Brabant and Hesbaye, and the edge of the Kempen "fan." Its right bank tributaries have cut back deep valleys into the plateau, leaving interfluvies orientated more or less from north-east to south-west. These interfluvies have been worn down gradually into

their present rounded forms, and transverse valleys have developed, so dividing them into individual summits. These transverse valleys are now usually streamless, because of the lowering of the water-table in the more deeply eroded valleys of the Demer and its main tributaries, together with the great permeability of the sandstone. The Veldbeek, for example, which joins the Demer just above the town of Diest,

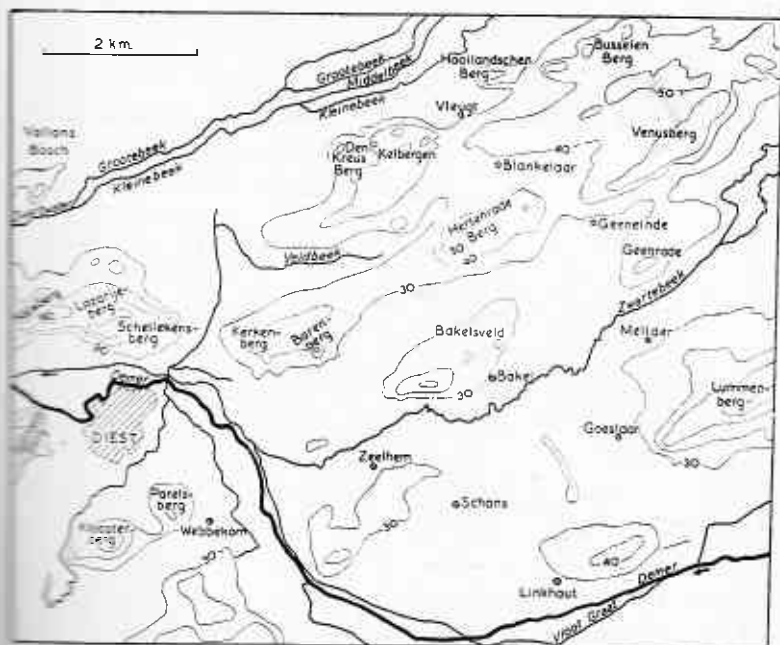
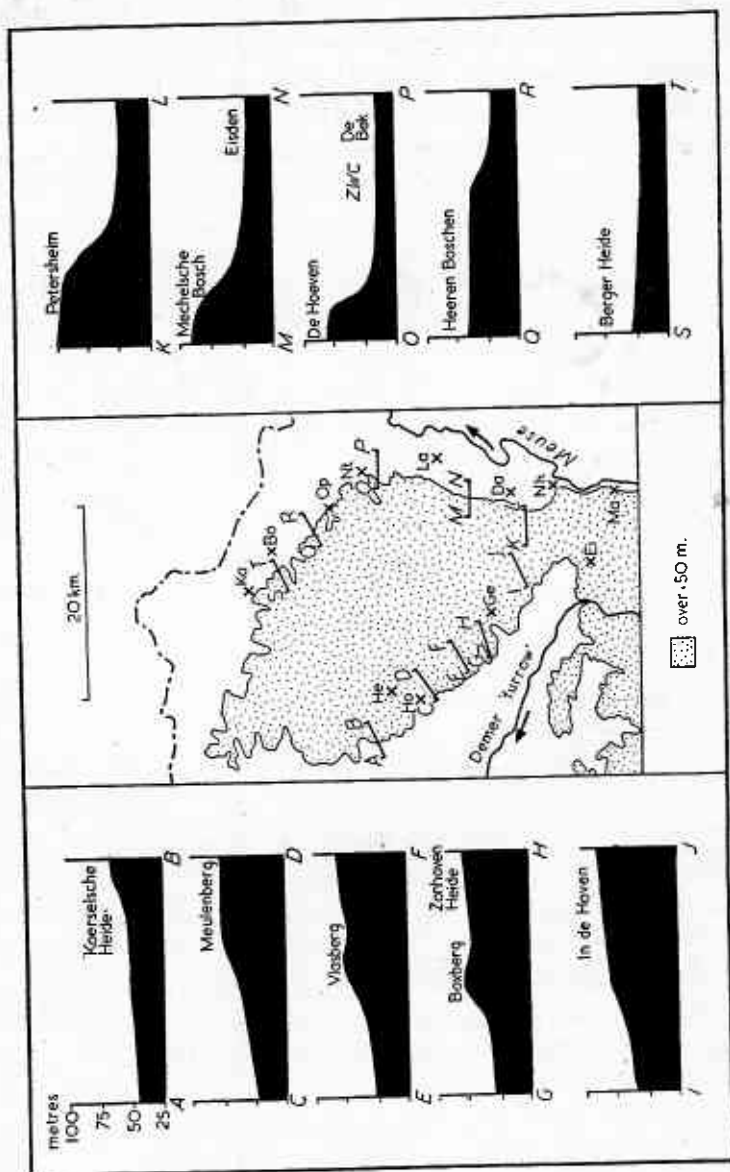


FIG. 11. THE DIESTIAN HILLS

The contours are drawn at ten metre intervals. The built-up area of the town of Diest is shaded.

marked in the past the longitudinal depression which, now streamless, continues the line of the river valley to the north-east (Fig. 11).

The surviving hills of compacted Pliocene sandstone lying beyond the edge of the plateau appear most strikingly in the neighbourhood of Diest, where they are in fact known as the Diestian Hills (Fig. 11). Parallel lines of these hills run more or less from north-east to south-west, their rounded summits separated by broad open valleys, although



occasionally, as near Linkhout, individual hills stand quite isolated. The summits of these *bergen* rise from ten to forty metres above the Demer valley; the highest, the Lazarijeborg, attains a height of sixty-six metres above sea-level.

To the east and south-east of the Diestian Hills, the edge of the plateau is defined by a marked change of slope, the "*rebords d'érosion*" (literally "erosion edge"), as it is termed by Belgian geologists (Fig. 12). This is first traceable with some degree of definition near Helchteren and Houthalen, and then it trends south-eastward as far as Eigenbilzen, overlooking the Demer valley to the south-west. This part of the plateau edge is much embayed by the valleys of the Demer's numerous right-bank tributaries, between which low spurs and isolated knolls have survived. To the north-west of Genk, for example, the Wlasberg (75 metres above sea-level) and the Boxberg (78 metres) swell gently from spurs projecting to the south-west from the plateau (Fig. 12). Near Eigenbilzen, at the head of the Demer "furnow," the steep erosion slope disappears, for a narrow "neck" of plateau just exceeding a hundred metres above sea-level links the Kempen with the plateau of Hesbaye to the south (Fig. 8); this "neck," in fact, formed the major obstacle to the construction of the Albert Canal.

The Kempen plateau in the east overlooks the Meuse valley, bounded by another "erosion edge"; Figs. 13 and 14 depict two examples of this. The first lies to the south in the neighbourhood of Daalgrimbic; from the surface of the plateau at over ninety metres above sea-level, the edge descends impressively to the river terrace at a height of forty-eight metres. This plateau edge is for the most part remarkably continuous; slight valleys and embayments do indeed cut back into the plateau, leaving spurs such as the Langenberg, but these interruptions are not so pronounced as those along the south-western margins.

FIG. 12. PROFILES OF THE EDGE OF THE KEMPEN PLATEAU

The commune centres are indicated as follows: Bo. Bocholt; Da. Daalgrimbic; E. Eigenbilzen; Ge. Genk; He. Helchteren; Ho. Houthalen; Ka. Kaulille; L. Linkhout; Ma. Maastricht; Nh. Neerharen; Nt. Neeroeteren; Op. Opieter; Z.W.C. Zuid-Willems Canal.

The Vertical Exaggeration is ten times.

The northern example (Fig. 14) is near Neeroeteren, where the eastern edge of the plateau changes direction and runs north-westward (Fig. 12); this change is possibly due to a fault. The valley of the Boschbeek here cuts deeply into the plateau, leaving a prominent spur projecting to the north-east. The plateau edge near X on Fig. 14 descends from the general level at about seventy-five metres to the Meuse terrace at forty-five metres, with an average gradient of approximately one in nine. The steep slope is, nevertheless, negotiated by two single-track railways, one from Hasselt to Maaseik on the banks of the Meuse, the other from Asch to Eisden colliery.

The edge of the plateau can be traced north-westward from Neeroeteren; its foot is followed closely by the Zuid-Willems Canal. Near Opitter, the edge slopes down from seventy-five to fifty metres, with an average gradient of about one in twelve. Further to the north-west, however, the edge becomes less and less marked, and beyond Bocholt the plateau slopes imperceptibly into the plain to the north.

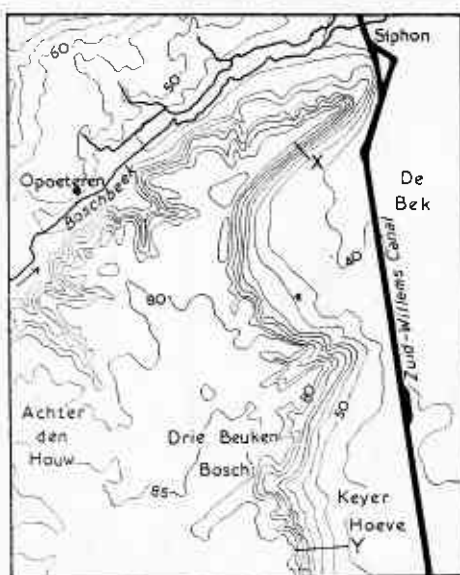
(3) *The Kempen Plain*

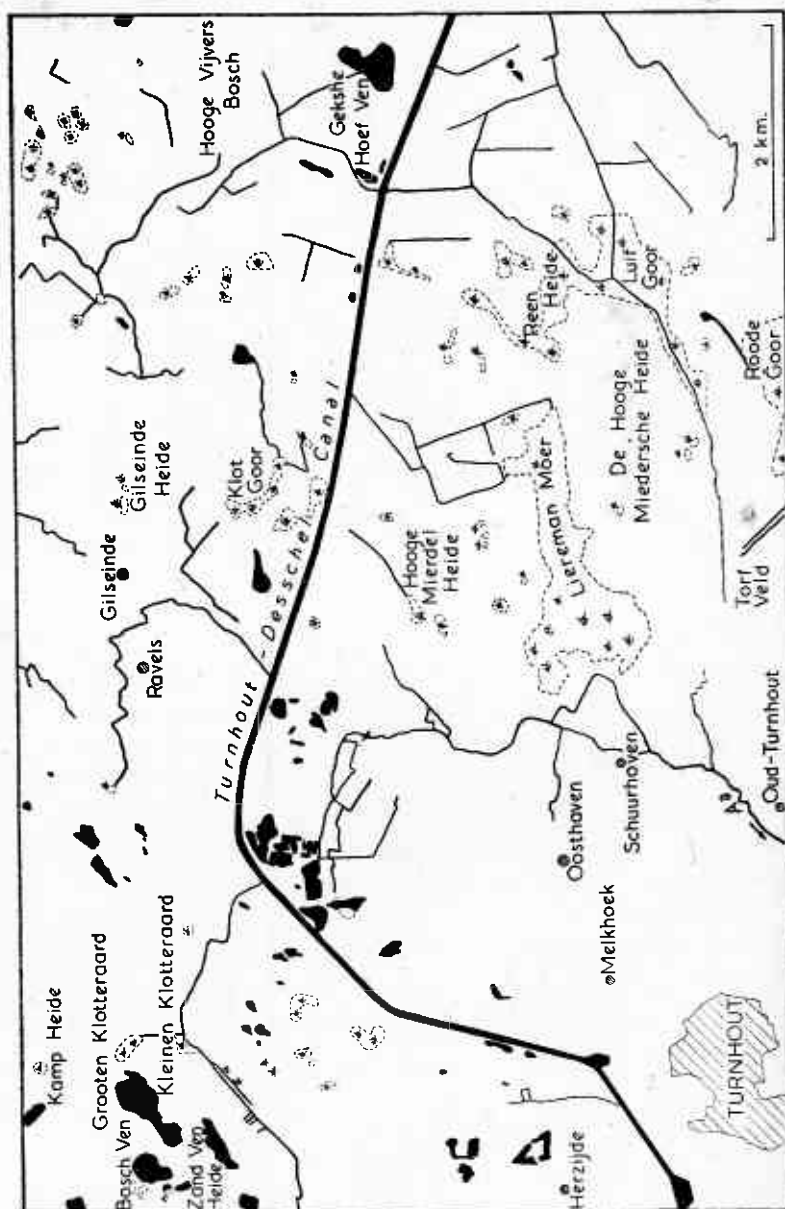
The plain differs from the plateau only in altitude, for the latter sinks gently northward into the Netherlands and to the west towards the Scheldt polder-lands. This general slope is interrupted by a faintly undulating bulge of land, rather more than twenty metres above sea-level, which projects to the north-west beyond Turnhout, forming a watershed between the south-flowing Nethe and the many streams which drain northward into the Netherlands and so to the lower Meuse (Fig. 8). It is almost impossible to say where the plateau ends or the plain begins, for each has the same general characters; the fifty-metre contour might be taken as a somewhat arbitrary line of demarcation.

The plain is rarely absolutely level, for it is interrupted on the one hand by low sand-dunes, on the other by the gentle slopes of the river

FIGS. 13, 14. THE EDGE OF THE KEMPEN PLATEAU NEAR DAALGRIMBIE (ABOVE)
AND NEAR NEEROETEREN (BELOW)

The contours are drawn at five metre intervals. The lines at X and at Y indicate the lines of gradient mentioned on this page.





valleys and marshy depressions, which sometimes contain small lakes (see pp. 33-5). This type of country is exemplified in the neighbourhood of Turnhout (Fig. 15). Occasional small hills are to be seen, little more prominent, however, than the sand-dunes. For example, in the south-west of the plain, near Herentals, there is an outcrop of Pliocene (Diestian) sandstone, which has produced a slightly more diversified topography than the sands and gravels which cover most of the plain, because of its greater resistance to erosion. These gentle hills are similar to the Diestian Hills near the western margin of the plateau (Fig. 11), but are much lower. Between Herentals and Kasterlee, for example, a line of these inconspicuous hills extends from north-east to south-west, between the valleys of the Kleine-Nethe and the Groot-Kaliebeek. The summits are mostly from about twenty-five to thirty metres above sea-level, the highest, the Langenberg, attaining forty metres. In places these hillocks slope quite sharply to the south, forming low steep faces. There are some other groups of low hills to the south of the Groote-Nethe valley, in the neighbourhood of Heist-op-den-Berg and Beerzel. The town of Heist, as its name implies, stands on an eminence overlooking the Groote-Nethe valley; the church rises from the flattened summit at a height of forty-five metres, with the old town clustering around. These hills are exceptional, however, in the Kempen plain, for mostly they form little more than faintly swelling mounds which pass almost unnoticed in the gently undulating landscape.

DRAINAGE

The salient features of the relief of the Kempen have been produced by the past and present activity of the rivers, and frequent reference has been made to them in the preceding sections. It merely

FIG. 15. THE KEMPEN PLAIN NEAR TURNHOUT

For key to the symbols, see Fig. 9. The built-up area of the town of Turnhout is shaded.

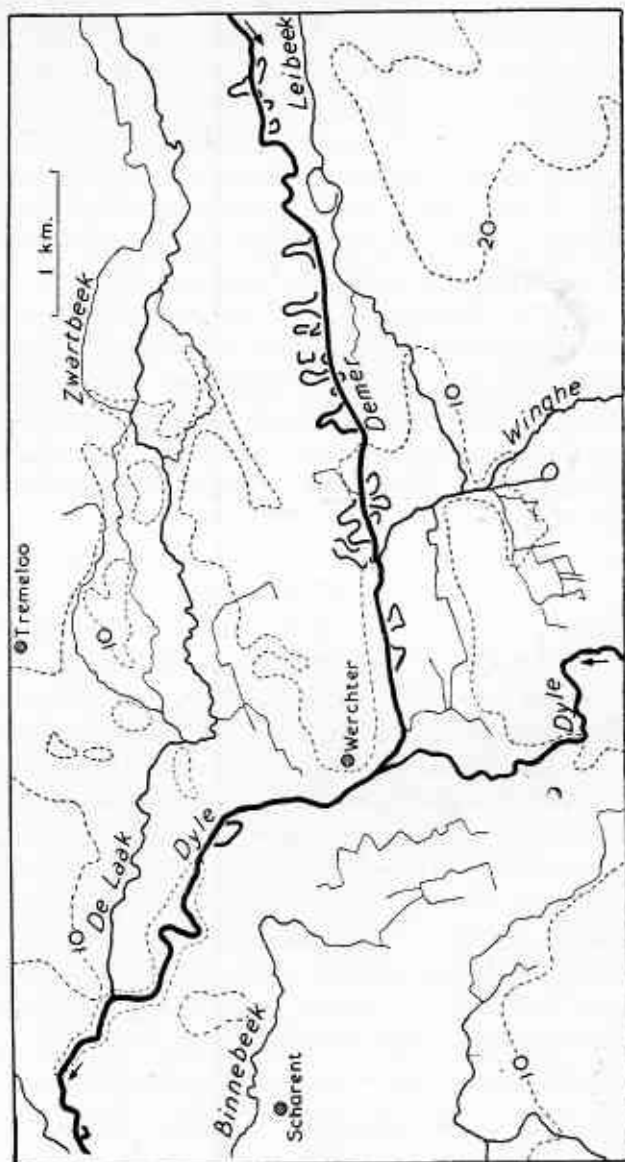
The location of this part of the plain is indicated on Fig. 16.

remains, therefore, to discuss the present-day pattern of the river systems, which is shown on Fig. 16. The gentle gradients, the low hills and the flat-floored valleys of the Kempen have produced a system of rather indeterminate drainage. The stream beds are shallowly incised, encumbered with sand and gravel banks, and frequently braided: that is, the main streams are split into numerous inter-connected channels. They meander endlessly, frequently leaving abandoned channels (Fig. 17), and sometimes broadening into extensive areas of marshland or shallow lakes that vary in extent with the seasonal rainfall. Thus in the spring of 1947, following the melting of the heavy winter snowfall, flooding was widespread, but, by contrast, after five months' drought during the summer and autumn of the same year, many of the smaller streams disappeared, and the larger ones dwindled into strings of pools among the banks of sand and gravel. The valley-floors are covered with a maze of artificial drainage channels (see p. 35).

The Kempen plateau forms a broad and indeterminate watershed (Figs. 9, 10) between the streams draining southwards and westwards to the Demer, and those draining northwards and eastwards to the Meuse. On Fig. 9, for example, the sources of the Boschbeek and the Steemerbeek are shown nearly two kilometres apart, but the land rises only about a metre between them, and the actual sources vary considerably from season to season. The hamlet of Waterschei and the André Dumont colliery are situated on this watershed. Towards the north-west of the Kempen, the watershed is lower and even more indeterminate than that in the east (Fig. 10), for it comprises only a low bulge of land over twenty metres. There are considerable areas of marsh, from which streams flow both northwards and southwards, and there is much artificial drainage. After heavy rain, it is sometimes possible to see streams flowing sluggishly in opposite directions from the same shallow mere.

FIG. 16. THE KEMPEN NATURAL DRAINAGE SYSTEM

The triangles A, B, C and D are shown on an enlarged scale on Figs. 9, 10, 11 and 12 respectively. The rivers and lakes outside Belgium are not shown.



The Demer and the Nethe, which together drain some two-thirds of the Kempen, join the Scheldt by way of the Rupel. The greater part of the main Scheldt system in central and south-western Belgium consists of more or less parallel rivers flowing approximately northwards, consequent upon the northward tilt of the land in Pliocene times. But the Demer, and its westerly continuation the Dyle, flow almost at right-angles to this trend, occupying the "furrow" they have cut into the southern edge of the Kempen alluvial "fan" (Fig. 6), while their tributaries flow south-westwards from the margins of the plateau. The Nethe, with its two main headstreams, the Groote- and Kleine-Nethe, drains the gentle western slope of the plateau, and joins the Rupel near the Senne-Dyle confluence. Both the Demer and the Nethe have a multiplicity of headstreams separated by gently sloping interfluvies.

The Meuse flows northwards along the eastern edge of the Kempen in its comparatively deeply incised valley. Its Kempen tributaries are few, for the high eastern plateau is almost streamless, although its edge is seamed with dry valleys. The only tributary of any size is the Boschbeek, twenty kilometres in length, which joins the Meuse below Maastricht. Most of the streams of the northern Kempen wander westerly across the frontier into the Netherlands, and find their way ultimately through the bogs of the Peel in North Brabant to the Dommel, and so to the Meuse. Some streams are picked up by the Wilhelmina or the Zuid-Willems Canals.

Lakes

Small lakes are numerous, occurring both in the marshy river valleys, and in depressions on the high plateau where an impervious "pan" has formed, a metre or so below the surface. Although small sheets

FIG. 17. THE DEMER VALLEY

~~The~~ location of this part of the valley is indicated on Fig. 16. The maze of ~~the~~ drainage channels and ditches is not shown.

of water are to be found all over the Kempen, two distinct groups of lakes are to be distinguished—one extending northward from Turnhout to the Netherlands frontier, the other smaller group in the south between Hasselt and Genk (Fig. 16).

The northern group of lakes includes three main types. One consists of irregular sheets of shallow water known as *Vennen* which vary in extent with the rainfall. These lie among the marshlands in the valleys of streams draining northwards into the Netherlands. Most of these valleys have been drained to form water-meadows, but to the west of Turnhout, between Brecht and Wuustwezel in the valley of the Dutch Aa, there is an area of marshland, the biggest in the Kempen, some seven by two kilometres in extent, which has been left in its natural state and serves as a firing-range. Here there are about eighty separate sheets of water in summer, apart from a great number of tiny meres; the largest, the Huick Ven, is about 400 by 200 metres at maximum extent. Other large *Vennen* are to be seen in the Zand Ven Heide, on either side of the railway from Turnhout into the Netherlands. The second type of lake in the north comprises shallow depressions, known as *Gooren*, partly filled with shallow water, partly with marsh, varying like the *Vennen* in extent with the season, but with their maximum extents defined by restricting artificial drainage channels. Such is the Meergoor, lying three kilometres to the north-west of Beerse; it is about one kilometre long and three-quarters of a kilometre broad, but in dry summers it may dwindle to a permanent water area of only about a hundred metres square. The third type in the northern group is quite artificial, but nevertheless forms a very striking feature of the landscape—the numerous flooded abandoned clay-pits of the brickworks along the line of the Desschel-Turnhout-Schoten Canal (Fig. 48).

The group of lakes in the south near Genk is strung out along the valleys of the Stiemerbeek and its tributaries. They lie at about fifty metres above sea-level, near the foot of the plateau edge, where the gradient flattens out abruptly. In Genk commune, the lakes cover a maximum area of 282 hectares, or 3.2 per cent of the total surface area of the commune. They vary in extent with the season, except where

they have been artificially embanked. The Borggraave Water, for example, lying about five kilometres north-east of Hasselt, is almost quadrilateral in shape, and the neighbouring Lang Water is a rectangle of water surface nearly two kilometres long and 150 metres wide, but cut up by banks into nine units, each about 150 metres square.

Artificial Drainage

The natural drainage in places has been modified profoundly by man. The irrigation and drainage ditches are discussed in greater detail on pp. 70-5 and 80, and the navigation canals on pp. 168-85. The main rivers Demer and the two Nethes have been regularized and embanked along most of their lengths, both to improve them for navigation and to prevent flooding. In spite of this, widespread floods are common, especially along the valley of the lower Nethe. The regularized Demer is shown on Fig. 17 near its junction with the Dyle; the river has been embanked, and its course straightened by the cutting of channels across the "necks" of meanders, leaving them as "ox-bows"; the flat floor of the main valley is intersected by drainage channels and ditches. A large part of the low-lying plain in the north, too, is patterned with these ditches, which lead into major channels and then into regularized streams, such as the Dommel. In winter and spring, the channels are primarily used for drainage, but commonly in summer water is led into them from the navigation canals through concrete sluices, and so used to irrigate the water-meadows.

Some of the Kempen navigation canals are used for drainage, but most of them are contained within high banks, and the beds lie some metres above the surrounding country-side. The streams are either siphoned beneath the canals—for example, both the Groote-Nethe and the Kleine-Nethe are led in concrete conduits under the Albert Canal—or are diverted into drainage channels parallel to the canals at the foot of their containing embankments.

CHAPTER II

THE HEATHLANDS

GENERAL FEATURES

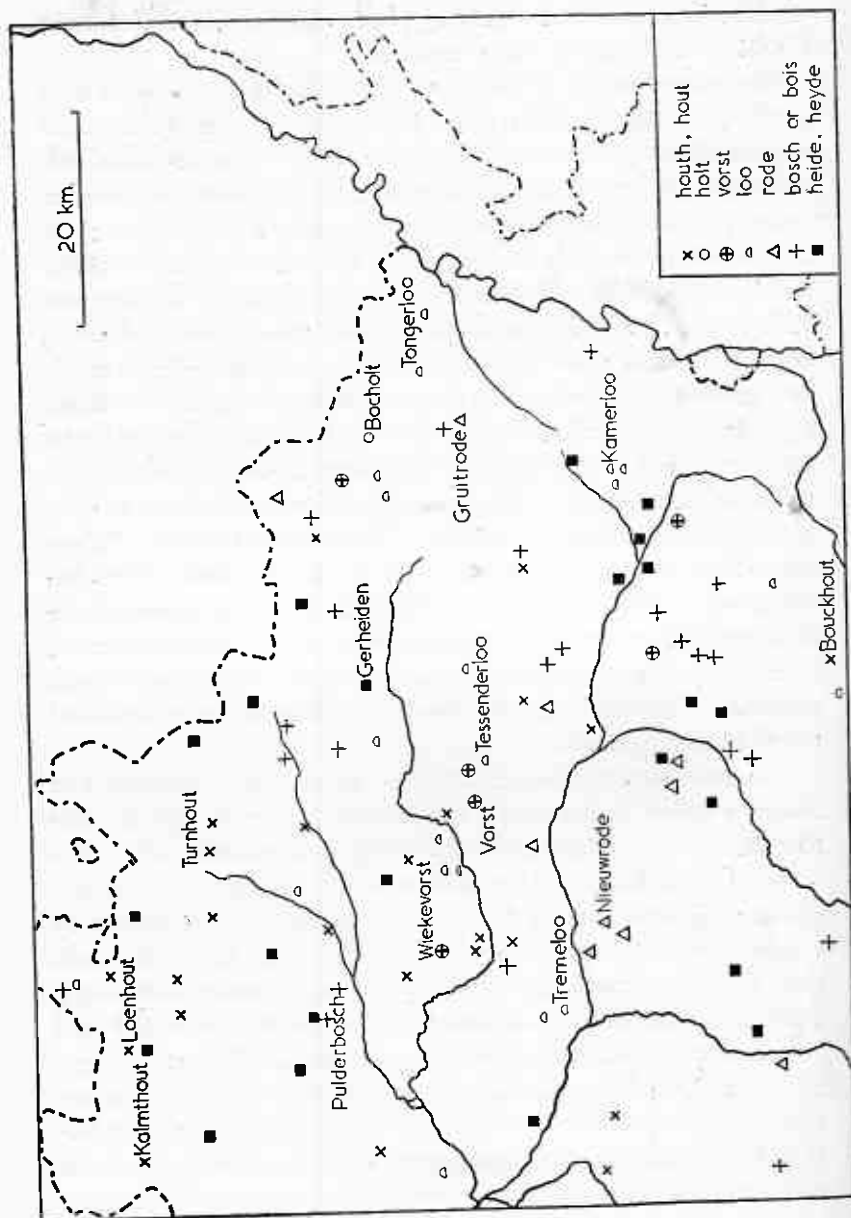
HEATHLANDS form a characteristic feature of the landscape of a large part of the North European Plain, especially where the surface is covered with sheets of coarse sand or gravel (Fig. 2). The podsol-type soils developed on the sands (see pp. 14-15) are commonly covered with a thin rather dry layer of acid peat, in which seedlings of ling (*Calluna vulgaris*), the dominant plant of the heathlands, readily establish themselves.

Heathlands may occur in western Europe where rainfall totals are between 550 mm. (c. 22 inches) and 1,000 mm. (c. 40 inches), that is, in a much wetter climate than that which gives rise to steppeland further east. From the available records, it appears that the higher parts of the Kempen plateau have a mean annual rainfall of about 600 to 750 mm. (c. 24 to 29.5 inches). Thus Leopoldsburg, in the central Kempen at a height of almost exactly fifty metres, has a mean annual total of 758 mm. (29.8 inches), while Mol, some fourteen kilometres to the north-west at twenty-six metres, has 710 mm. (27.95 inches). Maaseik, in the Meuse valley to the north-east, has 690 mm. (27.2 inches), and Sint-Truiden, on the southern borders of the Kempen, has 673 mm. (26.4 inches). These figures, of course, are only averages, and wide variations occur in the annual and seasonal totals; thus there was a long period of complete drought during the summer and autumn of 1947. The sandy soil, the average summer temperatures of 60° to 64°F., and the frequent strong winds on the exposed plateau, together considerably reduce the "effective total" of the rainfall, with the result that the

heathlands are colonized mainly by plants with xerophytic characters, capable of withstanding these conditions.

The rainfall total, however, is quite adequate to support tree-growth, and it seems, in fact, that much of the present heathland has resulted from the destruction or degeneration of former woodland. Medieval texts bear witness to the existence in the thirteenth century of extensive and continuous woodland over much of the Kempen; the dominant trees probably comprised oak, birch and hornbeam. Some indication of this is to be found in the distribution of the numerous village names containing woodland elements, such as *houth*, *holt*, *vorst*, *bosch*, *loo* and *rode*; the first four indicate the probable presence at one time of woodland, the last two denote clearings within the woodland. Fig. 18 shows the wide distribution of these names; they are by no means restricted to the valleys. Significantly, the only area where woodland names are notably absent is in the east-central part of the plateau, which is mainly over seventy metres above sea-level. Village names incorporating the element *heide* (heath) are found much less commonly. The names of the heathlands themselves, incidentally, are of course very numerous; from a close survey of large-scale maps, from unpublished commune maps and from miscellaneous local sources, no less than 145 individually named stretches of heathland have been distinguished.

It is probable that the destruction of the primitive woodlands in Belgium was well advanced by the sixteenth century; large clearance schemes by religious houses, the slow but gradual widening of the perimeter of arable land and of pasture around the villages in the valleys, and the wholesale cutting for fuel by the armies which repeatedly fought over the Low Countries, all took their toll. Once the woodland had been cleared, natural regeneration became increasingly difficult, for the clearing allowed the rapid destruction of the mild humus which forms under deciduous woodland, and its replacement by a thin acid layer in which heathland associations flourish. Further, regeneration was often prevented by the grazing of sheep, goats and cattle, which destroyed the young seedlings. Another adverse factor was the development of a hard "pan" layer (see p. 15), which forms



readily when the soil has been deprived of its protective deciduous forest cover; this cannot be penetrated by the roots of young trees, thus maintaining a shallow soil layer. The result of these adverse conditions is revealed by the first large-scale series of maps (1 : 86,400) covering the whole of the Low Countries, completed in 1777 by Joseph de Ferraris, *Directeur Général de l'Artillerie* to the Empress Maria-Theresa, which shows that the Kempen at the time of the survey was covered with almost continuous heathland. It was interrupted only by isolated villages, each with its ring of arable and pasture land, and by a few small surviving patches of woodland.

In the absence of these unfavourable artificial conditions, it is possible for woodland once again to develop through natural regeneration; this tendency may be indicated by the spread of rather scrubby birch-oak woods, and also by the fact that isolated pines may be seen growing in areas of heathland adjoining plantations. The regeneration has been helped by the virtual disappearance of the large flocks of sheep which were the main feature of Kempen economy at the beginning of the nineteenth century (see pp. 81-2). Yet regeneration is not easy; when plantations are deliberately and scientifically established, their early existence depends upon the creation and careful maintenance of favourable conditions (see p. 106), and natural regeneration is even more difficult.

The blank area in the woodland village names on Fig. 18, representing the land more or less above seventy metres, almost certainly indicates an area naturally unfavourable to tree-growth. Here the soils are exceptionally poor, and the high plateau is much exposed to strong winds. It is probable therefore that the high heathland in the central Kempen is primitive, and is the natural type of plant community developed on these soils under the particular climatic conditions; it is, in fact, a sub-climax in the normal developmental succession of the vegetation.

FIG. 18. THE DISTRIBUTION OF KEMPEN PLACE-NAMES CONTAINING WOODLAND AND HEATH ELEMENTS

Only the larger villages are included. Contemporary woodland and heathland not being village names, are omitted.

ASPECTS OF HEATHLAND VEGETATION

It is not easy to describe the Kempen heathland in general terms. Its aspect varies considerably from place to place as the different heathland associations change, and it is convenient therefore to attempt a description of these main associations, remembering of course that there are all stages of transition between them. They may be summarized as follows: (1) *Calluna* heath; (2) mixed heath; (3) grass heath; (4) oak-birch heath; and (5) wet heath; included for convenience in the last association are the bog communities where permanently waterlogged soil conditions occur.

(1) *Calluna* Heath

The most characteristic feature of the heathland is the extensive area of ling (*Calluna vulgaris*), which is commonly the dominant species. Its appearance varies according to the season and also to the age of the community, which means in effect the length of time which has elapsed since the last heath fire. The growth is usually close, but even with old woody and "leggy" plants the height of the layer is rarely above half a metre, and it never approaches the nature of the deep brush of some of the English moorlands, which may present considerable difficulty to the walker. In spring there is a tint of pale green, in autumn there are tones of deep purple and sepia, but after a widespread fire, whole tracts are of unrelieved black or grey. One of the largest remaining areas of *Calluna* heath is that lying to the north-west of Winterslag, called in various parts the Zonhoven Heide, the Molen Heide and the Haagdom Heide (Fig. 10). For seven kilometres the railway between Winterslag and Houthalen crosses this heathland; virtually unpopulated, its dreariness is relieved only by occasional meres, by pine plantations, and by the apparently rather aimless paths and tracks which wind about.

While ling is overwhelmingly dominant in the *Calluna* heath, several other layers can be distinguished, although of much less significance. Certain shade-tolerant plants such as bilberry (*Vaccinium myrtillus*) and dwarf gorse (*Ulex minor*) form a middle-layer, and there

is usually a ground-layer of mosses and lichens. Notable among the last are species of *Cladonia*, which are largely responsible for the formation of a surface layer of acid peat. The dwarf gorse sometimes forms a prostrate prickly mat among this ground-layer. Where the ling is absent, so too is the ground-layer; the sand, exposed to wind action by the absence of the binding roots of heather and of the wind-break effect of its bushy growth, remains almost entirely devoid of vegetation.

(2) *Mixed Heath*

A more varied type of heath vegetation is found locally among the *Calluna* heath. *Erica cinerea*, or purple bell-heather, sometimes occurs mixed with ling, and on sunny slopes, as for example to the south of Genk, it forms considerable stretches of colourful landscape, which contrast with the more sombre ling. In the damper areas, such as in broad shallow depressions on the plateau, or in the wet heath transition zone, the cross-leaved heath (*Erica tetralix*) is common. In addition to the heathers, there is an associated group of species, characterized by their tolerance of high soil acidity, by some degree of adaptation to summer drought, and by a very low demand on plant nutrients in the soil. These include broom (*Cytisus scoparius*), dwarf whins (*Genista anglica* and *G. pilosa*), juniper (*Juniperus communis*) and gorse (*Ulex europaeus*); the last is not a typical member of the heathland association, but seems to flourish by road-sides and near villages. To the east of Wansbeck colliery, for example, the broom forms dense continuous thickets, a metre or more high, intersected by footpaths and hard earth tracks. Incidentally, during the nineteenth century, broom-seed was commonly sown widespread as one of the first steps to improvement (see pp. 55-6). One of the finest and most continuous of these mixed heathlands lies between Mechelen in the Meuse valley and Asch on the plateau at a height of eighty-five metres—the great Mechelsche Heide. Much of it has now been planted with pinewoods, but still for many miles the gently undulating plateau, diversified here and there by small streams, is covered with ling, with great thickets of broom, with clumps of grasses and with much bare sand.

One or two other local associations deserve mention. The bracken fern (*Pteridium aquilinum*) is not a true heath plant, but in some parts of the heathland where the ling is not common it may indicate the site of former deciduous woodland. Considerable stretches are to be seen, for example, between Waterschei and Asch, and in the neighbourhood of Eelen. On the heathlands north of Genk there are dense and continuous thickets of brambles, and these are common in other localities.

(3) Grass Heath

Over many parts of the Kempen a more open heath is found, especially where constant burning or grazing has kept the ling from full development. It is noticeable that many of the grass heaths occur beyond the arable lands and the improved pastures around the villages, while the *Calluna* heaths lie still further away (Fig. 69). The ling, sometimes grazed, frequently fired, or cut for litter, has retreated from the nearer heathlands and dominates the higher and more remote parts. In the grass heaths, the true heath plants are much less numerous, and are often missing altogether. They are replaced by various heath-grasses, notably *Deschampsia flexuosa*, *Agrostis* spp. and *Festuca* spp. These sometimes form a more or less continuous turf carpet, while in other areas they grow in low clumps or tufts separated by bare sand. There is a very large number of annuals, often early flowering species, among the grasses. One of the most continuous grass heaths occurs to the north of Helchteren, in the Hoever Heide, which is covered with moorland grass, unrelieved by trees and shrubs and but rarely with ling. Other striking examples are the Dorper Heide to the west of Lommel (Fig. 69) and the Karrestater Heide to the east. The former is one of the largest completely treeless areas in the Kempen, and the coarse grass is interrupted by sheets of bare sand. Various transition stages are to be found between the grass heath and the *Calluna* or mixed heaths; scattered ling increases in frequency until the close *Calluna* heath entirely replaces the grasses.

(4) Oak-Birch Heath

Scattered silver birch (*Betula* spp.) often grow sporadically among the

grass heath, as on the Bretheide and Stalenheide to the north of Genk, and even occasionally in the *Calluna* heath. In particular, these trees occur in great numbers to the east of Asch, spread out almost uniformly at intervals of ten metres or so, with intervening patches of coarse grass. Between Waterschei and Asch there are areas where the birch trees are so numerous and continuous as to be called birch-woods. The heath in fact is being freely colonized by these trees.

In other districts, particularly in the lower heathlands to the north and north-west, the birch grows in association with dwarf oak and with other deciduous trees. Sometimes the trees are so numerous as to justify the name "oak-birch heath," as distinct from grass heaths and mixed heaths, where the trees form only sporadic elements. To the west of Turnhout, for example, there are scrubby woodlands of dwarf oak, willow, hazel, alder and ash, forming a dense layer one to two metres in height, often interlaced with brambles, while the slender trunks of the silver birch rise some five metres above the thicket. In the damper areas, alders and willows predominate. Here and there are isolated Scots pines, subspontaneously spreading from neighbouring plantations. In the north-east, near Maaseik, dwarf oaks form more continuous thickets, with an associated shrub layer which includes broom, buckthorn, bilberry and bracken. Where circumstances are particularly favourable, copses of mature trees may develop.

It seems then that on the heathlands there are all stages between oak-birch heath and *Calluna* or grass heath; undisturbed heath will be colonized by an oak-birch association, and over-grazed and over-cut oak-birch will revert to true heath. On the whole, it seems that the areas of oak-birch heath are increasing. It may well be that the oak-birch heath, if uninterrupted, could develop into oak forest, a return to the wooded conditions of the past. But oaks grow so slowly that some form of interruption almost certainly does take place.

Wet Heath and Bog

A characteristic feature of the Kempen, both in the lower areas to the west and north and in the high plateau, is the number of small lakes and ponds (see pp. 33-5). In the neighbourhood of these, in the damp

depressions around them, aquatic and heath communities come into close association. There are all transitions between bog, where permanently wet soil conditions occur, the intermediate wet heath, and the dry *Calluna* heath. In addition, the broad, gently sloping valleys have swampy areas; the lines of the streams and of the ditches leading into them are indicated by reeds, alders and willows.

In the northern and western Kempen, between the Dessel-Turnhout-Schoten Canal and the Netherlands frontier, there are areas known as *Moeren*; they are akin to and sometimes continuous with the *Hoogveen* in the Netherlands, in fact, the small meres in these areas are often known as *Vennen* (see p. 34). The *Moeren* lie generally at about twenty-five metres above sea level. The vegetation associated with them (*Carex* spp., *Phragmites* spp. and sometimes alders) suggests a transition from a bog to a true fen community, but it is probable that the limited deposition of silt and the acid nature of the drainage water will render unlikely the full development of the latter. One of the largest expanses of these *Moeren* occurs to the east of Turnhout (Fig. 15). Here there is a great shallow depression, almost encircled by the twenty-five metre contour, except in the south-west, where the Belgian Aa flows out on its way to join the Nethe near Herentals. The western part of this depression is occupied by the Liereman Moer, while further east are the irregularly shaped Luif Goor and Roode Goor. These depressions, covered with a layer of silt, are surrounded by heathlands which lie some five metres higher than the waterlogged areas. The vegetation shows strikingly the sequence from aquatic communities, through the wet heath dominated by *Molinia caerulea* (blue moor grass), to the dry grass heath with patches of ling.

On the high plateau, at altitudes exceeding fifty or sixty metres, true peat-bogs, akin to the *Hochmooren* of Germany and to the upland Mosses of Great Britain, occur sporadically in hollows among the heathlands. Even though the soil is sandy and highly permeable, these hollows become waterlogged, because the hard "pan" is well developed and the drainage on the indeterminate watersheds is so poor that much surface water remains stagnant. This bog is closely related to the heath which surrounds it, for it has the same poverty of mineral

nutrients and the same high acidity ; its difference is that the surface is permanently damp, while the true heath is dry. Should the bog or wet heath dry out, naturally or artificially, true heath will result. The characteristic plant association comprises blue moor grass, which often occurs in great tussocks, *Sphagnum* and other bog-mosses, cotton grass and heath rushes. Considerable thicknesses of highly acid and nutrient-poor peats develop in the hollows. In the transitional wet heath, there may be found the cross-leaved heath (*Erica tetralix*), which prefers damper localities than do the other heaths. Near the upper slopes of the depressions, ling becomes increasingly frequent.

An example of these high bogs is to be seen on the Dalder Heide, to the south of Genk, at a height varying from fifty-five to seventy metres above sea-level. There are some half-a-dozen large meres, between which is bog, except where artificial drainage and improvement has converted them into water-meadows. To the east the land rises gradually to the *Calluna* heath above eighty-five metres. A more extensive and higher area of bog is on the Donderslagsche Heide (Fig. 10), an area some eight by four kilometres in extent, lying to the east of Helchteren on the indeterminate plateau-watershed at a height of about eighty metres. Sheets of water are rare, except in rainy weather, but the bog is widespread. The heathland is used by ordnance firms as a firing range.

CHANGES IN THE AREA OF HEATHLAND, 1846-1942

Some impression of the extent of Kempen heathland a century ago may be obtained from a study of the Agricultural Census of 1846. It must be remembered, however, that provincial and *arrondissement* figures alone are available, and also that heathland was then not separately specified in the returns. Nevertheless, in the Kempen at that time much that was not included under the categories of agriculturally productive land, pasture or woodland, can be regarded as heathland ; the area occupied by roads and buildings formed a very small proportion of the total. The statistics for 1846 are summarized in the Table on p. 46 :

The Area of "Agriculturally Unproductive" Land, 1846

<i>Arrondissement</i>	<i>Total Area</i>	<i>"Agriculturally Unproductive"</i>	<i>Percentage of Total Area</i>
	(hectares)		
Antwerpen ..	97,206	37,053	38
Mechelen	50,368	9,133	18
Turnhout	135,737	65,911	49
Antwerpen province	283,311	112,097	40
Hasselt	90,983	29,780	33
Maaseik	86,543	53,121	61
Tongeren	63,789	11,112	17
Limburg province..	241,315	94,013	39
All Belgium ..	2,945,593	666,767	23

Note. The provincial total areas differ slightly from those of the present day ; this is the result of boundary alterations.

In this Table, the lower percentages of heathland for the Hasselt and Tongeren *arrondissements* in Limburg province result from the fact that large parts of them extend southward on to the agriculturally prosperous *limon*-covered plateau of Hesbaye. In Antwerpen province, the southern part of Turnhout and most of Mechelen *arrondissement* lie on the northern part of the fertile Brabant Plateau, while the western part of Antwerpen *arrondissement* consists of the Scheldt polder areas. The true heathland areas covered a large part of the northern *arrondissements* of Antwerpen province, much of northern Hasselt and two-thirds of Maaseik. The Kempen heathlands formed in 1846 nearly one-third of all Belgian "non-productive land."

By 1866, considerable progress had been made in the gradual reduction and reclamation of the heathlands, a progress which is

discussed in Chapters III and IV. The extent of actual heathland in the various Kempen *arrondissements* at the Agricultural Census of 1866 was as follows :

The Area of Heathland, 1866

<i>Arrondissement</i>	<i>Heathland (hectares)</i>	<i>Percentage of Total Area</i>
Antwerpen	16,176	16.6
Mechelen	1,965	3.9
Turnhout	33,933	24.9
Antwerpen province	52,074	18.4
Hasselt	6,567	7.3
Maaseik	30,373	35.5
Tongeren	11,348	17.7
Limburg province..	48,648	20.2

Note. These figures are of heathland alone, and are not strictly comparable with the Table on p. 46, which includes all "agriculturally unproductive" land.

This 1866 census was carried out on an elaborate scale, and the first detailed computation of the area of heathland in each commune was published as a result. From these statistics, the proportion of heathland expressed as a percentage of the total area of each commune has been computed (Fig. 19).

The Distribution of Heathland in 1866

In 1866, thirty-seven communes had two-fifths or more of their total area under heath ; these communes, shown in black on Fig. 19, extend along the Netherlands frontier and south-eastward on to the high plateau. They occupy about one-third of the Kempen. Twenty communes had more than half of their area under heath. Hechtel, in

the heart of the eastern Kempen, had 2,217 hectares of heathland (that is, sixty-five per cent of its total area). Gruitrode, to the west of Maaseik town, had 2,263 hectares (fifty-nine per cent) and Lommel, the third largest commune in Belgium, had 5,921 hectares (fifty-eight per cent). These three communes are all in Maaseik *arrondissement*, that is, in the Limburg Kempen. The high heathland proportions continued

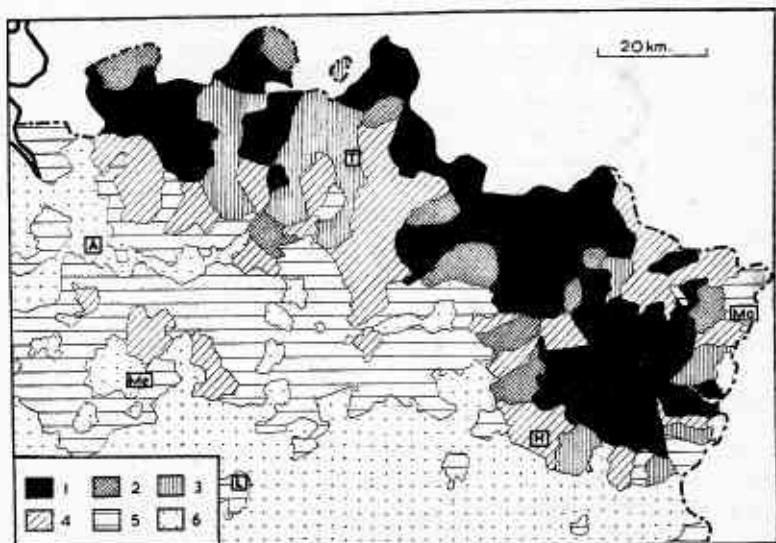


FIG. 19. THE DISTRIBUTION OF HEATHLAND, 1866

The extent of heathland in each commune was obtained from *Agriculture : Recensement Général* (Bruxelles, 1866).

The figures in the key indicate the percentage of the total area of each commune under heath, as follows : 1. over 40 ; 2. 30 to 40 ; 3. 20 to 30 ; 4. 10 to 20 ; 5. 1 to 10 ; 6. under 1.

The main towns are indicated by abbreviations, as follows ; A. Antwerp ; H. Hasselt ; L. Lier ; Ma. Maaseik ; Me. Mechelen ; T. Turnhout.

southward into Hasselt *arrondissement*, where Niel had fifty-seven per cent, Genk fifty-six and Asch fifty-five. So, too, in northern Turnhout near the Netherlands frontier, where Poppel had 2,104 hectares of heathland, which, covering sixty-seven per cent of the total area of the commune, was the highest proportion of any in the Kempen. Weelde had fifty-nine and Brecht fifty-four per cent.

The Distribution of Heathland in 1942

The most recent cadastral survey of Belgium, providing detailed land utilization statistics, was carried out in 1942, during the German occupation. Agricultural statistics are available for 1946, but heathland, woodland and other agriculturally non-productive lands were not then

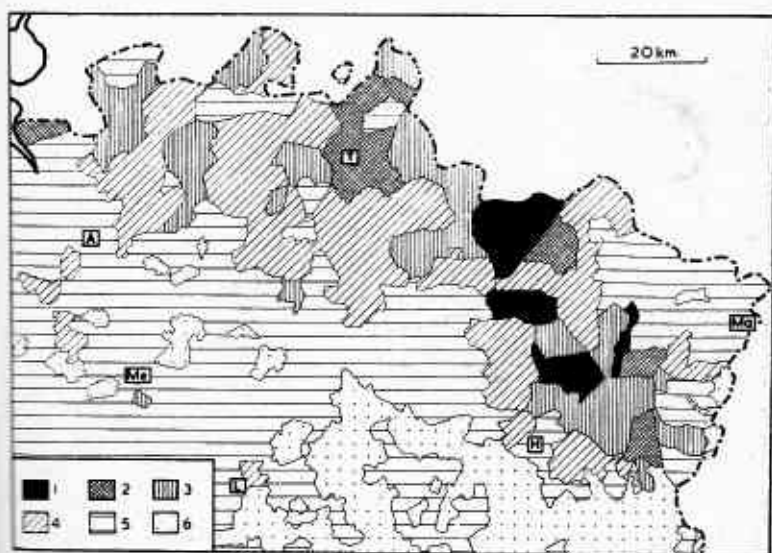


FIG. 20. THE DISTRIBUTION OF HEATHLAND, 1942

The extent of heathland and other waste land (see pp. 49-50) was obtained from the results of the unpublished cadastral survey of 1942, made available by the *Institut National de Statistique* in Brussels.

The figures in the key indicate the percentage of the total area of each commune under heath, as follows: 1. over 40; 2. 30 to 40; 3. 20 to 30; 4. 10 to 20; 5. 1 to 10; 6. under 1.

The main towns are indicated by abbreviations, as follows: A. Antwerp; H. Hasselt; L. Lier; Ma. Maaseik; Me. Mechelen; T. Turnhout.

returned. Unfortunately, however, heathland was not separately and specifically distinguished in the 1942 survey. It was returned in a composite category which also included lakes, marshland, quarries, sand-pits, sand-dunes, reservoirs, mines and industrial ground, parks and land devoted to communications, but it did not include built-up

areas. However, in the Kempen at least, it may be assumed that heathland forms a dominating and outstanding part of the category; especially as marshland can be included broadly as "wet heath," and sand-dunes are in fact a feature of the heathlands. The statistics

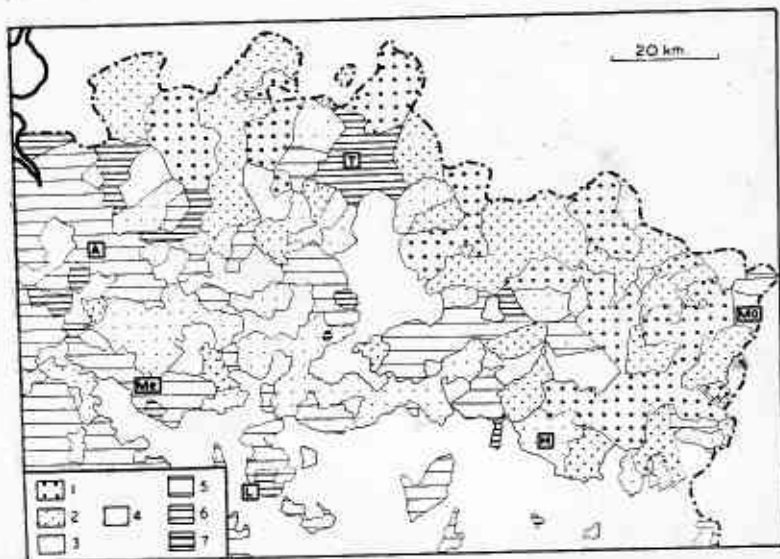


FIG. 21. CHANGES IN THE DISTRIBUTION OF HEATHLAND, 1866-1942

The change in each commune was calculated from statistics obtained from *Agriculture: Recensement Général* (Bruxelles, 1866) and from the results of the unpublished cadastral survey of 1942, made available by the *Institut National de Statistique* in Brussels.

The figures in the key indicate the change in the area of heathland between the two surveys, expressed as a percentage of the total area of each commune, as follows: 1. decrease exceeding 25; 2. decrease of 10 to 25; 3. decrease of 2 to 10; 4. little or no change, i.e. less than plus or minus two; 5. increase of 2 to 10; 6. increase of 10 to 25; 7. increase exceeding 25.

The main towns are indicated by abbreviations, as follows: A. Antwerp; H. Hasselt; Li. Lier; Ma. Maaseik; Me. Mechelen; T. Turnhout.

grouped together as "heathland, . . . etc," in the cadastral survey have been used to plot Fig. 20, and it is not too misleading to regard this as providing a fairly accurate picture of the extent of the heathland in 1942. In any case, the difficulty of drawing a boundary line between, for example, "heathland" and "rough grazing," is very great.

Different surveyors, with their varied interpretations, probably introduced considerable errors of detail into both the 1866 and 1942 surveys. It is reasonable, therefore, to regard Figs. 19 and 20 as being more or less comparable.

When Fig. 20, depicting conditions in 1942, is examined, it will be seen that only five communes had over forty per cent of their total area under heath. Four of these were Hechtel, with 2,140 hectares (sixty-three per cent of the total area), Lommel (forty-six per cent), Houthalen and Wijshagen (forty per cent each). The fifth, Leopoldsburch, consists for the most part of heathland permanently reserved in its more or less natural state as training-ground and firing-ranges for a large military camp; this land is not taxable and is consequently not returned in the statistics. The heathland, however, certainly occupies more than half of the area of the commune.

The great reduction of the area of the heathland is revealed strikingly in Fig. 21. Twenty-eight communes had a decrease in heathland equivalent to more than a quarter of their total area; these communes for the most part are those which had high proportions of heath in 1866, and therefore offered scope for reclamation and for more profitable land use as the population increased. The most marked decreases, equivalent to about half of the total area in each case, were in the following communes:

<i>Commune</i>	<i>Percentage of Total Area under Heath</i>	
	<i>In 1866</i>	<i>In 1942</i>
Tongerloo	55	1
Gruitrode	59	8
Sint-Huibrechts-Lille ..	50	5
Opoeteren	56	11
Poppel	67	22

The first four of these communes are in Maaseik *arrondissement* in the north-east; the last, near the Netherlands frontier in Turnhout, showed

an absolute reduction in the area of heathland of no less than 1,401 hectares.

While most of the large Kempen communes reveal this considerable decrease in the area under heath between 1866 and 1942, a few show little change. For example, the heathland in Hechtel decreased merely from 2,217 to 2,140 hectares, in Geel from 1,850 to 1,797 hectares, in Houthalen from 2,016 to 1,957 hectares, and in Lommel from 5,921 to 4,560 hectares. In these communes, the heathland is particularly poor and the areas of sand-dunes, bog and meres are considerable; the technical problems are greater and the costs of reclamation are higher, while the probable returns are much less than in other heathlands.

The areas of increase in the category of "heathland etc.," as indicated by Fig. 21, are small, and can be explained by the fact already stressed that the 1942 statistics refer not to heathland alone but also to other categories of non-productive and waste land. For example, Turnhout, Oud-Turnhout and Beerse mainly owe their increases to the extension of the clay-pits, both the present abandoned ones and those in active operation which supply the numerous brick-yards along the Desschel-Turnhout-Schoten Canal (Fig. 48). The increase in Leopoldsburg is due to the large areas taken over as military training grounds. Outside the Kempen proper, the slight rises in many communes are due to the increase in the areas of land needed for industrial purposes, as in the neighbourhood of the Rupel and Scheldt estuaries.

CHAPTER III

AGRICULTURE

HISTORICAL BACKGROUND

THE earliest attempts to improve the Kempen for agricultural purposes were made in the twelfth century, mainly by the religious houses, but the results were limited in extent. Throughout the succeeding centuries, the perimeter of the cultivated land round each of the small isolated villages was pushed slowly outwards. Occasionally, official stimulus was applied, notably under Spanish rule in 1572, in 1577 and again in 1586, when grants of land were made to individuals on condition that these areas were cleared of heath and made productive. In 1772, during the reign of the Empress Maria-Theresa, a law was passed to further the reclamation of waste land. In effect, ownership of heathland was vested in those who were able to enclose and improve it. A further inducement was that such land was exempted from all taxes, tithes and public charges for thirty years, and during the succeeding thirty years it was to be assessed at very low rates. If within six months of the grant, the improvement had not been started, the land lapsed into State ownership, as indeed did improved land that was subsequently abandoned. These edicts, sound in principle, aroused much opposition, and in practice proved to be unworkable. Few concessions of land, in fact, were taken up, for the Kempen then offered little prospect of reward, even to the energetic speculator. Of those concessions that were accepted, not a few failed because the schemes were too ambitious, in that the areas involved were too extensive. The new occupants did indeed clear considerable stretches

of land, strip off the ling, and grow crops of buckwheat, rye and barley for two or three years. But the slight initial fertility of the soil was speedily exhausted, and the abundant supplies of organic manure needed by the light sandy soils were rarely forthcoming.

The Kempen peasantry themselves, as distinct from outside colonizers, pursued at the beginning of the nineteenth century a way of life which enabled them to win a meagre subsistence from their limited environment. From the survey of Ferraris in 1777 (see p. 39), it seems that most of the central and eastern Kempen was at that time covered with almost continuous heathland, known generally as *les landes*, interrupted here and there by patches of woodland and by small tracts of cultivated land round the villages. Probably two-thirds of the Kempen, or about three thousand square kilometres, was agriculturally unproductive in 1800. But the small-scale agricultural activity that the region supported was after all sufficient for the needs of the scanty population. The basis of their limited economy was a combination of the cultivation of small fields near the villages with rye, buckwheat and potatoes, and the grazing of sheep and cattle, together with the exploitation in various ways of the heathland, much of which was owned by the various communes and held in common by their inhabitants. There were indeed already some small-scale efforts to improve the sandy soils for cultivation. An English clergyman, who travelled widely in the Low Countries during the third decade of the nineteenth century, described in very considerable detail this work of improvement.¹

"The poor sandy heaths, which have been converted into productive farms, evince the indefatigable industry and perseverance of the Flemings. They seem to want nothing but a space to work upon; whatever be the quality or texture of the soil, in time they will make it produce something. The sand in the Campine can be compared to nothing but the sands on the sea-shore. . . . It is highly interesting to follow step by step the progress of improvement. Here you see a cottage and rude cow-shed erected on a spot

¹ Rev. W. L. Rham, 'On the Agriculture of the Netherlands', in *Journal of the Royal Agricultural Society*, Series 1, no. 2, pp. 43-63 (London, 1841).

of the most unpromising aspect. The loose white sand blown into irregular mounds is only kept together by the roots of the heath ; a small spot only is levelled and surrounded by a ditch ; part of this is covered with young broom, part is planted with potatoes, and perhaps a small patch of diminutive clover may show itself ; but there is a heap of dung and compost forming. The urine of the cow is collected in a small tank, or perhaps in a cask sunk in the earth ; and this is the nucleus from which, in a few years, a little farm will spread around.

“ In another spot more extensive improvements are going on ; a wealthy proprietor or lessee is trenching and levelling the surface, sowing broom-seed, and planting young fir-trees, which are to be cut down in a few years. In another, the process has gone on further : the firs or the broom are already cut down ; a vein of loam has been found, and is dug out to be spread over the sandy surface ; the cart with liquid manure is preparing the surface for the reception of seed, or the same, diluted with water, is poured over the young blade just appearing above ground. The soil is created, and, if the cost and labour were reckoned, is paid for at a dear rate ; but perseverance insures success, and there are few instances of improvements being abandoned, after they are fairly begun, unless they were undertaken on too large a scale . . . ” (the usual mistake of outside colonizers).

The general practice was to trench and level the soil, using a light wooden spade, shod with iron, together with a pick-axe to break the underlying “ hard-pan.” As each trench was dug, and the earth from the next trench turned over into it, hollows were filled and small eminences removed. Sometimes a thin layer of soil, together with ling stalks and roots and the surface peat, was removed and burnt in piles, and the residue dug into the soil as potash fertilizer. But such a practice was undoubtedly wasteful, and often did more harm than good, for it left surfaces of bare sand on which the natural regeneration even of ling was slow. After the ground had been levelled, the practice followed varied according to whether organic manure was or was not available.

"If there is no manure at hand, the only thing that can be sown on poor sand, at first, is broom : this grows in the most barren soils ; in three years it is fit to cut, and produces some return in fagots for the bakers and brickmakers. The leaves which have fallen have somewhat enriched the soil, and the fibres of the roots have given a certain degree of compactness. It may now be ploughed and sown with buckwheat, or even with rye, without manure. . . ."¹

The farmer who was able to keep a few cows had a considerable advantage.

" . . . If about 20 small cart-loads of dung can be brought on each acre of the newly trenched ground, the progress is much more rapid. Potatoes are then the first crop, and generally give a good return. The same quantity of dung is required for the next crop, which is rye, in which clover is sown in the succeeding spring ; and a small portion is sown with carrots, of which they have a white sort . . . which even in this poor soil, gives a tolerable supply of food to the cows in winter. Should the clover fail, which sometimes happens, the ground is ploughed in spring, and sown with oats and clover again. But if the clover comes up well among the rye stubble, it is cut twice. . . . The clover-ley is manured with 10 cart-loads of dung to the acre, and rye sown again but not clover. After the rye comes buckwheat without any manure ; then potatoes again, manured as at first, and the same rotation of crops follows. It is found that the poor land gradually improves at each rotation from the quantity of dung used. . . ."

This is an example of the careful patience used to bring the sandy heathland soils into production. Various other systems and rotations were of course used. Sometimes broom-seed was sown with rye ; the latter was reaped in autumn, leaving a long stubble among which the broom continued to grow for two more years ; the green tops were used as litter, the woody stems as fuel, and the roots ploughed in. Another method was to sow oats, clover and broom together ; the oats were reaped in the first autumn, the clover and broom-tops in the

¹ Rev. W. L. Rham, *op. cit.*, p. 45.

second year, and the broom cut in the third. As the English observer of these practices wrote :

"... All these various methods of bringing poor sands into cultivation show that no device is omitted which ingenuity can suggest to supply the want of manure. . . ." ¹

But these schemes of improvement were all of a small-scale nature, as compared with the great area of heathland which remained virtually untouched except in the immediate neighbourhood of the villages. In fact, the opposition to government edicts which aimed at furthering these schemes was considerable, for the communes jealously guarded the common rights on their heathlands. These rights included the grazing of sheep and cattle, and the cutting of turves and ling. The last was of considerable value ; when dried, it provided litter for the stock ; the young shoots were browsed by large flocks of sheep ; the woody stems and roots served as fuel, valuable in a largely treeless region, for they were burnt with dried peaty clods torn from the areas of wet heath ; and the stalks were chopped and mixed with mud for the lath-and-daub method of cottage construction. Many communes, in fact, made token improvement schemes to meet the government edicts, but in practice did little. Their populations at that time were but slowly increasing, and there was little need to extend the area of the arable lands, for communications were so poor that lack of access to markets limited agricultural production to that needed for local consumption.

The newly formed kingdom of Belgium, finally established in 1839, included in its ambitious programme of economic development a great increase in the extent of agriculturally productive land. But, as in 1772, one of the main obstacles to any integrated scheme was the extensive area owned by the communes. A law was therefore passed in 1847, in terms very similar to those of the Austrian edict of 1772, by which the State could order the sale of unimproved communal lands. The new occupant was granted a reduction or even complete remission of taxes and tithes, in return for which he was obliged to convert the waste

¹ Rev. W. L. Rham, *op. cit.*, p 46.

into arable land or pasture. This measure affected no less than 167 communes. Despite considerable opposition from the communes, the edict was applied much more stringently than that of 1772, but by no means to the extent envisaged by the government. Exact records were kept and periodic inspections made. Between 1847 and 1860, the State ordered 33,130 hectares of uncultivated communal land in Belgium to be sold; of this total, 10,922 hectares were in Antwerpen and 11,895 in Limburg, or about two-thirds of all land so scheduled in Belgium. Several communes, in order to avoid losing their land, embarked themselves upon a policy of afforestation, which was recognized by the State as constituting "improvement." Others, such as Genk, helped their own inhabitants to become land-owners by ceding to them pieces of land to be cleared, in return for small annual payments.

Prospects for agricultural development were, it is true, much more promising than in the eighteenth century; communications were being rapidly developed, more State and private capital was available, and the rapidly increasing industrial population offered growing markets and better prices for food-stuffs. The area of communally-owned land improved annually in the two provinces between 1847 and 1866, either by the communes themselves or by individuals to whom areas of land were granted, averaged about 830 hectares. The Agricultural Census of 1866 estimated that an additional area of private estates, amounting to about 800 hectares annually, was improved by their owners, giving an average yearly increase of over 1,600 hectares of improved land in the Kempen between 1847 and 1866. About half of this area was put under woodland, one-third became pasture and about one-sixth arable land. While the total was considerably less than the original rather optimistic estimates, the results would not have been unsatisfactory if this rate of improvement could have been maintained. But, after 1866, while afforestation continued to flourish, the area improved annually as arable land and as pasture showed a substantial decline, for the more accessible and amenable lands were reclaimed first.

One method of agricultural improvement proposed towards the middle of the nineteenth century was the creation of State agricultural

colonies and farms. There were protracted discussions, but the actual results in the Kempen were negligible, where the only State scheme carried out was the formation of a colony to the north-west of Lommel, which is known as La Colonie (Fig. 68) to this day, an indication of its uniqueness (see p. 227). Although twenty farms were built, the colony was hardly a success, for the original settlers from Flanders soon wearied of the desolation of the heathland country and returned to their former villages in the crowded Flanders Plain. More successful were such private enterprises as the large estates maintained by the Trappist monasteries at Westerloo and at Achel near the Netherlands frontier (see pp. 80 and 227).

The change in the area of farm-land (the *domaine agricole*, or, in Flemish, *landbouwdomein*) in the two Kempen provinces between 1846 and 1946 can be seen from figures given in the various agricultural censuses. These afford broadly accurate comparisons between the various surveys, although there were minor changes in computation and definition; sometimes, for example, the figures are derived from a cadastral survey, at others from the addition of returns by individual farmers.

Area of Farm-land, 1846-1946 (square kilometres)

	1846	1866	1895	1938	1946
Antwerpen ..	1,346	1,573	1,454	1,340	1,370
Limburg ..	1,281	1,300	1,308	1,318	1,196

The extent of the *domaine agricole* shows surprisingly little change in a century, especially if the figures for 1938 are considered, rather than those for 1946, which in Limburg at least reveal to some extent the adverse effects of the war of 1940-45. The slight change is all the more remarkable when it is realized that the definition of farm-land includes not only arable land, but also enclosed pasture, orchards and nurseries (see p. 75), and it emphasizes that the most common method of heathland improvement, certainly on the eastern plateau in Limburg,

was by afforestation. It will be appreciated, of course, that this almost negligible change in area gives no indication of the qualitative improvement of the farm-land, which was sometimes considerable; for example, what was then little more than grass heath was commonly

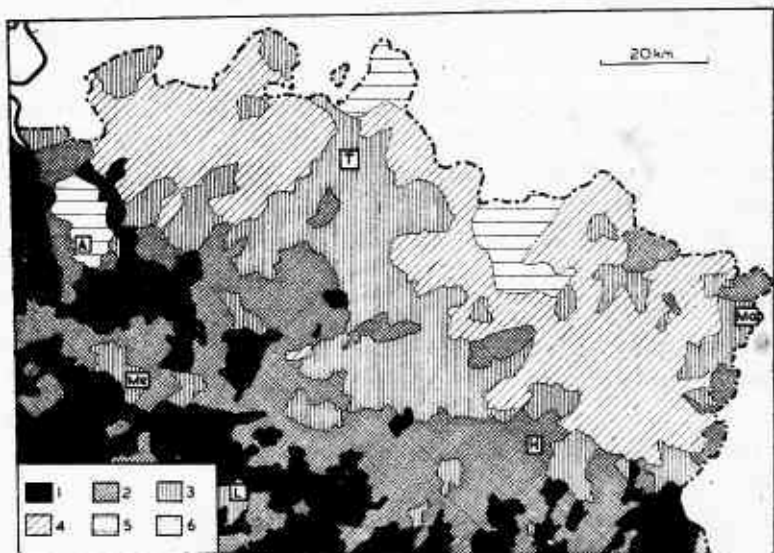


FIG. 22. THE DISTRIBUTION OF ARABLE LAND, 1866

The extent of arable land in each commune was obtained from *Agriculture : Recensement Général* (Bruxelles, 1866).

The figures in the key indicate the percentage of the total area of each commune under arable land, as follows : 1. over 75 ; 2. 50 to 75 ; 3. 30 to 50 ; 4. 15 to 30 ; 5. 5 to 15 ; 6. under 5.

The main towns are indicated by abbreviations, as follows : A. Antwerp ; H. Hasselt ; L. Lier ; Ma. Maaseik ; Me. Mechelen ; T. Turnhout.

included in the 1866 returns as permanent pasture, but by 1946 this had often been improved into true pasture of reasonable quality.

CHANGES IN THE AREA OF ARABLE LAND, 1866-1946

Arable land is entered in the census returns under "*agriculture proprement dite*." This is not altogether satisfactory, for it does not

include rotation grasslands, which in Great Britain, for example, play an integral part in the cultivation of arable land. The rotation grasslands are however of comparatively small extent in the Kempen (see p. 65). The distribution of arable land in the Kempen and in its marginal districts at the time of the Agricultural Census of 1866 is shown

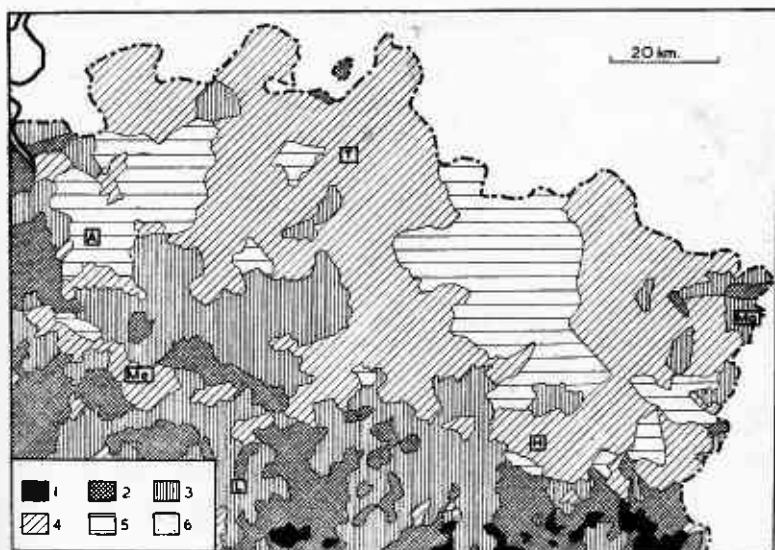


FIG. 23. THE DISTRIBUTION OF ARABLE LAND, 1946

The extent of arable land in each commune was obtained from unpublished statistics made available by the *Institut National de Statistique* in Brussels.

The figures in the key indicate the percentage of the total area of each commune under arable, as follows: 1. over 75; 2. 50 to 75; 3. 30 to 50; 4. 15 to 30; 5. 5 to 15; 6. under 5.

The main towns are indicated by abbreviations, as follows: A. Antwerp; H. Hasselt; L. Lier; Ma. Maaseik; Me. Mechelen; T. Turnhout.

on Fig. 22. In that year, most of the communes in the Kempen itself had only some twenty to thirty per cent of their total areas under arable. This low proportion contrasted markedly with the marginal lands in the Antwerp area to the west, in Brabant and Hesbaye to the south, and in the Meuse valley to the east, where most communes had more than half of their areas under arable, many indeed more than

three-quarters. In the small commune of Zoerle-Parwijs, in fact, the proportion reached eighty-seven per cent. In these marginal communes, although the soil still has a predominantly sandy character, the land is lower than on the plateau, and moreover the numerous tributaries of the two Nethe rivers and the Dyle have fertile alluvial valleys.

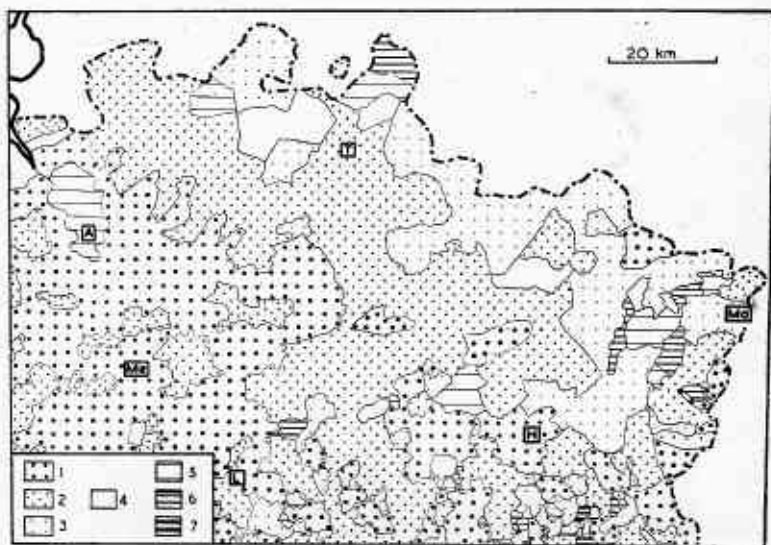


FIG. 24. CHANGES IN THE DISTRIBUTION OF ARABLE LAND, 1866-1946

The change in each commune was calculated from statistics obtained from *Agriculture : Recensement Général* (Bruxelles, 1866), and from unpublished statistics for 1946 made available by the *Institut National de Statistique* in Brussels.

The figures in the key indicate the change in the area of arable land between the two surveys, expressed as a percentage of the total area of each commune, as follows : 1. decrease exceeding 25 ; 2. decrease of 10 to 25 ; 3. decrease of 2 to 10 ; 4. little or no change, i.e. less than plus or minus two ; 5. increase of 2 to 10 ; 6. increase of 10 to 25 ; 7. increase exceeding 25.

The main towns are indicated by abbreviations, as follows : A. Antwerp ; H. Hasselt ; L. Lier ; Ma. Maaseik ; Me. Mechelen ; T. Turnhout.

Furthermore, the rapidly increasing population of the city of Antwerp and also, to a less extent, that of Mechelen and of the Rupel estuary towns, afforded a growing demand for vegetables and so encouraged

market-gardening. But in the Kempen proper, as distinct from its margins, the arable land in 1866 was restricted to small areas around the isolated villages, for the percentage of heathland in each commune was usually high. There were, of course, variations in detail, and several Kempen communes had proportions of arable land markedly higher and conversely others markedly lower than the general average of some twenty to thirty per cent of the total area of each.

Proportions of Arable Land, 1866

<i>High Proportions of Arable</i>		<i>Low Proportions of Arable</i>	
<i>Commune</i>	<i>Percentage of Total Area</i>	<i>Commune</i>	<i>Percentage of Total Area</i>
Koersel ..	61	Eksel ..	10
Opitter ..	56	Lommel ..	14
Bocholt ..	51	Poppel ..	14
Beringen ..	50	Wijshagen	15
Thielen ..	50		

The decrease in the extent of arable land between 1866 and 1946, as shown on Figs. 22-4, is one of the most striking features of much of both the Kempen and its margins. Admittedly, the figures for 1946 were reduced by the effects of the war, but only slightly; the total area of arable land in the provinces of Antwerpen and Limburg in 1946 was 1,444 square kilometres, only about five per cent less than the figure for 1938. The decrease in the arable land between 1866 and 1946 was especially marked in the Antwerpen Kempen in the west, in Brabant and Hesbaye along the southern margins, and in the Kempen plain in the north-east near the Netherlands frontier.

One reason for this reduction in the arable land of many communes in the Antwerpen Kempen is their great growth of population, and therefore the spread of built-up areas over what was formerly cultivated land. Thus Mortsel, Ekeren, Merksem, Deurne, Borgerhout,

Berchem and Wilrijk, all with high proportions of arable land in 1866, were by 1946 almost wholly urbanized, forming part of the Antwerp agglomeration. But the main reason for the overall general decrease is that the nature of the farming system in the Kempen as a whole has changed. Under the influence of the great nearby markets offered by Antwerp, Mechelen, Brussels and other towns in central Belgium, the emphasis is now on cattle-keeping for milk and veal, and the area of permanent pasture has been increased accordingly at the expense of field-crops such as cereals. What arable land remains is under either intensively cultivated market-gardens or fodder crops.

*Communes with a marked Decrease in Arable Land,
1866-1946*

<i>Commune</i>	<i>Percentage of Total Area under Arable</i>	
	<i>In 1866</i>	<i>In 1946</i>
<i>Antwerpen region</i>		
Mortsel	85	15
Ekeren	92	24
Merksem	82	15
<i>Brabant and Hesbaye (Kempen margins)</i>		
Vaalbeek	85	33
Oplinter	72	30
<i>Northern Kempen Plain</i>		
Bocholt	51	23
Sint-Huibrechts-Lille ..	43	19

Only in the heathland communes of the east-central plateau and to the north of Turnhout has there been little or no decrease in the area of arable land. Here there was little arable land in 1866 anyway, merely a small area surrounding each village or hamlet, used to produce

subsistence crops for the scanty population. A few communes have even slightly increased their areas of arable land, mainly because of the growth of the industrial population (see p. 204), so producing an increase in the number and total area of small-holdings used for subsistence cultivation.

*Communes with an Increase in Arable Land,
1866-1946*

Commune	Percentage of Total Area under Arable	
	In 1866	In 1946
Wijshagen ..	15	29
Eisden ..	35	48
Poppel ..	14	27
Tongerloo ..	20	32
Opoeteren ..	20	30

CHANGES IN THE AREA OF PASTURE, 1866-1946

The figures of pasture as returned in the Belgian agricultural censuses include four categories : *prairies temporaires fauchées* (rotation grassland for mowing), *prairies temporaires pâturées* (rotation grassland for grazing), *prés et prairies permanentes fauchés* (permanent grassland for mowing), and *prés et prairies permanentes pâturés* (permanent pasture). The area of the two categories of permanent pasture in the Kempen is very much greater than that of rotation grassland ; thus, in 1946, there were 102,917 hectares of permanent pasture in Antwerpen and Limburg, but only 2,778 hectares of rotation grassland. The four categories are commonly grouped together as "*prairies*."

The distribution of all pasture in the Kempen and its marginal lands in 1866 is shown on Fig. 25. In that year, many of the communes had less than one-tenth of their areas under pasture ; thus Genk had only

five per cent and Weelde six per cent, consisting for the most part of small tracts of water-meadows along the alluvial valleys or around the margins of lakes. A number of communes, it is true, had proportions of pasture rather higher than the general average, ranging from ten to twenty per cent of their total areas, occasionally even more, as in

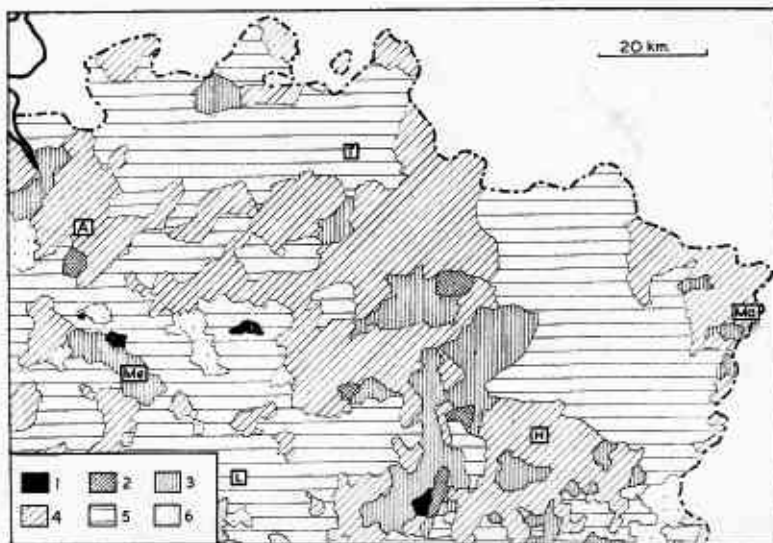


FIG. 25. THE DISTRIBUTION OF PASTURE LAND, 1866

The extent of pasture land in each commune was obtained from *Agriculture : Recensement Général* (Bruxelles, 1866).

The figures in the key indicate the percentage of the total area of each commune under pasture, as follows : 1. over 40 ; 2. 30 to 40 ; 3. 20 to 30 ; 4. 10 to 20 ; 5. 1 to 10 ; 6. under 1.

The main towns are indicated by abbreviations, as follows : A. Antwerp ; H. Hasselt ; L. Lier ; Ma. Maaseik ; Me. Mechelen ; T. Turnhout.

Olmen (thirty-one per cent) and in Lummen (twenty-seven per cent). These higher proportions occurred mainly in the central Kempen, along the western and south-western edge of the plateau, where rise the numerous headstreams of the Kleine- and Groote-Nethe and of the Demer. Their alluvial valleys, with gentle gradients and a high water-table, carried water-meadows, which contrasted markedly both

with the sandy soils, the streamless surface and the heath vegetation of the plateau to the east, and with the arable lands of the Antwerpen Kempen to the west. The influence of river valleys on the extent of pasture can be seen on Fig. 25; the lines of communes, with proportions of pasture above the average, are strung out along the valleys of the Kleine- and Groote-Nethe, and stand out clearly among the arable lands of western Antwerpen. In the north-east the influence of irrigation water drawn from the Meuse-Scheldt and the Zuid-Willems Canals, used to maintain water-meadows, can also be recognized.

There was a considerable increase between 1866 and 1946 in the area of pasture in the provinces of Antwerpen and Limburg, as indicated :

Province		1866	1946
		(hectares)	
Antwerpen	..	32,098	60,533
Limburg	..	29,998	45,163
Total	62,096	105,696

The proportion of pasture has increased in almost every commune in the area covered by Figs. 26-7. By 1946, twelve communes had more than two-fifths of their area under pasture; Donk, in the Demer valley to the west of Hasselt, had as much as sixty-three per cent, while Loenhout, near the Netherlands frontier in the north-west, had fifty-six per cent. This great increase in the area of pasture between 1866 and 1946 is due to two main reasons. In the west and south it has been complementary to the reduction of the arable land, as shown in Fig. 24. On the other hand, in the east and north it has been due to the decline in heathland, as shown in Fig. 21. In both districts, the fundamental cause has been the great development of cattle-farming for milk and veal.

Examples of the increase in pasture at the expense of arable between 1866 and 1946 are listed in the Table on the next page. All these communes lie on the western or southern margins of the Kempen.

<i>Commune</i>	<i>Pasture</i>	<i>Woodland</i>	<i>Heathland etc.</i>	<i>Arable</i>
Aartselaar	+31	+3	-13	-17
Donk.. ..	+49	-6	N	-34
Putte	+32	-5	-12	-15
Sint-Lambrechts-Herk	+48	-3	N	-45
Vremde	+32	-1	N	-38
Waarloos	+34	-2	- 4	-38

The figures are calculated in terms of the total area of each commune. + signifies increase, — decrease, and N little or no change, i.e., less than plus or minus two per cent of the total area of each commune. Thus Aartselaar had only two per cent of its total area under pasture in 1866, but by 1946 this had risen to 33 per cent, an increase equivalent to 31 per cent of the area of the commune. It will be realized that other categories of land utilization, including built-up areas, air-fields, military grounds and non-taxable areas, are not included in the table, although they are of course involved in the calculation of the percentages, and so the increases and decreases in these four major categories cannot always be equated exactly.

By contrast, among the eastern and northern Kempen communes, eleven have increased their extent of pasture by amounts equivalent to a quarter of their total area, mainly by the reduction in heathland. The six following communes are representative of this change :

<i>Commune</i>	<i>Pasture</i>	<i>Woodland</i>	<i>Heathland etc.</i>	<i>Arable</i>
Esschen	+25	+2	-19	-16
Loenhout	+32	-9	-17	+5
Merksplas	+33	-25	-9	+1
Minderhout	+30	+6	-34	-3
Vlimmeren	+36	+6	-31	-7
Wuustwezel	+26	+7	-32	-9

The last three communes have increased their pasture almost entirely at the expense of the heath, Merksplas and Loenhout at the expense of

both heath and woodland, and Esschen at the expense of both heath and arable land.

Only a few communes had a decrease in their areas of pasture between 1866 and 1946. These changes were usually slight, and were due either to land being put under fodder crops, or to an extension of

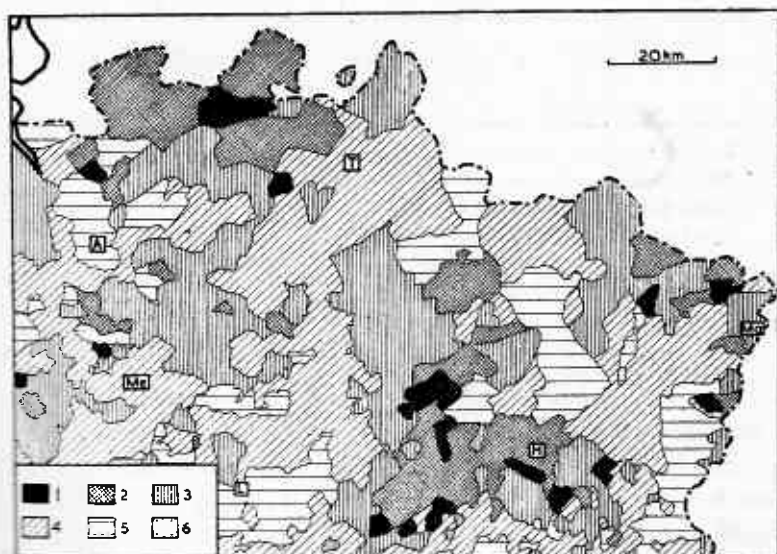


FIG. 26. THE DISTRIBUTION OF PASTURE LAND, 1946

The extent of pasture land in each commune was obtained from unpublished statistics made available by the *Institut National de Statistique* in Brussels.

The figures in the key indicate the percentage of the total area of each commune under pasture, as follows : 1. over 40 ; 2. 30 to 40 ; 3. 20 to 30 ; 4. 10 to 20 ; 5. 5 to 10 ; 6. under 5.

The main towns are indicated by abbreviations, as follows : A. Antwerp ; H. Hasselt ; L. Lier ; Ma. Maaseik ; Me. Mechelen ; T. Turnhout.

the built-up areas, with a complementary increase in gardens and small-holdings. Two communes, Lichtaart and Lummen, had a decrease in pasture equivalent to one-tenth of their respective areas.

The Sowing of Pastures

The area of pasture has been increased in the heathlands by the replacement of the heath associations with carefully selected cultivated

grasses. Much research has been carried out to discover mixtures of seed suitable for dry sandy soils—quick-growing, drought-resistant, and with tenacious binding roots. The following mixture is recommended by the *Station de l'Etat pour l'Amélioration des Plantes* at Melle, maintained by the *Ministère de l'Agriculture* :

	Kilograms per hectare	Pounds per acre
English rye-grass (<i>Lolium perenne</i>)	20	17·8
Meadow fescue (<i>Festuca pratensis</i>)	12	10·7
Smooth-stalked meadow grass (<i>Poa pratensis</i>)	6	5·3
Wild white clover (<i>Trifolium repens</i>)	5	4·5
Italian rye-grass (<i>Lolium italicum</i>)	4	3·6
Total	47	41·9

The heathland intended for reclamation is cleared, sometimes by burning in the late autumn, and roots of shrubs are removed. The area is then deep-ploughed, dressed with basic slag, and allowed to winter before the grass-seed is sown. The pastures are usually intersected with ditches, which serve for drainage in the winter and sometimes for irrigation in the summer.

Irrigated Meadows

During the mid-nineteenth century, great efforts were made to increase the area of agriculturally productive land in Belgium (see pp. 57-8). One body of opinion was in favour of the extended use of irrigation in the heathlands, by taking water from the newly constructed navigation canals. With plentiful irrigation water, they hoped to increase the area of meadows and so the number of cattle, resulting in greater supplies of dung for the light soils. An engineer, Ulrich Kümmer, was put in charge of a large-scale scheme, and he planned as a first step the irrigation of some twenty-five thousand hectares in the north-east of

the Kempen, using water from the Meuse-Scheldt Canal and its branches, and from the Zuid-Willems Canal. His efforts made some progress during the first ten years after 1847, when areas of land immediately adjacent to the canals were easily supplied with water,

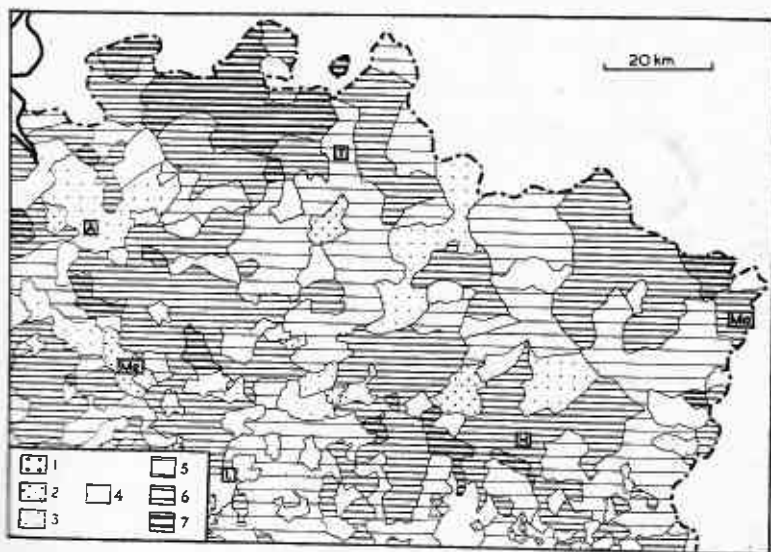


FIG. 27. CHANGES IN THE DISTRIBUTION OF PASTURE LAND, 1866-1946

The change in each commune was calculated from statistics obtained from *Agriculture : Recensement Général* (Bruxelles, 1866) and from unpublished statistics for 1946 made available by the *Institut National de Statistique* in Brussels.

The figures in the key indicate the change in the area of pasture between the two surveys, expressed as a percentage of the total area of each commune, as follows: 1. decrease exceeding 25; 2. decrease of 10 to 25; 3. decrease of 2 to 10; 4. little or no change, i.e. less than plus or minus two; 5. increase of 2 to 10; 6. increase of 10 to 25; 7. increase exceeding 25.

The main towns are indicated by abbreviations, as follows: A. Antwerp; H. Hasselt; L. Lier; Ma. Maaseik; Me. Mechelen; T. Turnhout.

especially as these waterways often lay within embankments above the surrounding countryside, and so the meadows could be supplied through sluices by gravity-flow. By 1856, just over three thousand hectares of land, owned both communally and privately, had been irrigated.

The Irrigated Area in the North-Eastern Kempen, 1856

Zuid-Willems Canal		Meuse-Scheldt Junction Canal		Turfhout Branch Canal		Beverloo Branch Canal	
Commune	Area (hectares)	Commune	Area (hectares)	Commune	Area (hectares)	Commune	Area (hectares)
Bocholt ..	57	Achel ..	111	Arendonk ..	309	Mol ..	54
Bree ..	3	Bocholt ..	100	Postel ..	37		
Eelen ..	82	Geel ..	369	Ravels ..	50		
Eisden ..	5	Hamont ..	158	Retic ..	333		
Gruitrode ..	4	Kaulille ..	56				
Neeroeteren ..	109	Lommel ..	438				
Opitter ..	1	Mol ..	279				
Roeren ..	5	Balen ..	216				
Rotem ..	45	Desschel ..	80				
		Neerpelt ..	122				
		Overpelt ..					
		Sint-Huibrechts-Lille					
Totals ..	311		1,929		729		54

But Kümmer had both under-estimated the amount of water needed for irrigation and over-estimated the quantity which could be taken from the waterways, especially in dry summers. The maximum area

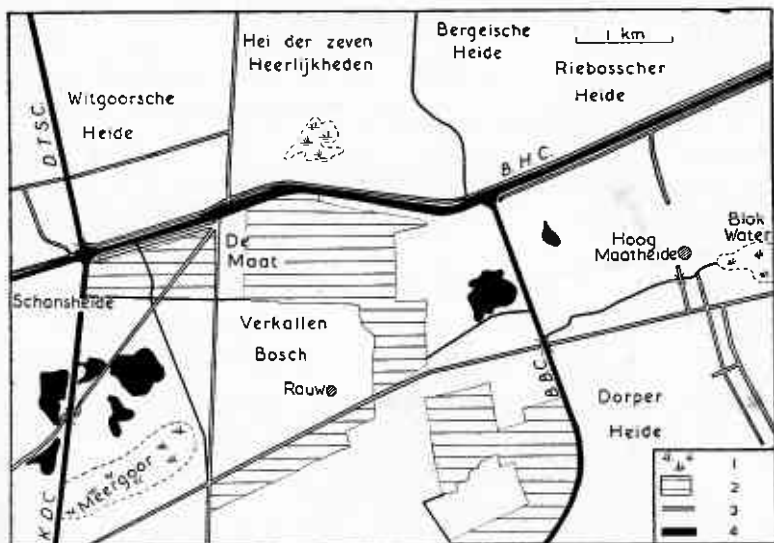


FIG. 28. IRRIGATED WATER-MEADOWS IN THE KEMPEN PLAIN

The figures in the key are as follows : 1. marsh (approximate area delimited by pecked lines) ; 2. irrigated area ; 3. roads ; 4. canals. The abbreviations are as follows : B.B.C. Beverloo Branch Canal ; H.B.C. Herentals-Bocholt Canal ; D.T.S.C. Desschel-Turnhout-Schoten Canal ; K.D.C. Kwaadmechelen-Desschel Canal. Village centres are indicated only diagrammatically by shaded circles. The minor irrigation channels which criss-cross the area are not shown.

The irrigated area lies between Desschel to the west and Lommel to the east. On either side of the Herentals-Bocholt Canal there are extensive heathlands, with areas of sand-dunes, although parts have recently been planted with conifers. The irrigated land near this canal and also near the Beverloo Branch Canal is criss-crossed with a close network of parallel ditches, in places ten or even five metres apart. The major irrigation canals feeding the ditches are led from the navigable waterways through sluices. The land is low-lying, and the ditches serve also to drain the land after heavy rain, especially in winter.

of irrigated land in the north-east of the Kempen was in fact achieved in 1860, when it totalled 3,068 hectares, and since then it has fallen slightly. Two examples of present-day irrigation areas in the north-east are shown in Figs. 28-9 ; the former is of the area between

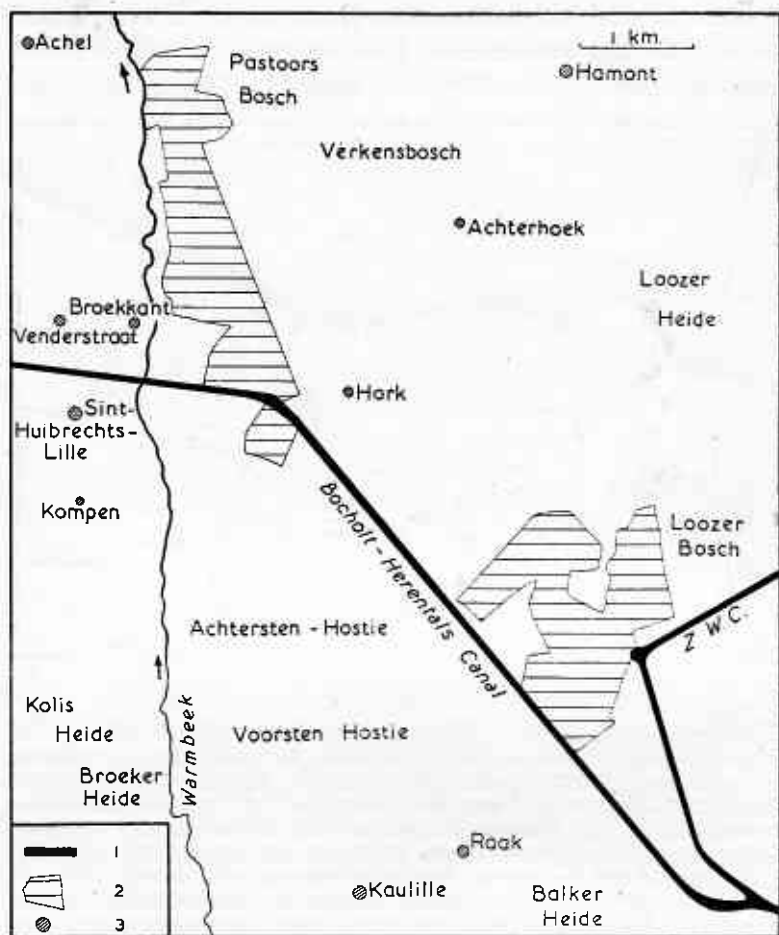


FIG. 29. IRRIGATED WATER-MEADOWS NEAR SINT-HUIBRECHTS-LILLE

The figures in the key are as follows : 1. navigable waterways ; 2. irrigated area ; 3. village centres. The abbreviation Z.W.C. indicates the Zuid-Willems Canal. The minor channels which criss-cross the area are not shown.

The area of water-meadows lying to the north-east of the village of Sint-Huibrechts-Lille is supplied with water both from the Warmbeek and from an irrigation channel fed from the Herentals-Bocholt Canal through a sluice in the thick earth banks. A second irrigated area lies within the angle of the junction of the above canal with the Zuid-Willems Canal, and is supplied with water from both.

Desschel and Lommel, known as De Maat, along the Herentals-Bocholt Canal, the latter lies near the junction of that waterway with the Zuid-Willems Canal. The efficacy of the irrigation system in these districts was shown by the contrast, particularly noticeable during the dry summer and autumn of 1947, between the brown heathland beyond the irrigated area and the damp green meadows, crossed by drainage ditches. Elsewhere in the Kempen, irrigation is limited mainly to the valleys of the Demer and the Nethe, where even in primarily arable areas water-meadows frequently border the rivers, as in Fig. 30, which shows part of the Groote-Nethe valley near Itegem.

The irrigated areas so described are supplied with water by gravity from the streams, canals and small lakes. But the heathlands above fifty metres, where improvement is most needed, cannot be irrigated except on a very limited scale, because of the absence of streams on the plateau. This need is rather strikingly exemplified in Genk commune, where water-sprinklers have to be kept constantly playing in the gardens of the housing-estates.

ARABLE FARMING

As a preliminary to a consideration of present-day farming, it is useful to compare the areas of the main categories of cultivation for the two Kempen provinces in 1846 and in 1946 (see Table overleaf). The reduction in the total area of arable land in each province has already been discussed (see pp. 62-5 and Fig. 24). Apart from this, there are three important changes in the nature of the arable farming brought out by this Table. In the first place, there has been a very great reduction in the area of land under cereals. In the second place, there has been a considerable increase in the area under root-crops, much more marked however in Antwerpen than in Limburg. In the third place, there has been an increase in the area devoted to market-gardening, fruit-growing and allied activities. The detailed changes may be appreciated most readily by an examination of the Table on p. 88, which analyzes, for eight representative communes in various parts of the Kempen and its margins, the areas under the main crops in 1846 and 1946.

Categories of Arable Cultivation, 1846-1946

	<i>Antwerpen</i>		<i>Limburg</i>	
	1846	1946	1846	1946
	<i>(hectares)</i>			
Cereals	74,226	32,960	68,219	35,992
Industrial crops ..	3,990	270	1,570	5,707
Root-crops.. ..	11,577	20,175	8,529	9,997
Leguminous crops..	1,138	827	3,044	661
Green fodder crops	12,680	7,392	8,502	6,944
Fruit	3,625	2,289	5,933	13,134
Vegetables		4,664		1,030
(not field-crops)				
Others		1,586		827
(flowers, nurseries, etc.)				
Total	107,236	70,163	95,797	74,292

Rye is the main cereal, indeed the chief cultivated crop in the Kempen, for it can stand poor sandy soils, and it occupied nearly half of the arable area in 1946. But, as in the case of all cereals, even the area under rye has diminished in the last eighty years. Oats is grown mainly as a fodder crop in the damper river valleys; in some of the low-lying communes along the Netherlands frontier its area closely approaches and occasionally exceeds that under rye. Wheat now occupies only about four per cent of the arable land, and its extent has decreased in Antwerpen and Limburg from about 27,000 hectares in 1866 to less than a third of that area in 1946. Buckwheat, a quick-maturing grain but of uncertain yield, which, like rye, can be grown on poor soils, was widely cultivated in the nineteenth century, but by 1946 had almost completely disappeared. About one-fifth of the arable land in the two provinces in 1946 was under root-crops; the two outstanding items were potatoes (15,476 hectares) and fodder-beet

(13,759). The area under potatoes has decreased, however, by about half since 1866, while fodder-beet has gained ground almost everywhere in the Kempen, partly at the expense of leguminous and green fodder crops.

Rotation Systems

Until the latter part of the nineteenth century, rotation methods in the Kempen were of the simplest. In some of the higher heathlands a system was practised which was really a form of shifting agriculture. An area of heath was cleared, the top layer was burnt and dug back into the soil, and two or three successive crops of rye, followed by one of potatoes, were taken. After this, the area was allowed to lie fallow, and another patch was cleared. Needless to say, yields were extremely low.

Since the end of the nineteenth century, the increase in the number of livestock has made available more manure, while chemical fertilizers and lime, which can be distributed cheaply by waterway, have been used in much greater amounts. Many Kempen farmers are members of fertilizer purchasing societies affiliated to the *Boerenbond* (see p. 82). More effective rotation systems have been introduced as the result of modern agricultural research. Five examples chosen from various parts of the Kempen and its margins are tabulated on p. 78; except for the system used on the very poor soils of the plateau in the east, where a period of fallow is frequently introduced, these rotations do not vary much in principle. Under another system used in many heathland communes, areas of land are laid down under grass and left as pasture for three years or more, then a crop of either potatoes or a cereal is taken, and the land is regressed. The dominance of rye and potatoes in any rotation used on poor sandy soils with a rainfall of 600 to 750 millimetres is obvious.

<i>Year of Rotation</i>	<i>South-western margins</i>	<i>Antwerpen Kempen</i>	<i>Northern Kempen Plain</i>	<i>Meuse Valley</i>	<i>Central and Eastern Plateau</i>
1	Potatoes	Potatoes	Potatoes	Potatoes	Potatoes
2	Wheat	Rye, wheat or barley	{ Rye Turnips	Rye	Rye
3	Clover	Clover	Oats and clover (ii)	Rye or barley	Oats and clover
4	Wheat or barley	Clover	Clover	Oats and clover	Fallow (iii)
5	{ Rye Turnips (i)	Oats	{ Rye Turnips	Clover	Fallow
6	—	—	Oats, buckwheat or lupins	—	Fallow

Note. (i) Turnips follow rye as a catch-crop ; (ii) oats and clover are grown together for green fodder ; (iii) in the eastern plateau, the period of fallow varies from one to three years or even more, according to the nature of the soil. In the first, second and fourth example, the rotation is on a five-year basis, in the third example on a six-year basis.

The improvements in agricultural methods, together with the fact that the poorest lands have gone out of cultivation, frequently to be afforested, are shown by a comparison of the average yields per hectare in Antwerpen and Limburg with those in Belgium as a whole for 1945. While the figures for the two Kempen provinces were in general slightly lower, there was not the great discrepancy which might be expected. Only rye showed results markedly poorer, and the yield of fodder-beet, of potatoes and of lucerne was actually higher in the Kempen provinces than in all Belgium. It must be remembered that the output of Belgian agriculture declined markedly during the war of 1940-45, and reached a record low in 1945 before recovery started ; the averages for Belgium in 1938 are appended as an indication of this wartime decline, but provincial figures are not available.

*Average yields in Antwerpen, Limburg and Belgium
(kilograms per hectare)*

	<i>Antwerpen</i> 1945	<i>Limburg</i> 1945	<i>Belgium</i> 1945	<i>Belgium</i> 1938
Winter wheat ..	18.9	17.8	19.1	} 28.2
Spring wheat ..	13.0	14.8	15.6	
Rye	10.8	9.8	13.0	25.9
Barley	12.9	15.2	16.6	26.2
Oats	15.7	19.1	21.8	28.0
Fodder-beet ..	513.3	492.4	482.7	630.4
Potatoes	130.0	137.7	131.2	225.2
Lucerne	46.2	59.1	54.4	53.0
Hay	43.1	32.0	37.2	34.8

Market-Gardening and Small-holdings

The neighbouring large markets of Antwerp, of the Scheldt estuary and Demer valley towns, and even of Brussels, have greatly encouraged the output of market-garden produce. The light and warm Kempen sands, when heavily fertilized, are very suitable for the intensive cultivation of vegetables, particularly of early varieties. Such crops as peas, sown at the end of January and picked in early June, asparagus, early potatoes, carrots and chicory are grown along the northern edge of the Demer valley between Mechelen and Lier, forming a belt of prosperous activity. Glass-house produce, bush- and orchard-fruits, and flowers are also important. Thus this part of the western Kempen has locally an outstanding intensity of agriculture.

Garden-cultivation on a smaller scale is to be found around most of the Kempen towns and villages, carried on not for the production of cash-crops but for subsistence. The allotment or small-holding system is one of the most characteristic features of Belgian life, and most industrial workers have their own holdings (see p. 85). Consider,

for example, Fig. 69, which depicts the land utilization in the neighbourhood of Lommel. Behind the houses which line the main roads are large gardens and small-holdings, usually surrounded with low privet hedges, each with a clump of shelter trees, a small orchard, and a large vegetable patch growing tomatoes, sunflowers for their seed, runner beans and miscellaneous vegetables. Many of the gardens are intersected with ditches, which invariably contain stagnant water. Outside the "garden zone" is a circle of arable land divided into small fields, separated by wire fences or ditches, and cultivated in narrow strips of maize, rye, potatoes and fodder-beet. In the agricultural returns of 1946, Lommel had thirteen hectares of kitchen-garden and eight hectares of orchards.

The yield of all crops, but especially of those grown in intensively worked market-gardens, is raised considerably when irrigation water can be applied to the warm but dry sandy soils. This is commonly practised in a simple way in the valleys, and especially in those communes near navigable waterways. Near Herentals, for example, a large number of small-holdings and market-gardens are supplied with water from a short cul-de-sac off the Herentals-Bocholt Canal. The water is taken from this at a sluice, then led through concrete conduits into trenches surrounding and intersecting the holdings. The water-level in the canal is some three metres above the surrounding land, and the vegetable beds can be efficiently watered by gravity flow, even in a dry summer.

An interesting example of intensive cultivation on a garden scale is seen at the Sint-Benedict monastery near Achel on the Dutch frontier, in the north-east of the Kempen. The gardens and holdings in Achel village itself are irrigated in places by water led from the Herentals-Bocholt Canal by major channels. But to the north-east of Achel the countryside is open and dry, comprising the Binne Heide, on which are some areas of rye and much coarse pasture. About five kilometres from Achel station, in the midst of the Binne Heide, is the monastery, which is an outstanding example of nineteenth century heathland colonization. The poplar wind-breaks, the irrigation channels which take their water from the Warmbeek, a stream flowing

northwards into the Netherlands, the carefully fenced fields, the walled kitchen-gardens and orchards, all maintained by the diligent and selfless labours of the Brothers, produce results which are a by-word in the north-eastern Kempen.

LIVESTOCK

The changes in the numbers of livestock in the provinces of Antwerpen and Limburg during the last hundred years are indicated by statistics derived from five representative agricultural censuses.

Livestock in Antwerpen and Limburg, 1846 to 1946

	<i>Sheep</i>		<i>Cattle</i>		<i>Pigs</i>		<i>Horses</i>		<i>Goats</i>	
	<i>Ant.</i>	<i>Lim.</i>	<i>Ant.</i>	<i>Lim.</i>	<i>Ant.</i>	<i>Lim.</i>	<i>Ant.</i>	<i>Lim.</i>	<i>Ant.</i>	<i>Lim.</i>
1846	23,606	51,750	115,831	87,923	26,399	47,348	16,536	17,365	23,487	4,785
1866	26,613	49,579	127,286	94,090	41,859	54,777	17,091	16,930	42,332	9,175
1895	20,110	23,447	130,061	105,217	91,399	99,251	21,495	14,310	43,546	7,909
1929	9,216	11,576	157,095	111,929	78,962	100,818	20,716	19,591	35,054	6,073
1946	8,307	18,252	151,095	112,216	68,415	77,082	25,164	21,471	26,753	3,271

There were about a million sheep in Belgium at the beginning of the nineteenth century, of which a fifth were to be found in the Kempen. These subsisted on the poor grasses and young ling shoots of the heathlands; grazing was in fact one of the rights threatened by the State-instigated reclamation schemes of the mid-nineteenth century. But even before this time, the flocks were rapidly declining; in 1816, Limburg had 155,933 sheep, but by 1846 there was only one-third of this number. This steady reduction continued into the present century, although there has been some increase in Limburg since 1929. The decline has been due mainly to the more profitable use which has been made of the heathlands. Moreover, wool is now

for the most part imported, and there is very little demand for mutton, which in Belgium is regarded as a secondary and not very attractive meat. Even in Genk commune, on the heathlands of the eastern plateau, where in 1866 there were 1,160 sheep, the number had fallen by 1946 to only 364.

In the nineteenth century, Kempen cattle were characterized by their small size, poor bone formation and low milk yield, deficiencies mainly the result of inadequate feeding and of uncontrolled breeding methods. Their merits were that they were at least hardy, and did produce some manure, though by no means enough, for the hungry soils. Stall-fed during the winter, they grazed the better heathland pastures in spring until mid-April, and again from mid-September until the end of October. In summer they grazed those valley-meadows not needed for mowing, and then were turned on to the rye-stubble. In 1900, it was estimated that the annual milk yield of the average milch-cow in the eastern Kempen was about 2,500 litres, as compared with 3,500 litres in the Flanders Plain. The standard of cattle-rearing, as of farming in general, has improved considerably in the present century. This has been due in no small measure to the activity of the *Boerenbond*, a powerful institution with its headquarters in Leuven, which aims at furthering the principles of co-operation and at introducing more scientific methods into agriculture. Numerous local societies and syndicates are affiliated. It encourages agricultural education by a monthly publication, by information and advisory bureaux, and by periodic conferences. It has established associations for the insurance of cattle and for the provision of agricultural credit, co-operative dairies, and buying concerns to supply members with seed, implements and fertilizers. The *Boerenbond* had a membership in the Kempen of some twenty thousand before 1939. It is an interesting fact that of the 436 Belgian societies handling the insurance of farm animals, 118 were in Limburg. Nevertheless, co-operation is not yet widely established. It is estimated that only about one-third of Kempen milk is handled by co-operative organizations, although the proportion is rather higher in the east. In conjunction with dairying, there has been a big increase in the fattening of calves for

veal, the favourite meat in Belgium, and the Kempen production is largely responsible for the fact that in the years before 1939 the Belgian market was almost wholly supplied by home-produced veal and beef. In 1946, the provinces of Antwerpen and Limburg provided the markets with nearly 60,000 calves.

Horses have increased steadily in numbers, because the characteristic small-sized Kempen holdings are not suited to mechanized methods; of the 21,471 horses in Limburg in 1946, 19,268 were used in agriculture. Pigs, too, are more numerous than in 1866. They are eminently suited both to small-holdings and also to larger farms where the concentration of activity is on milk-production for the creameries, so that the skimmed milk can be returned to the pigs. The decline shown in 1946 was due both to a series of bad outbreaks of foot-and-mouth disease in previous years and to the widespread slaughtering during the German occupation and in the "hungry period" following the liberation. Goats have declined in numbers since 1866, both because of the reduction in the area of rough heathland grazing and because of the increased amounts of cow's milk that are being produced. They are still commonly to be found, however, tethered by the roadsides or on patches of heathland common.

WORKERS AND HOLDINGS

In 1846, the number of people engaged in agriculture in the whole of Belgium, including the working members of families, was 1,083,604, or about a quarter of the total population. The Kempen *arrondissement* had outstandingly high proportions of their populations engaged in agriculture. Maaseik, with forty-eight per cent, had the highest figure in Belgium, in fact Bastogne in Luxembourg was the only other *arrondissement* in Belgium with over forty per cent.

*The Agricultural Population in the Kempen
Arrondissements, 1846*

	<i>Agricultural Population</i>	<i>Percentage of Total Population</i>
Antwerpen	33,014	17
Mechelen	34,790	30
Turnhout	38,276	38
Antwerpen province	106,080	26
Hasselt	26,428	34
Maaseik	17,875	48
Tongeren	24,855	35
Limburg province..	69,158	38

By 1929, at the time of the last detailed census of agricultural workers, the position had changed very considerably. The Table overleaf analyzes the agricultural population of the two provinces at that date.

Between 1846 and 1929, the percentage decrease in the agricultural population was thirty-five in Antwerpen and twenty-seven in Limburg. Most of this decline represents the reduction in the number of hired labourers, which is characteristic not only of the Kempen but also of all Belgium. For example, in 1856, there were no less than 41,185 agricultural labourers in Limburg, but in 1929 the number had sunk to 4,379. This decline can be explained in two ways. In the first place, there has been the increasingly greater attraction of urban life and of the higher wages and shorter hours offered by industry in other parts of Belgium, and particularly after 1900 in the Kempen itself, with the development of the coalfield and the introduction of new industries. Secondly, those labourers who wished to stay in agriculture often

became farmers on their own account ; this is shown by the increase in the number of owner- or tenant-cultivators, in Limburg, for example, from 17,516 in 1846 to 30,125 in 1929.

*The Agricultural Population in Antwerpen and Limburg,
1929*

	<i>Cultivators and their Families</i>	<i>Paid Labourers</i>	<i>Total</i>
<i>Antwerpen</i>			
Male ..	36,211	4,327	40,538
Female ..	26,788	1,265	28,053
Total ..	62,999	5,592	68,591
<i>Limburg</i>			
Male ..	27,049	3,076	30,125
Female ..	18,847	1,303	20,150
Total ..	45,896	4,379	50,275

Holdings

A characteristic feature of Belgian agriculture is the tendency towards ~~the~~ extreme sub-division of the land into small holdings. This ~~results~~ in part from the large numbers of industrial workers who live in the country and cultivate a small plot in their spare time with the help of their families. They are often obliged to travel some distance to work, but can take advantage of the cheap fares afforded by the *Chemins de Fer Vicinaux* (see p. 193). It is a striking fact that in 1929 there were 138,367 individual holdings in Antwerpen and Limburg, but only 118,866 full-time agricultural workers. The desire to own or rent land, frequently the latter, since before 1939 ~~prices~~ were relatively low as compared with the purchase price, is an

outstanding characteristic of many Belgians. Furthermore, the inheritance laws divide property equally among all the heirs, and thus *parcelllement* has been carried to excess. The small fields resulting from

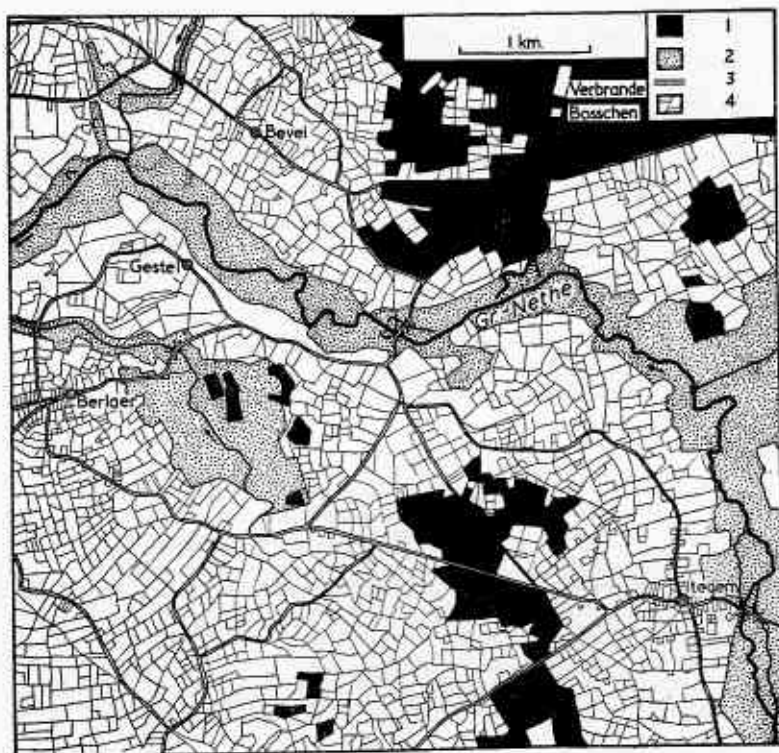


FIG. 30. THE FIELD-PATTERN IN THE NEIGHBOURHOOD OF ITEGEM

The figures in the key are as follows : 1. woodland ; 2. pasture ; 3. major roads ; 4. field boundaries. The cultivated land is left white. Village centres are indicated by shaded circles.

Itegem lies to the south-west of Antwerp.

this *parcelllement* are illustrated on Fig. 30, a map of an area on the south-western margins of the Kempen, lying on either side of the valley of the Groote-Nethe. The fields are demarcated by hedges, by wire fences,

by ditches, sometimes only by hard earth paths. Individual holdings may consist of a number of these scattered "parcels," with the obvious disadvantages to efficient agriculture. The increase in the number of individual holdings between 1846 and 1929 in the two Kempen provinces has been considerable.

*Number of Holdings in Antwerpen and Limburg,
1846-1929*

<i>Province</i>	1846	1866	1895	1929
Antwerpen	47,935	59,068	62,813	84,450
Limburg ..	32,170	45,747	38,291	53,917

A very large proportion of these holdings, particularly those cultivated by part-time workers, consisted of tracts of land of less than one hectare ; in fact, holdings of an hectare or less made up three-quarters of the total number, but occupied only about seven per cent of all the farm-land. The area of land occupied by the groups of holdings of from one to twenty hectares comprised nearly three-quarters of the total area of farm-land in Antwerpen and Limburg, a rather greater proportion than in Belgium as a whole. The average full-time holding in the Kempen proper, as distinct from the gardens and small-holdings cultivated by miners and factory workers, comprised an hectare or two of arable land behind the house or within a short distance of the village in which the homestead was situated, together with several hectares of enclosed pasture on the marshy edge of a valley or on the margins of the heathland. The proportion of the total area of the Kempen occupied by the larger estates of over a hundred hectares was about twice as great as in the rest of Belgium ; most of these were almost wholly under pasture.

Arable Cultivation in representative Kempen Communes (hectares)

Commune	Total Area	Rye	Wheat	Oats	Buck-wheat	Potatoes	Fodder beet	Green Fodder Crops	Orchards	Kitchen gardens	Other Cultivation	Arable % of total area
	1945	1866	1946	1866	1946	1866	1946	1866	1946	1866	1946	1866 1946
<i>Northern Kempen</i>												
Eschen ...	4,213	730 282	26	324 284	215	1 107 110	3 105 227	42	1 21 32	29	63 113	41 25
Meerle ...	2,463	375 223	—	5 115 238	85	— 41 64	5 71 105	18	— 23 16	22 24	33 32	28
<i>Western Kempen</i>												
Wommelgem	1,300	356 119	79	8 118 59	6	— 137 82	— 53 122	11	4 50 26	50	23	67 35
<i>Central Kempen</i>												
Geel ...	10,854	2,600 933	145	20 337 331	501	2 614 419	— 150 415	224	5 33 77	58	166 16	43 22
<i>Eastern Kempen</i>												
Lommel ...	10,216	728 3	1	— 194 199	91	— 161 101	3 64 109	116	— 8 8	5 43	15 14	7
'Genk ...	8,780	720 273	2	— 137 23	136	3 129 39	1 44 71	12	11 12	3 3	32 8	18 15
<i>Southern Kempen Margins</i>												
Lubbeek	2,293	435 112	168	170 332	104	55	— 218 75	30 162 213	17	33	100 18	60
Wellen ...	1,696	323 100	173	61 126	86	1	— 138 288	12 106	84	52 100	367 21	6 13 296 59

Note. These communes are located on Fig. 4.

GENK, A LAND UTILIZATION SURVEY OF A HEATHLAND COMMUNE

The main features of Kempen agriculture in a heathland commune can be effectively summarized by considering Genk in some detail. The

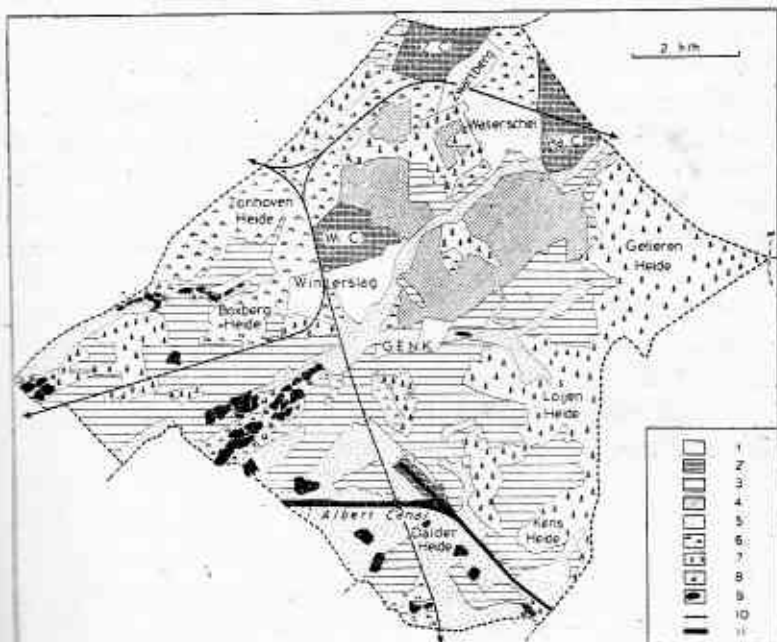


FIG. 31. LAND UTILIZATION IN THE COMMUNE OF GENK

Based on a manuscript map in the possession of the *Technisch Dienst* of the commune of Genk.

The figures in the key are as follows: 1. built-up areas; 2. industrial sites (including buildings, sidings, stacking-space, waste land etc.); 3. small-holdings; 4. field cultivation; 5. pasture; 6. heathland; 7. woodland; 8. marsh; 9. meres; 10. main-line railways; 11. waterways. The key of course refers only to the area of the commune, and extra-communal territory is left blank. The three collieries are indicated by abbreviations, as follows: **Wa.C.** Waterschei; **W.C.** Winterslag; **Z.C.** Zwartberg.

greater part of this commune lies on the heathland in eastern Limburg at a height exceeding seventy-five metres, although the south-western part beyond the plateau edge is below fifty metres. The commune

summarizes in itself many of the characteristic features of the Kempen—the quite extensive heathlands which still cover nearly a quarter of the total area, the blocks of coniferous plantations, the limited tracts of enclosed arable and pasture land, and the numerous small-holdings and gardens near the housing-estates. One of the largest communes in Belgium, Genk had a population of about twenty-nine thousand in 1945; of this total, about six thousand men worked in the three collieries of Winterslag, Zwartberg and Waterschei (see pp. 114-15, 228-30 and Figs. 70-1), which, with their housing-estates, have so radically transformed the landscape in parts of the commune. Relatively few men were employed full-time in agriculture, with the exception of a small number of market-gardeners, nurserymen and dairy-farmers near Genk village itself and in the lower lands to the south-west. There was also a number of forestry workers. A large proportion of the farm-land was held in small-holdings by colliery workers, who cultivated them in their spare time.

The main categories of land utilization in 1946 are shown on Fig. 31; their areas were as follows:

Land Utilization in Genk, 1946
(hectares)

Built-up areas	345.40
Collieries	386.25
Cultivated area	1,509.85
(small-holdings, orchards, open fields)	
Pasture	1,322.00
Heathlands	1,892.45
Woodland	1,983.25
Marsh and other waste land	330.80
Lakes	282.10
Communications	726.60
Total	8,778.70

During the eighty years between the surveys of 1866 and 1946, the heathland decreased by an amount equivalent to twenty-nine per cent of the total area of the commune and the arable land by three per cent, while on the other hand woodland and pasture each increased by the equivalent of ten per cent. The heathland not afforested or improved into pasture has been replaced mainly by the collieries, by the housing-estates and by the spread of new railways, roads and waterways. The remaining heathlands lie mainly in the north and west, such as the Zonhoven Heide; the former eastern heathlands, notably the Gelieren Heide, have been afforested.

Field cultivation, as distinct from gardens and small-holdings, mainly occupies the centre of the commune between the housing-estates and the town of Genk, comprising an area of about seven hundred hectares, of which nearly half in 1946 was under grassland for mowing as hay; two crops are commonly taken each summer from water-meadows along the Stiemerbeek or near small lakes. The areas devoted to the main crops in 1946 are listed in the Table on p. 88. Small-holdings and orchards occupy a considerable area in the south-west along the main road to Hasselt and in the district to the east and south-east of Genk town (Fig. 67), where many small hamlets and individual houses are strung out along the main roads or dispersed among the holdings. Each of the houses in the colliery estates also has its own garden, usually carefully cultivated; as there were almost three thousand houses in these estates in 1946, the aggregate area of garden was quite considerable. Detailed figures are not available of the extent of this garden-cultivation and of small-holdings, but the total amount so utilized probably covers about half of all the arable area. This proportion is higher than in most communes, because of the dense industrial population. Apart from a total of twelve hectares of fruit, made up of groups of a few trees round each house, the land is cultivated in small strips of potatoes, haricot beans, peas, carrots and turnips, green fodder for the livestock on the holding, sunflowers, maize, tomatoes and miscellaneous vegetables. Many of the gardens in the south-west of the commune are irrigated by means of ditches leading from the Stiemerbeek or from one of its many small tributaries

which rise near the edge of the plateau. The fields on the plateau cannot as a rule be irrigated because of the absence of surface water, although some market-gardens near the Waterschei colliery are irrigated by piped water. Most of the gardens in the colliery housing-estates are equipped with water-sprinklers, installed when the houses were built, and supplied from high concrete water-towers which draw water from very deep wells ; in mid-summer, the vivid green of the lawns and the luxuriant growth in the vegetable-gardens contrast with the brown heathlands outside the estates.

Pasture land is found in the lower areas in the south and south-west beyond the plateau edge, where surface streams and meres are more numerous, in narrow strips along the valleys of the confluent Stiemerbeek and Dorpbeek, and occasionally in carefully fenced fields on the plateau, as round the small reedy meres to the south of Winterslag colliery. The open heathland is grazed only by a small number of tethered goats and sheep. In 1946, there were 1,602 cattle, 540 pigs mostly kept on small-holdings, 495 horses and 154 goats. Several thousand sheep grazed on the heathlands in the eighteenth and early nineteenth centuries ; in 1866 there were still 1,160, but in 1946 the number had fallen to 364. This decline in the number of sheep is typical of the Kempen generally.

CHAPTER IV

AFFORESTATION

WOODLAND covers about one-fifth of the total area of Belgium, and most of this is to be found either in the Ardennes or in the Kempen. The woodlands of the Ardennes plateau comprise mainly deciduous trees—beech, oak and birch, but those of the Kempen, apart from some small areas of poor oak-birch forest, consist of extensive plantations of conifers. The planting of woodland was one of the main items in the economic development of the new Belgian State in the mid-nineteenth century. By the law of 1847 the State was empowered to sell compulsorily any "unimproved" commune lands (see p. 58), and many communes began to increase their own woodlands as a safeguard, for afforestation was accepted as "improvement." As a result, of the 53,582 hectares of uncultivated communally or publicly owned land which were officially recorded during the period 1847 to 1929 as having been "improved," 38,074 hectares were put under woodland. Thus, on the one hand, plantations of soft-woods afforded the most profitable, sometimes the only possible, utilization of the tracts of poor sandy soils in the Kempen, as in other parts of the North European Plain; on the other hand, they helped in some measure to meet the increasing demand for constructional timber, pit-props and pulp-wood. The Kempen heathlands offered obvious scope for afforestation, and the plantations established there have provided a welcome contribution, if only relatively small, towards Belgium's heavy timber consumption.

CHANGES IN THE AREA OF WOODLAND, 1846-1942

The area of all woodland at the time of the first Agricultural Census in 1846, calculated on an *arrondissement* basis, was as follows :

Area of Woodland in Antwerpen and Limburg, 1846

	Area (hectares)	Percentage of Total Area
Antwerpen	13,458	13.8
Mechelen	6,385	12.6
Turnhout	15,947	11.8
Antwerpen province	35,790	12.3
Hasselt	9,395	10.3
Maaseik	5,864	6.8
Tongeren	3,665	5.8
Limburg province..	18,924	7.8
Belgium	485,666	18.7

The percentage area under woodland was considerably lower for the Kempen *arrondissements* than for Belgium as a whole. Most of the central and western parts of the country, however, had figures much lower even than those for the Kempen ; thus Veurne and Kortrijk *arrondissements*, both in Oost-Vlaanderen province, had only 0.6 and 3.5 per cent respectively of their total areas under woodland. The high average for Belgium as a whole results from the densely forested Ardennes region, where the *arrondissements* of Virton and Philippeville had almost half of their area under woodland.

A detailed land utilization survey was made during the Agricultural Census of 1866 ; from the commune statistics, Fig. 32 has been constructed, and it affords a reasonably accurate picture of the mid-nineteenth century Kempen woodland. Most of the communes had

between ten and twenty per cent of their areas under woodland. The highest proportions were found in the northern Kempen, to the west of Turnhout; three communes there had in fact more than two-fifths of their areas under woodland. A second district more extensively wooded than the average was in the extreme east of the Kempen, where

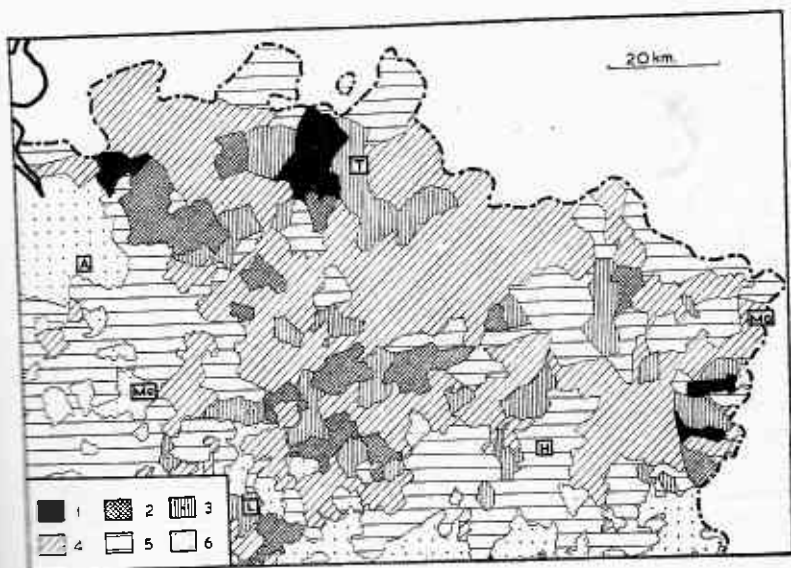


FIG. 32. THE DISTRIBUTION OF WOODLAND, 1866

The extent of woodland in each commune was obtained from *Agriculture : Recensement Général* (Bruxelles, 1866).

The figures in the key indicate the percentage of the total area of each commune under woodland, as follows : 1. over 40 ; 2. 30 to 40 ; 3. 20 to 30 ; 4. 10 to 20 ; 5. 5 to 10 ; 6. under 1.

The main towns are indicated by abbreviations, as follows : A. Antwerp ; Ma. Maaseik ; Me. Mechelen ; L. Lier ; T. Turnhout.

The Meuse valley communes extend on to the plateau. One commune, Landgraaf, had almost exactly half of its area wooded, the highest proportion of any in the Kempen.

From 1866 onwards, planting of the heathlands with conifers went on steadily. Progress was interrupted during the war of 1914-18, when large areas of forest were cleared by the Germans, and this

destruction was continued in the post-war period of reconstruction, when the shortage of building materials caused a steep rise in the price of soft-woods, and the woodlands were inevitably over-exploited. Since then, the Government has encouraged new plantations by capital

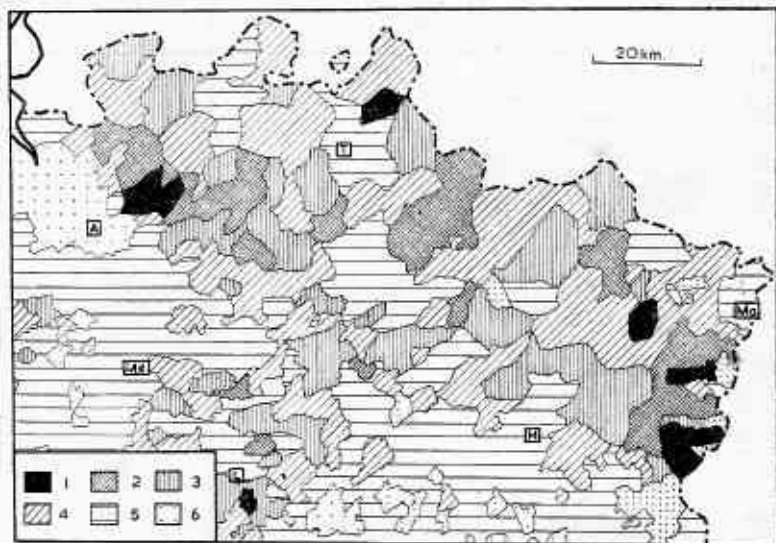


FIG. 33. THE DISTRIBUTION OF WOODLAND, 1942

The extent of woodland in each commune was obtained from the results of the unpublished cadastral survey of 1942, made available by the *Institut National de Statistique* in Brussels.

The figures in the key indicate the percentage of the total area of each commune under woodland, as follows: 1. over 40; 2. 30 to 40; 3. 20 to 30; 4. 10 to 20; 5. 1 to 10; 6. under 1.

The main towns are indicated by abbreviations, as follows: A. Antwerp; H. Hasselt; L. Lier; Ma. Maaseik; Me. Mechelen; T. Turnhout.

assistance towards the costs of clearing, by taxation relief and by sylvicultural education. The success of these methods was shown by the great areas of young plantations to be seen in the Kempen in 1947, in spite of the further depredations of the second German occupation; extensive tracts of year-old trees revealed the efforts that have been made to make good the deforestation during this period.

The latest available woodland statistics were obtained from the

cadastral survey of 1942, carried out during the German occupation, and the results are shown in Fig. 33. In that year, seven communes had two-fifths of their areas wooded, and two indeed had more than half.

Woodland Communes, 1942

<i>Commune</i>	<i>Area of Woodland (hectares)</i>	<i>Percentage of Total Area under Woodland</i>
's-Gravenwezel	839	56
Lanklaar ..	848	54
Rekem	758	48
Schoten ..	1,376	47
Ravels	954	41
Gruitrode ..	1,567	41
Lanaken ..	894	40

It will be realized that many of the larger communes had extensive woodlands in 1942, but, because of their size, the proportions of woodland were not so striking as in those listed. Sixteen communes, in fact, had over a thousand hectares each of woodland. The largest return was 3,793 hectares in Mol, the biggest commune in Belgium, although this woodland covered only one-third of its total area. The most extensively and continuously wooded part of the Kempen in 1942 lay on the eastern plateau, and stands out clearly on both Figs. 33 and 36. From Niel on the plateau at eighty metres to the Zuid-Willems Canal on the Meuse terrace stretch the great pine plantations of the Lanklaarder Bosch, the Dilsener Bosch, the Drie Beuken Bosch and the Stockhemder Bosch; the northern part of this area is shown in detail on Fig. 34.

The changes in the area of woodland in each commune between 1866 and 1942 are indicated on Fig. 35. Most of the northern and eastern Kempen, with the exception of the area to the west of Turnhout and of a few communes in north-eastern Maaseik, shows an increase of woodland. The greatest increases are in the high eastern plateau, that

is, in those parts of the sandy heathland which could only be economically improved by putting them under soft-woods. Six communes increased their woodlands by amounts equivalent to a quarter or more of the total area of each.

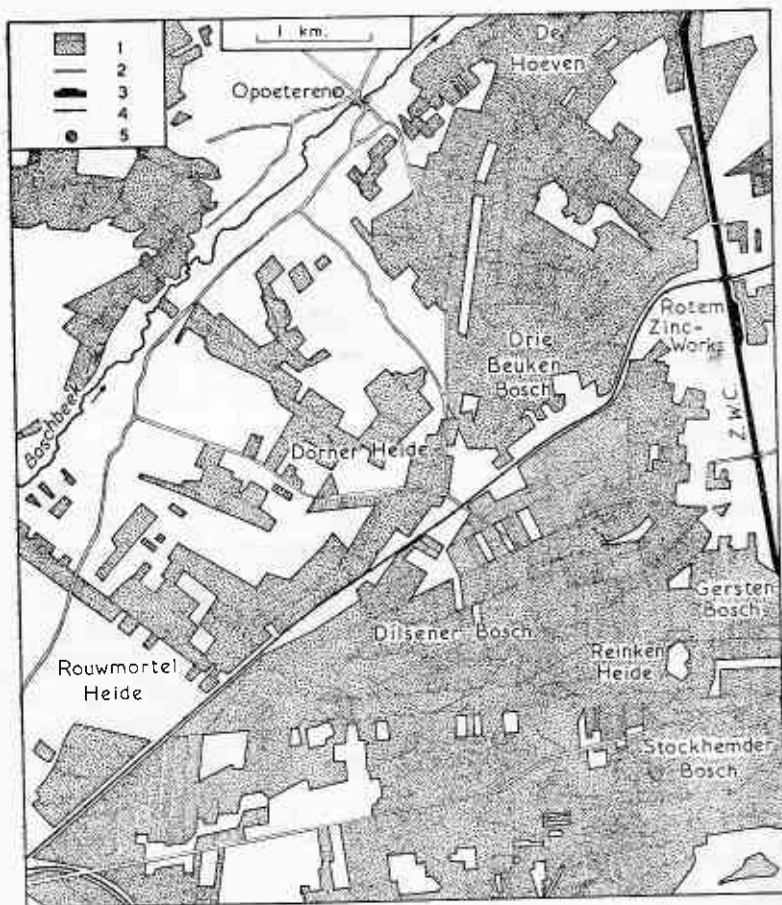


FIG. 34. PLANTATIONS TO THE NORTH-EAST OF ASCH

The figures in the key are as follows : 1. plantations ; 2. main roads ; 3. waterways ; 4. main-line railways ; 5. village centres. The abbreviation Z.W.C. indicates the Zuid-Willems Canal. The forest "rides" which intersect the plantations are shown by thin lines.

Most of the area shown on this map lies on the high plateau at an altitude exceeding eighty metres above sea-level.

*Communes with a marked Increase or Decrease in the Area under
Woodland, 1866-1942*

Commune	Percentage of Total Area under Woodland	
	In 1866	In 1942
Ravels	5	41
Gruitrode	7	41
St Job-in-'t-Goor ..	1	33
Rekem	18	49
Niel-bei-Asch	7	36
Pulderbosch	1	30
Sint-Lenaarts	33	4
Leopoldsburg	28	0*
Bekkevoort	34	6
Merksplas	41	16

*The actual area of woodland was 4 hectares, or less than 0.4 per cent of the area of the commune.

It will be realized that many of the smaller communes showed considerable proportional increases because they had very little woodland in 1866, as in the case of St Job and Pulderbosch. Conversely, while some of the larger heathland communes showed great absolute increases, because of their size the rise in the proportion of the total area under woodland was less striking. For example, Mol had 1,739 hectares more woodland and Genk had 942 hectares more, but the increase was equivalent to little more than one-tenth of the total area of each.

Twelve communes showed a decrease in the area of their woodlands between 1866 and 1942 equivalent to a fifth of the total area of each, and four had a decrease of as much as a quarter. The area of most marked decrease lay to the west of Turnhout, that part, in fact, which had the highest percentage of woodland in 1866. These decreases were due to the great extension of pasture land

(Fig. 27), occasionally to a slight increase in arable land, and locally to the expanding area occupied by the clay-pits of the brick-works. The western and southern Kempen also showed a decrease in the area of woodland. Not only was little planting done, but here the land could

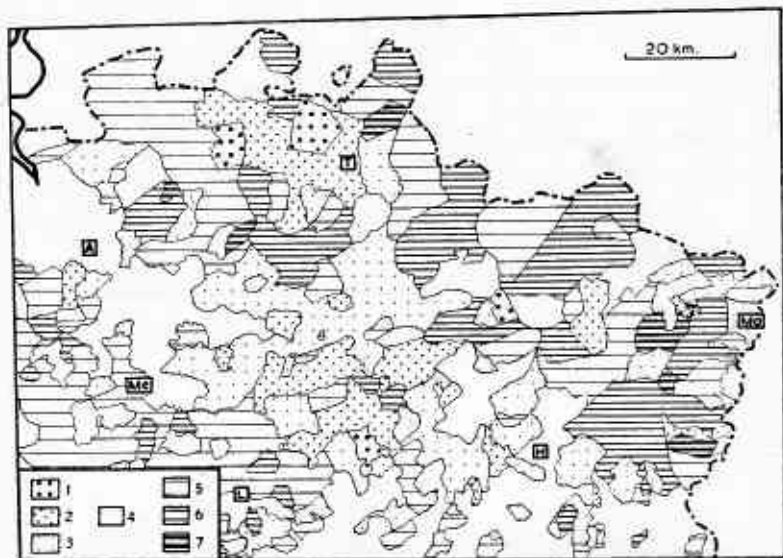


FIG. 35. CHANGES IN THE DISTRIBUTION OF WOODLAND, 1866-1942

The change in each commune was calculated from statistics obtained from *Agriculture: Recensement Général* (Bruxelles, 1866) and from the results of the unpublished cadastral survey of 1942, made available by the *Institut National de Statistique* in Brussels.

The figures in the key indicate the change in the area of woodland between the two surveys, expressed as a percentage of the total area of each commune, as follows: 1. decrease exceeding 25; 2. decrease of 10 to 25; 3. decrease of 2 to 10; 4. little or no change, i.e. less than plus or minus two; 5. increase of 2 to 10; 6. increase of 10 to 25; 7. increase exceeding 25.

The main towns are indicated by abbreviations, as follows: A. Antwerp; H. Hasselt; L. Lier; Ma. Maaseik; Me. Mechelen; T. Turnhout.

be more profitably used under pasture. The almost complete disappearance of woodland in Leopoldsburg in the centre of the eastern Kempen was due to the fact that a large part of the commune had been cleared for the training-grounds and firing ranges of the Beverloo military camp.

THE NATURE OF THE WOODLAND

Figs. 33 and 35 are based on the most recently available returns of the area of woodland, those derived from the cadastral survey of the country made in 1942 during the German occupation. These returns, however, simply gave the total wooded area in each commune, without specifying the nature of the woodland. The last survey to provide these details was made as long ago as 1929; its results for each of the two Kempen provinces, and, as a comparison, for all Belgium, may be summarized.

Area and Nature of Woodland, 1929

<i>Nature of Woodland</i>	<i>Antwerpen</i>	<i>Limburg (hectares)</i>	<i>Belgium</i>
<i>Deciduous woodland</i>			
Forests	855	337	52,036
Brushwood, with occasional standards	3,471	3,301	190,885
Brushwood	4,928	965	94,513
Plantations	292	72	3,912
Total of deciduous woodland ..	9,546	4,675	341,346
<i>Coniferous woodland</i>	26,461	28,009	199,793
Total of all woodland	36,007	32,684	541,139

In 1929, therefore, there were nearly seventy thousand hectares of woodland in the two provinces, covering thirteen per cent of the total area. Some impression of the general distribution of these wooded regions is given by Fig. 36.

Ownership

Belgian woodlands are owned by the State, by the communes, by various public bodies or by private individuals. The next Table

summarizes the areas in Antwerpen and Limburg which fell into each of these categories in 1929 :

Ownership of Woodland, 1929

	<i>Antwerpen</i>	<i>Limburg</i> (hectares)	<i>Total</i>
State	1,267	1,317	2,584
Communes	3,753	10,613	14,266
Public bodies	1,632	838	2,470
Private individuals ..	29,355	19,916	49,271
Total	36,007	32,684	68,591

In Antwerpen a very large proportion of the woodlands was owned by private individuals, whereas in Limburg the communes owned about one-third. The proportion of communally-owned woodland is particularly high in eastern Limburg on the plateau ; the plantations occupy areas of former heathland on which the inhabitants in the past had common rights (see p. 57). Parts of these heathlands have been planted with conifers, as this is the most profitable way in which the communes have been able to make the heathlands contribute to their revenues, especially as the State assists them in the costs of clearing and of planting, and in addition exempts the new plantations from taxation for four years.

DECIDUOUS WOODLAND

The probability that much of the Kempen was covered with primeval oak and birch forest, which degenerated into heathland, has already been discussed (see pp. 37-9). In 1929, as shown in the Table on p. 101, only a fifth of the total wooded area of Antwerpen and Limburg comprised deciduous trees, and most of this was in Antwerpen province. Some of this deciduous woodland represents the natural

colonization of the heathland by silver birch and dwarf oak (see pp. 42-3), mainly due to the removal of the factors responsible for the destruction of the original forest cover. Sometimes the woodland is merely brushwood, officially known as "*taillis simples*," mostly of dwarf oak, hazel and hornbeam, and in moister parts of close thickets of alder and willow. In some districts it forms "coppice with standards" ("*taillis composés*,") a brushwood from which at intervals

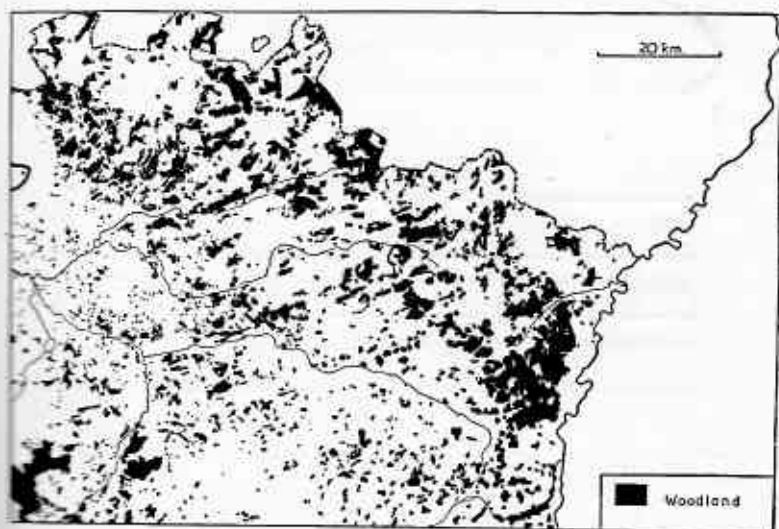


FIG. 36. KEMPEN WOODLAND

The wooded areas are not continued across the frontier of the Netherlands.

the taller trees, usually silver birch. The true deciduous forest occupied in 1909 just under 1,200 hectares, or less than two per cent of the total woodland. It consists mainly of copses of oak, beech and hornbeam, mostly in small groups round the villages in western Antwerpen and in the Meuse valley. Another deciduous tree growing in the Kempen is the poplar, lines of which have been planted to act as wind-breaks, so dividing the countryside into large squares.

These deciduous woodlands have decreased considerably in extent since the middle of the nineteenth century. Before that date, the chief profit to the owners of woodland lay in the production of deciduous coppice, to provide tan-bark, charcoal, poles and firewood. After that time, it was found to be more worthwhile to plant the eastern plateau with rapidly maturing softwoods and to turn the northern and western plain into pasture. So between 1880 and 1929 the area of deciduous woodland declined strikingly, especially in Limburg.

Area of Deciduous Woodland, 1880-1929

	Antwerpen	Limburg (hectares)	Total
1880	13,201	7,799	21,000
1929	9,546	3,675	13,221
Percentage reduction . .	27.7	52.9	37.0

CONIFEROUS WOODLAND

About four-fifths of the woodland in the provinces of Antwerpen and Limburg in 1929 was coniferous. One of the most characteristic, if alien, features of the Kempen landscape is the frequent occurrence in plantations of solid stands of Scots pine (*Pinus sylvestris*) and occasionally of Corsican pine (*P. nigra* var. *calabrica*). These are not indigenous conifers, indeed, there is none in Belgium, but they have been introduced because they can tolerate the light sandy soils, the exposed plateau situations, and a climate which has a tendency towards extremes. Furthermore, they have the advantage of attaining maturity reasonably quickly, that is, within thirty or forty years. The trees are usually planted in long straight lines, forming square or rectangular blocks. Two examples of these extensive plantations are shown in Figs. 34 and 37.

the first on the plateau in the eastern Kempen, the second on the plain in the north. Only occasionally do these introduced conifers occur less formally. For example, a few scattered pines have colonized

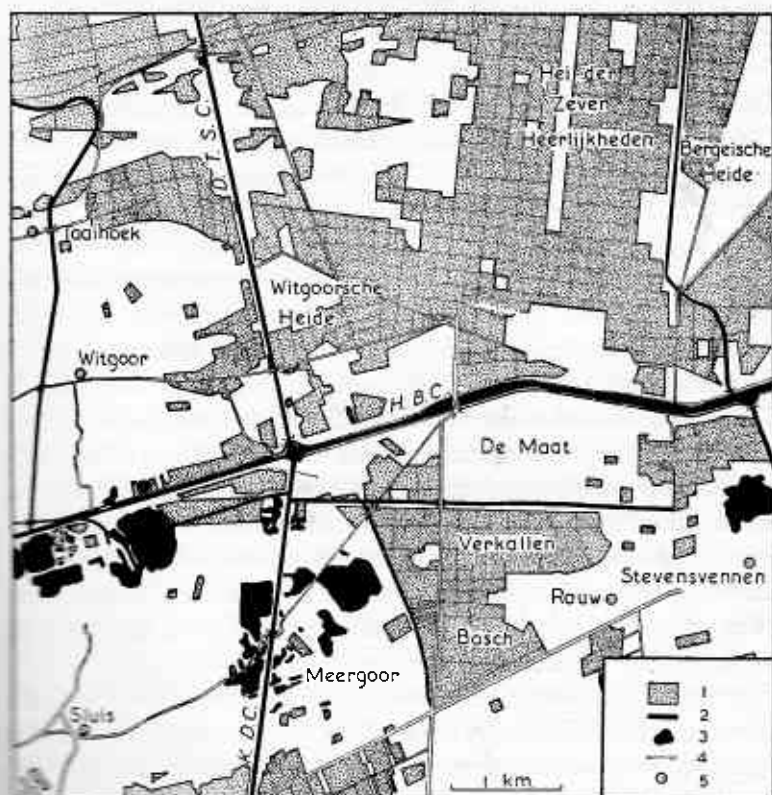


FIG. 37. PLANTATIONS NEAR DESSEL

The figures in the key are as follows: 1. plantations; 2. waterways; 3. meres; 4. main roads; 5. village centres.

The abbreviations are as follows: D.T.S.C. Desschel-Turnhout-Schoten Canal; H.B.C. Herentals-Bocholt Canal; K.D.C. Kwaadmechelen-Desschel Canal.

~~plantations~~ oak-birch heath (see pp. 42-3), while here and there ~~groups of trees~~ have been planted to arrest the movement of the ~~plantations~~ (see p. 17), or for decorative purposes in the vicinity

of the collieries and factories and along the roads in the housing-estates, or as shelter belts around farm-houses.

An area of heathland scheduled for planting is roughly cleared ; the bushes and shrubs are stacked to dry for fuel. It is then deep-ploughed to break the underlying "pan," and drainage ditches are dug. The long furrows are given heavy dressings of basic slag and kainite, and the land is usually left to weather during the succeeding winter. Young trees from the nurseries are planted in the furrows at half-metre intervals, the ridges of upturned sods providing some protection for them. Each plantation is divided into blocks by "rides," long straight lanes some five metres wide, which allow the passage of carts, make for convenience of exploitation, and help to protect against forest fires. Sometimes the trees are grown more casually in the open unimproved heathland ; a sod is lifted at intervals among the heather and coarse grass, and the roots are planted in the hollow thus formed. The trees are thinned at intervals during the first ten years, and are then allowed to grow on to maturity in periods varying from thirty years in the lower western and northern Kempen to forty years on the higher eastern plateau. The trunks are sold mainly as pit-props, the loppings and larger branches are sent to the Brussels pulp-mills, and the remaining stacks of brushwood are auctioned locally for fuel. The roots are removed, commonly by tractor and chains, and the land is ploughed for subsequent replanting.

It may be estimated that some fifty thousand hectares of conifers have been planted in the provinces of Antwerpen and Limburg. This figure represents about ten per cent of the total area of the provinces, mostly replacing heath, and the plantations thus constitute a most important modification of the Kempen landscape.

CHAPTER V

THE EXPLOITATION OF THE COALFIELD

THE production of coal in Belgium rose steadily during the nineteenth century, from 2.6 million tons in 1835 to 23.5 million tons in 1900, at which total it remained more or less stationary until 1914. Before the war of 1914-18, this whole Belgian coal output came from the Sambre-Meuse coalfield, known as the *Bassin Sud*, which extends eastward from the French frontier in a series of five mining districts. But the consumption of coal increased much more rapidly than did the output, and it was becoming increasingly obvious in the latter half of the nineteenth century that the Sambre-Meuse field alone would soon be unable to supply Belgium's needs. This was indicated by the considerable increase in the imports of coal and coke, which in 1835 totalled less than ten thousand tons, but by 1900 had attained three million tons.

Although these imports were partly due to the fact that Belgium was short of gas- and coking-coals and of long-flame, highly volatile coals for use in forges, it was evident that the supplies of home-produced coal were becoming inadequate. Moreover, after 1900 the costs of production in the Sambre-Meuse field were rising steeply. The mines are very deep—in fact, near Mons they are the deepest in the world. The seams have been very much disrupted and contorted by faulting, and fire-damp is a serious problem. Many mines which could not be worked economically have consequently been closed down. The number of collieries in exploitation declined from a maximum of 173 in 1875 to only seventy-seven in 1939, in spite of Government subsidies, price controls and reductions in railway coal freights. As a

result of all these adverse circumstances, increasing attention was paid to the possibility of the existence of exploitable coal deposits in other parts of the country.

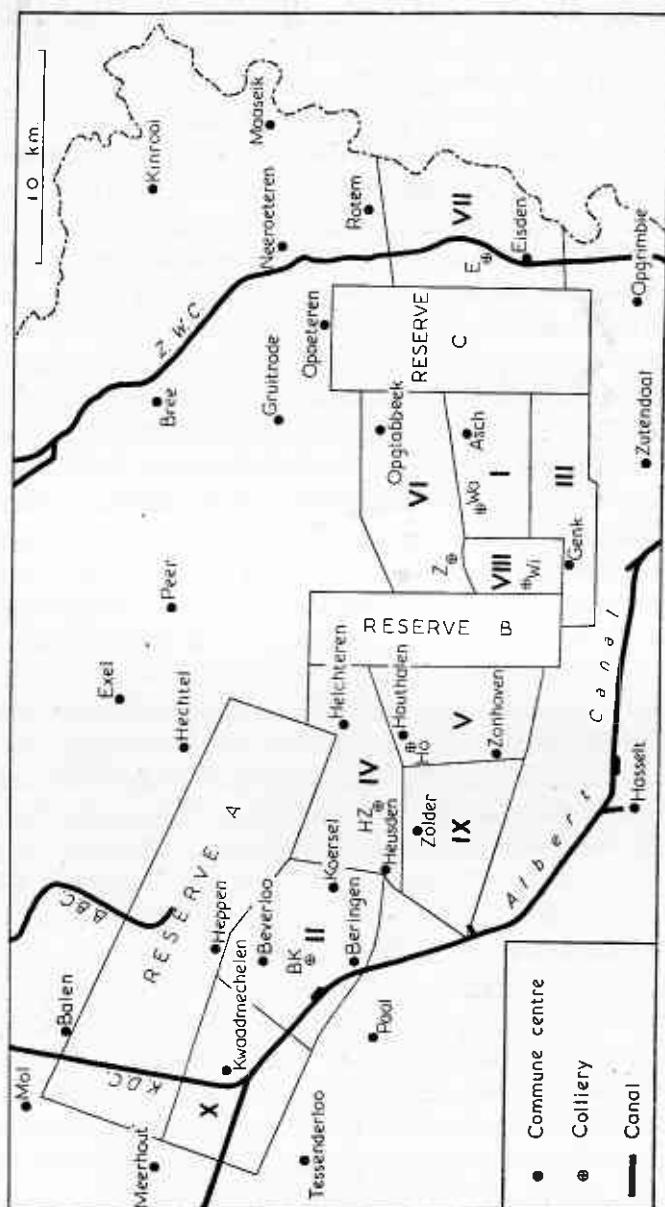
INITIAL PROBLEMS

The Upper Carboniferous series, in which most of the coal-bearing strata of western Europe occur, is strung out in a series of disconnected basins along the northern edge of the Hercynian uplands. In Germany the great Ruhr-Westphalian field, lying mainly to the east of the Rhine, and the smaller Aachen field near the frontier of Dutch Limburg, are geologically continuous, but are separated by fault-lines. Further to the south-west lies the Sambre-Meuse field in southern Belgium, continued by the coalfield of northern France in the *départements* of Nord and Pas-de-Calais. The structural continuation of the Aachen field westward is in Dutch Limburg, to the east of the Meuse valley. The existence of these fields has been known for a considerable time; in fact, in Dutch Limburg open-cast mining was first recorded as early as 1131 near the Abbey of Kloosterrade in the valley of the Worm, a left bank tributary of the Roer. Sporadic attempts at mining took place in Dutch Limburg during the succeeding centuries, mainly in the east, where the coal seams actually outcropped. After the middle of the nineteenth century, large-scale investigations were carried out in this district by means of trial borings, with the result that a number of mining concessions were granted, and by 1900 four collieries were in production.

This development of mining activity in Dutch Limburg had considerable results in the Kempen on the opposite side of the Meuse valley, for Belgian geological and mining experts became increasingly interested in the possibility that the coal deposits of the Aachen and Dutch Limburg fields might well extend north-westward into the Kempen, perhaps even as far west as Antwerp. Much geological speculation took place as to the presence of coal at workable depths in the Kempen. The theoretical interest was stimulated, as has been seen, by the grave practical doubts that were being expressed as to the future adequacy of the Sambre-Meuse coalfield in meeting Belgium's needs.

Probably the first mention of the possibility of a coal basin in northern Belgium was made in 1806, when the brothers P. and J. Castiau of Oudenaarde suggested that the coal basins of western Europe and of the British Isles were geologically continuous, and that therefore between Westphalia and South Wales, in the latitude of approximately 51° North, that is, in northern Belgium, there were coal deposits. Again, in 1855 an English geologist, Godwin Austen, considered the possibility of the existence of an eastward extension of the coal deposits of south-eastern England. In the third quarter of the nineteenth century, a number of studies appeared, written by Belgian geologists and mining engineers; among these were Guillaume Lambert, Professor de Walque, Renier Malherbe, André Dumont and Professor Lohest. The names of Guillaume Lambert and of André Dumont are perpetuated in the titles of the companies working the collieries at Eisden and Waterschei respectively. Their theories, sometimes inaccurate in detail but often correct in principle, were based primarily upon the probability of the continuity of sedimentary strata, and it was evident that only trial borings could verify the various suppositions, a method already in use in Dutch Limburg. André Dumont from 1873 urged upon the Belgian government the advisability of granting financial assistance to further this research. The first borings were put down to the north of Liège in 1877 by a group of mining firms, but they failed to reach coal. The first deep boring actually in the Kempen itself was sunk near Lanaken to the north of the Maastricht enclave, but this also was unsuccessful. In June 1899, André Dumont, with the backing of a recently formed company, put down the deepest boring yet to 878 metres below the surface, at Eelen on the edge of the Meuse valley to the south-west of Maaseik, but again fruitlessly.

Finally, success was attained. A company sank a boring at Zuiden, near Asch, and on 2 August 1901 this reached a coal seam at a depth of 531 metres, from which a sample of workable coal was brought to the surface. Geological research has since gone on constantly, and as each new boring has been sunk, more data have become available for a detailed reconstruction of the basement geology under the thick covering of sands and gravels. By 1903, forty-four borings had been completed,



of which thirty-seven, mostly in the neighbourhood of Genk, had reached coal; the seven negative results were useful in that they helped to delimit the extent of the workable basin. For example, the negative borings at Hoeselt, at Kessel and at Lanaken indicated the southern limits of the basin, and moreover these finally caused abandonment of the long-held hope that the workable deposits of the new field might be continuous with those of the Liège basin to the south. By 1907, the number of borings totalled 105, the deepest of which, Number 86, at Wijvenheid, reached a depth of 1,912 metres. By 1946 there were 113 borings.

The existence has thus been proved of a coal basin seventy-five to eighty kilometres in length from Dutch Limburg to the east of Antwerp, fourteen to eighteen kilometres in width, and some twelve hundred square kilometres in area. One recent estimate puts the reserves in the field at about eight milliard tons; it is significant that the Sambre-Meuse field is estimated to have workable reserves of little more than three milliard tons. The Kempen coal, however, lies at a considerable distance below the surface; half is at depths exceeding a thousand metres. In the east, between Eidsen and Genk, the

FIG. 38. CONCESSIONAL AREAS IN THE KEMPEN COALFIELD

Based on maps in various volumes of the *Annales des Mines* (Bruxelles).

The concessions are numbered as follows: I. S.A. des Charbonnages André Dumont-sous-Asch; II. S.A. des Charbonnages de Beeringen; III. S.A. des Charbonnages Winterslag (Genk-Zutendaal concession); IV. S.A. des Charbonnages d'Helchteren-Zolder (Helchteren concession); V. S.A. des Charbonnages Houthalen; VI. S.A. John Cockerill, Division du Charbonnage des Liégeois; VII. S.A. des Charbonnages de Limbourg-Meuse; VIII. S.A. des Charbonnages Winterslag (Winterslag concession); IX. S.A. des Charbonnages d'Helchteren-Zolder (Zolder concession); X. Société pour favoriser l'Industrie minière (Oostham-Quadmechelen), abandoned in 1931. The three State reserves are indicated by the letters A, B, C.

The seven active collieries are indicated by abbreviations, as follows: BK. Beeringen-Koersel; E. Eidsen; Ho. Houthalen; HZ. Helchteren-Zolder; Wa. Waterschei; Wi. Winterslag; Z. Zwartberg. (See note on the names of the collieries, p. 132).

The waterways are shown by heavy black lines and indicated by abbreviations, as follows: B.B.C. Beverloo Branch Canal; K.D.C. Kwaadmechelen-Desschel Canal; Z.W.C. Zuid-Willems Canal.

first workable coal occurs at 477 metres, but the steady westward dip of the measures shows that in the portion of the field beyond Kwaadmechelen towards Antwerp, the coal is too deep to be economically workable as yet ; at Vlimmeren, to the west of Turnhout, for example, coal was only reached at a depth of 896 metres.

Concessions

The evidence supplied by the first fifty borings was sufficiently conclusive to enable concessions to be granted. At first, the Belgian government seriously considered the question of State ownership and operation of the new coalfield. This possibility was stimulated by the example of the Netherlands, which had become alarmed because the four companies operating in Dutch Limburg at the end of the nineteenth century were all foreign-controlled ; in 1901, it therefore reserved to the State all territory not as yet leased to the private companies. Perhaps the deciding factor in Belgium, however, was the enormous cost which would be involved in the development of the field, and the necessity of attracting both Belgian and foreign capital. The State therefore contented itself with the demarcation of three reserves, with a total extent of 19,980 hectares, in the north-west, centre and east of the field (Fig. 38) ; these reserves, occupying about a sixth of the proven area, are still unworked.

Many industrial firms, both Belgian and foreign, sought to take up mining concessions. They included Liège metallurgical, chemical and glass-making companies, vitally interested in the maintenance of their supplies of fuel, while commercial and financial companies which participated included the *Banque de Bruxelles* and the *Société Générale*, two of the greatest Belgian banking-houses. The financial transactions were complicated, and the first concessions, seven in number, were not granted until 1906. There were in the course of time several changes from the original seven. New concessions were granted in 1911 and 1912, two holding companies were amalgamated in 1919, and a new concession, that of Oostham-Kwaadmechelen, was granted in 1924. In 1929, the Genk-Zutendaal and Winterslag companies were merged, and finally, in 1930, the Oostham-Kwaadmechelen concession was

abandoned. It was considered that this concession lay too far west, and that workable coal therefore occurred at too great depths for profitable

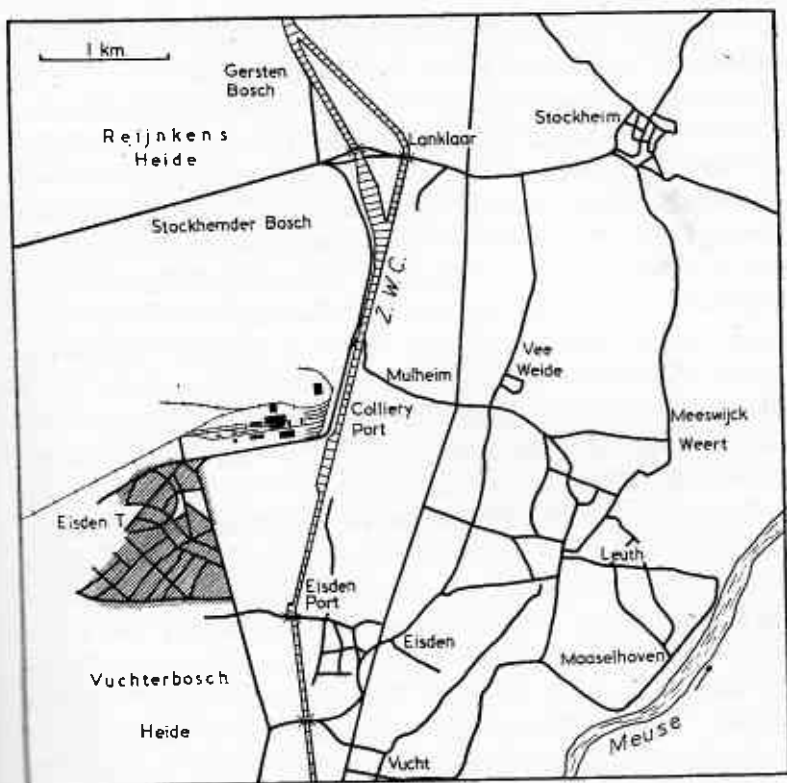


FIG. 39. EISENDEEN COLLIERY

The area of the colliery housing-estate is indicated by diagonal shading. Other built-up areas, comprising small villages, are not shown. The abbreviations are as follows: **Eisden T.** Eisden Tuinwijk (housing-estate, or *ciité-ouvrière*); **Z.W.C.** Zuid-Willems Canal.

The main-line railway from the colliery runs westward to join the Hasselt-Maastricht line at Asch.

exploitation. So at the present time there are nine concessions, held by seven individual companies, together with the three additional State reserves. The details of the concessions are listed at the end of

this Chapter on pp. 131-2 and their positions and extent are shown on Fig. 38.

The Location of the Collieries

Although nine concessions exist, there were only seven individual collieries in operation in 1947; their location is shown on Fig. 38. Three of them, Winterslag, Zwartberg and Waterschei, are situated in the commune of Genk, to the north of that town. Each is at a height of about eighty metres above sea-level, on the open heath-covered plateau which forms the watershed between the Demer and the Meuse river systems. The lay-out of the three collieries and their respective housing-estates is shown on Figs. 70-1. Some twelve kilometres to the north-west of Genk, on the Houthalenberg Heide, is Houthalen, the most recently developed colliery. It lies at a height of sixty-five metres above sea-level, on a gently sloping spur projecting south-westward from the plateau between the valleys of the Mangelbeek and the Laambeek, two of the Demer's right bank tributaries. Its neighbour, Helchteren-Zolder, lies three kilometres further westward, near the little hamlet of Voort. It stands on the edge of the Kempen plateau, on the fifty-metre contour line, at the northern side of the flat alluvial valley of the Mangelbeek. Beringen-Koersel, the most westerly of the seven collieries, is situated on the Tervansche Heide at about forty metres above sea-level, between two of the low headstream valleys of the Zwartbeek, which joins the Demer above Diest. The Eisdon colliery (Fig. 39) lies seventeen kilometres east of Genk, on the Vuchterbosch Heide overlooking the Meuse valley to the east. The colliery is at a height of forty-five metres above sea-level; about a kilometre to the west the land rises more sharply to form the edge of the Kempen plateau.

THE DEVELOPMENT OF THE COLLIERIES

In 1906, when the first concessions were granted, the companies started the immense work of developing the coalfield. It was no easy task. Not only did workable coal lie at a depth usually exceeding five hundred metres, but the overlying deposits of waterlogged sands and

gravels meant that the technical problems of sinking shafts were very considerable. The surface consisted of heathland, with few settlements, and with therefore almost no local sources of labour. A very great building programme was necessary, both for the colliery surface installations and for housing the imported labour. Furthermore, communications were poor or non-existent, and roads, main-line railways, colliery sidings, light railways and possibly new waterways had to be constructed to serve this new industrial region. It is hardly surprising that the first coal was not raised until 1917, and until 1921 only one colliery was producing at all. In one respect the situation of the collieries in the open heathlands was a positive advantage, for the pit-head gear, ancillary buildings and administrative offices, together with the roads and railway-sidings serving them, could be efficiently laid out on spacious lines. So in less than thirty years this part of the Kempen was transformed, and the ceaseless activity at the collieries now emphasizes the emptiness and loneliness of the heathlands within which they stand. Each colliery purchased its land on leasehold terms from the commune. In Genk the *André Dumont*, *Les Liégeois* and *Winterslag* companies bought between them about one-ninth of the total area of the commune (see Table overleaf).

Winterslag colliery, for example, lies on the west of the main road running north from Genk. Its administrative buildings, of creeper-covered grey stone, are approached from the road by sweeping drives. Surrounded by lawns, shrubberies and trees, the buildings present an appearance of greenness and freshness not usually associated with a colliery. Similarly, there are lawns and flower-beds in front of the long four-storeyed red brick and grey stone offices of the *André Dumont* colliery at Waterschei. Notable features associated with each of the collieries are the several *cités ouvrières* (in Flemish *zwinwijk* or *ninnijk*), the housing-estates built by each colliery company on "garden-city" lines for their employees (see pp. 227-30).

The Sinking of the Shafts

The method used to sink the shafts through the overlying sands and gravels to the coal-bearing basement rocks was that of shaft-freezing

Land owned by the Genk Collieries, 1947

Category	<i>André Dumont</i> (at Waterschei)	<i>Les Liégeois</i> (at Zwartberg) (hectares)	<i>Winterslag</i> (at Winterslag)
Heathland ..	79.40	128.70	45.75
Woodland ..	20.15	4.30	30.70
Meadows	25.15	0.60	11.10
Cultivated land ..	11.60	0.00	9.50
Lakes	14.00	0.00	12.80
Waste	6.15	0.00	9.00
Colliery buildings	53.65	54.35	72.95
Colliery grounds (sidings, roads, etc.)	53.60	32.20	52.20
Housing-estates ..	103.00	24.75	80.70
Sports grounds ..	2.10	0.00	3.40
Total colliery land	368.80	244.90	328.10

(*congélation*), which had been invented and developed in Germany, notably for working the Stassfurt salt deposits. The process consisted of four main operations.

In the first place, a number of bore-holes, some fifteen to twenty centimetres in diameter, were sunk to the required depth, on a circumference a metre or so wider than the intended diameter of the shaft. The two Eisden shafts, for example, had forty-nine and fifty-three bore-holes respectively, while those at Helchteren-Zolder had fifty-five and fifty-one. The total length of boring was therefore immense; at Eisden it totalled some 52,000 metres for the two shafts, at Helchteren-Zolder some 66,000 metres. These figures give an idea of the vast nature of the undertaking.

The second operation consisted of circulating a refrigerating fluid through these bore-holes for a certain period of time, so as to form an "ice-wall" which would prevent water from entering the shaft, and

would also take the pressure of the surrounding rocks until the permanent shaft lining had been inserted. Conditions varied considerably, and special methods had frequently to be devised to meet particular situations. In some cases, for example, the subterranean water was briny and therefore very difficult to freeze, while at Beringen-Koersel, at a depth of 622 metres, a bed of quicksand some fourteen metres thick had to be negotiated. Each bore-hole was fitted with two sets of tubes, with the descending refrigerating fluid in the centre and the ascending fluid in the outer tubes; at great depths a third tube was used to insulate both tubes carrying the fluid. The tubes were connected to distributing and collecting mains, and a calcium or magnesium chloride solution, cooled by an ammonia refrigerating plant at the surface to -25 degrees Centigrade, was circulated simultaneously through all the bore-holes.

The third operation consisted of the sinking and lining of the shaft through the frozen ground to the desired depth. The boring was usually started before the centre of the area enclosed by the bore-holes was completely frozen, as obviously sinking would then be easier. But it was a slow and expensive process. The first shaft at Waterschei was sunk to a depth of 505 metres in eleven months, but the Zwartberg shaft, 553 metres deep, took four years and three months. In some cases, shafts were sunk to the first workable coal and then sinking ceased while galleries were developed; later, sinking was resumed to open up deeper seams. The deepest shaft is at Zwartberg, which reaches a depth of 1,010 metres, while the shallowest, that at Eisdén, is only 477 metres in depth. At each colliery, two shafts, one in reserve and for ventilation, have been sunk, varying in diameter from 5.1 metres at Helchteren-Zolder to 6.1 metres at Eisdén. As each shaft was sunk, it had to be progressively lined; in the Kempen the method used was "tubbing," that is, the lining of the shafts with segments of heavy cast-iron, fitted with ribs and flanges to provide watertight joints. At Beringen-Koersel, where, as already mentioned, quicksands were met at depths exceeding 622 metres, a specially strengthened lining had to be used, comprising double concentric tubbing, between which was pumped a concrete filling.

The final operation was the thawing out of the frost wall round the lined shaft. An early method used was the blowing of steam through the pipes which carried the freezing solution, but later warm brine was circulated in conjunction with hot air blown down the shaft by fans. The freezing tubes were then where possible extracted, and the bore-holes filled with cement.

Underground Workings

The development of the underground workings, still in progress, has been a long and costly process. This can be seen from Fig. 43, which shows when each colliery produced its first coal, in some cases many years after work had been started on the shafts. This slowness has been due partly of course to the war of 1914-18, but much more to the technical problems which development presented. These involved drainage, for all the mines are "wet," and the difficulty of coping with the instability of the rocks. The Kempen coal seams, however, are fairly horizontal and continuous, and compare very favourably in this respect with the contorted seams of the Sambre-Meuse field. By British standards, the Kempen seams are thin, and in 1938 those being worked averaged only 1.04 metres in thickness, but even this compares favourably with the Sambre-Meuse field, where the workable seams average only 0.70 metres.

The Winterslag colliery provides an example of the development of the underground workings. The three main galleries and roadways are driven horizontally at depths of 600, 660 and 735 metres, the galleries being roofed usually by concrete arcs, occasionally "tiled" with concrete blocks. In each case, the main gallery lies below the seam which is being worked. For example, one coal seam is at 560 metres, with the gallery forty metres below, from which there are vertical shafts with lifts up to the workings. The latter are roofed with adjustable steel girders, made in three sections, with two curved side pieces and a roof arc, the three being bolted together. The great problem of roof support has led the Winterslag engineers to devise their own patented extensible steel pit-prop; no timber supports are used in this colliery at all. Coal is cut entirely by machinery, usually by

pneumatic picks or drills, although the Winterslag engineers have developed a type of cutting machine which itself supports the roof. The advancing "long wall" method is used exclusively here, as in all the Kempen collieries. The coal is passed back from the face by means of moving bands, tipped into tubs, and hauled by electric locomotive to the foot of the main shaft. Shaft No. I is used for raising coal to the surface from the galleries at 600 and 660 metres, and the reserve or ventilation shaft is used for raising from the 735 metre gallery.

COAL OUTPUT

Type of Coal

The type of coal varies considerably within the Kempen basin, but the output is mainly of types known in Belgium as *gras* (a bituminous coal with some sixteen to twenty-five per cent volatile matter) and *flénu* (a long-flame coal with over twenty-five per cent volatile matter). In the Upper Coal Measures of some parts of the field, long-flame coals with as much as forty-five per cent volatile matter are worked. These types of coal are good for coking and for gas extraction. This is fortunate, since Belgium is short of coking coal, for, with the exception of the Mons district, the Sambre-Meuse field produces mainly *maigre* (short-flame coals and semi-anthracite, with under eleven per cent volatile matter) and *demi-gras* (semi-bituminous coal with only eleven to sixteen per cent volatile matter). Belgium is obliged to import considerable amounts of both coking coal and coke, totalling in 1937, for example, over ten million tons. The increasing Kempen output of high-volatile coking-coals is therefore exceedingly welcome to Belgian metallurgical firms.

Production

The production of coal in the Kempen and Sambre-Meuse fields from 1917 to 1946 is shown graphically on Fig. 40, together with the percentage of the Belgian total contributed by the former. The output of the Sambre-Meuse field has varied little from between twenty and twenty-three million tons, except during the depression and war years. But the most significant feature has been the steadily

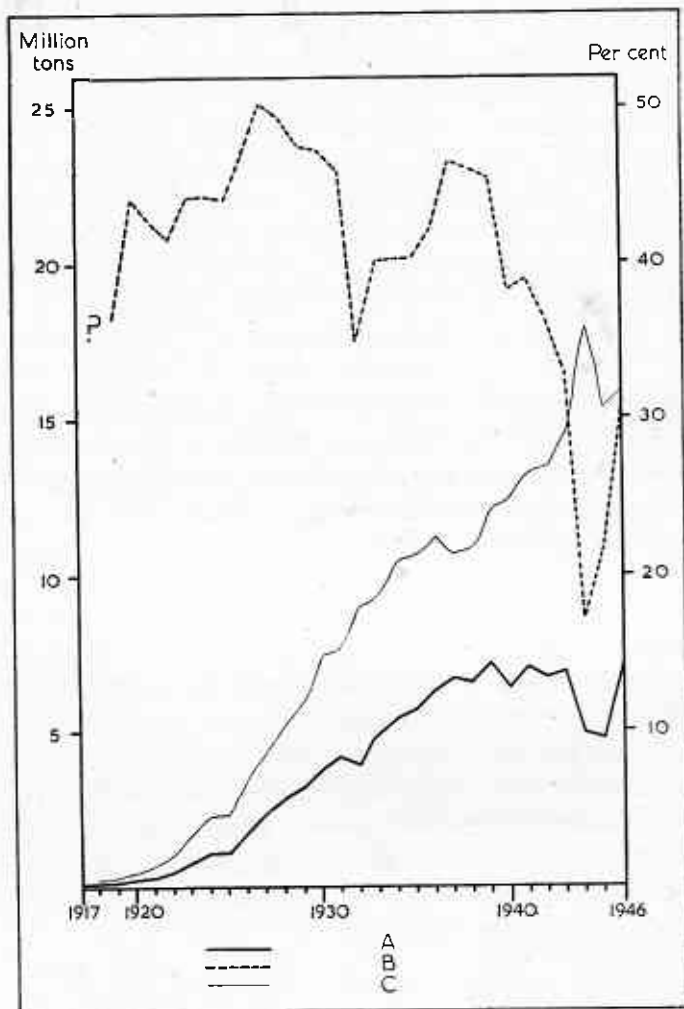
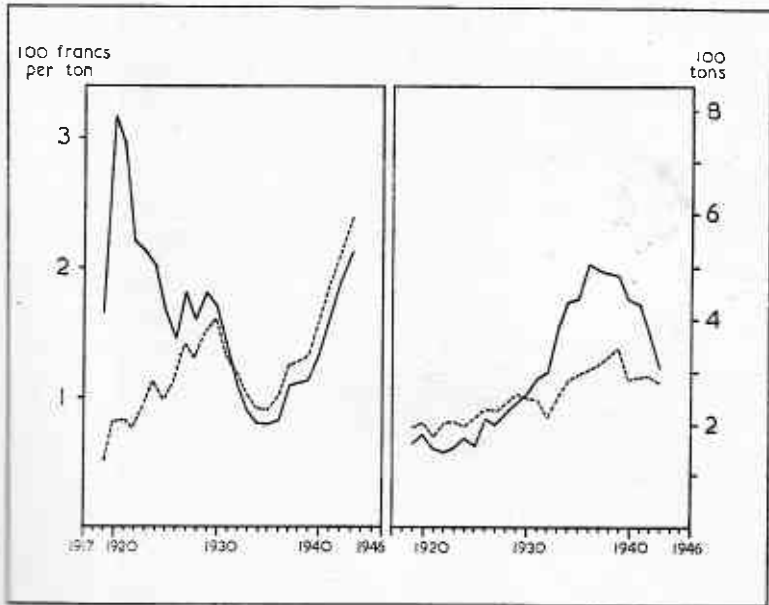


FIG. 40. THE OUTPUT OF BELGIAN COAL, 1917-46

The graphs were drawn from statistics obtained from successive volumes of the *Annales des Mines* (Bruxelles).

The three lines of the graphs are as follows: A. output of the Kempen field (left scale); B. output of the Sambre-Meuse field (left scale); C. percentage of the Belgian total produced by the Kempen field (right scale). No accurate figures are available of the output of the Sambre-Meuse field during the German occupation years of 1917-18.

increasing proportion of the Belgian total for which the Kempen has been responsible ; from under one per cent in 1919, it increased to twenty-two per cent in 1938 and to nearly thirty-two per cent in



FIGS. 41, 42. THE ANNUAL AVERAGE COST OF EXTRACTION PER TON OF KEMPEN AND SAMBRE-MEUSE COAL (LEFT), AND THE ANNUAL AVERAGE OUTPUT PER UNDERGROUND WORKER IN THE TWO FIELDS (RIGHT)

The graphs were drawn from statistics obtained from successive volumes of the *Annales des Mines* (Bruxelles).

In each diagram, the solid line represents the trend in the Sambre-Meuse field, the pecked line the trend in the Kempen field. Figures for the years 1944-6 are not available.

In Fig. 41, the significance lies in the relative costs of production in the two fields; i.e. before 1932, Kempen coal was more expensive to produce than Sambre-Meuse coal, after that year it was cheaper. Owing to changes in the value of the franc, the absolute costs of production over the whole period are not comparable.

1920. The absolute rise has been from 11,640 tons in 1917, when the mineral was raised, to 7.25 million tons in 1946.

The average annual production cost per ton in the Kempen and

Sambre-Meuse fields is compared on Fig. 41. The cost per ton in the Kempen decreased steadily until the economic crisis of 1935, and since 1932 the figure has been markedly less than that for coal produced in the Sambre-Meuse field. The figures for the average annual output per underground worker (Fig. 42) are equally significant; from under 200 tons per annum in 1919, this figure rose steadily to 506 tons in 1936, comparing very favourably with 306 tons in the Sambre-Meuse field. During the war of 1939-45, output fell markedly, a result of absenteeism, of the "go-slow" policy of passive resistance to the German occupation, and of the inadequate rations of the miners. But, while details are not available, it is certain that the 1946-7 output figures approached closely, if not actually exceeded, those of the pre-war years.

The output of the individual collieries from 1919 to 1946 is shown diagrammatically on Fig. 43. For five years, between 1917 and 1921, only Winterslag produced any coal, except for small incidental amounts at the other collieries during underground development; it was followed into production by Beringen-Koersel and by Eidsen in 1922, by Waterschei in 1924, by Zwartberg in 1925, by Helchteren-Zolder in 1930 and finally by Houthalen in 1938. The output of each colliery is indicated on the diagram, and needs little further comment. It might be noted, however, that the first colliery to produce a million tons in a single year was Waterschei (1.08 million tons in 1930), that the largest total in any one year was 1.53 million tons by Eidsen in 1939, and that the largest total in the first complete post-war year of 1946 was 1.41 million tons, also by Eidsen.

FIG. 43. THE PRODUCTION OF KEMPEN COAL, 1917-46, BY INDIVIDUAL COLLIERIES

The columnar diagram was drawn from statistics obtained from successive volumes of the *Annales des Mines* (Bruxelles), with the exception of the unpublished figures for 1946, which were supplied by the *Ministère des Mines* in Brussels. Beringen-Koersel and Eidsen each produced about 7,600 tons in 1922, Waterschei 24,300 tons in 1924, Zwartberg 3,000 tons in 1925, and Houthalen 1,200 tons in 1928; these amounts are too small to show on the diagram.

The collieries are shown in chronological order of production, as follows: A. Winterslag; B. Beringen-Koersel; C. Eidsen; D. Waterschei; E. Zwartberg; F. Helchteren-Zolder; G. Houthalen. (See note on the names of the collieries on p. 132).

The Marketing of Kempen Coal

Detailed figures are not available concerning the destination of all Kempen coal, but three examples will help to provide an adequate impression. Firstly, the Genk coal-port shipped 1.3 million tons of coal in 1946, or rather more than one-sixth of the total Kempen production; fifty-four per cent moved westwards to Antwerp, and forty-six per cent in the opposite direction to Liège. Secondly, the Eisdien colliery in 1946 despatched 855,000 tons, of which two-thirds went to Liège and one-third to Antwerp; incidentally, railway and canal in this case carried almost equal amounts, 425,000 and 430,000 tons respectively. Thirdly, a more detailed analysis can be made of coal shipments in 1946 from Winterslag colliery alone:

<i>Destination</i>	<i>Percentage of Total Despatched</i>
Liège ..	32
Antwerp	16
Charleroi	13
Vilvoorde	7
Gent ..	5
Others ..	27

It is interesting to note that sixty-five per cent of the coal from this colliery moved by rail, thirty-one per cent through the Genk coal port and so along the Albert Canal, and four per cent by road.

These figures, together with information of a more general nature, suggest that in 1946 just over half of the total Kempen coal, or about 3.6 million tons, moved to the Liège and Charleroi industrial areas; the coke-oven plant at Seraing and at Ougrée together consumed more than a million tons of coal, a large part of which came from the Kempen. Rather more than a quarter, or about 1.8 million tons, moved westwards along both the Albert Canal and the railways to the industrial areas of the lower Scheldt and the Rupel, and some went

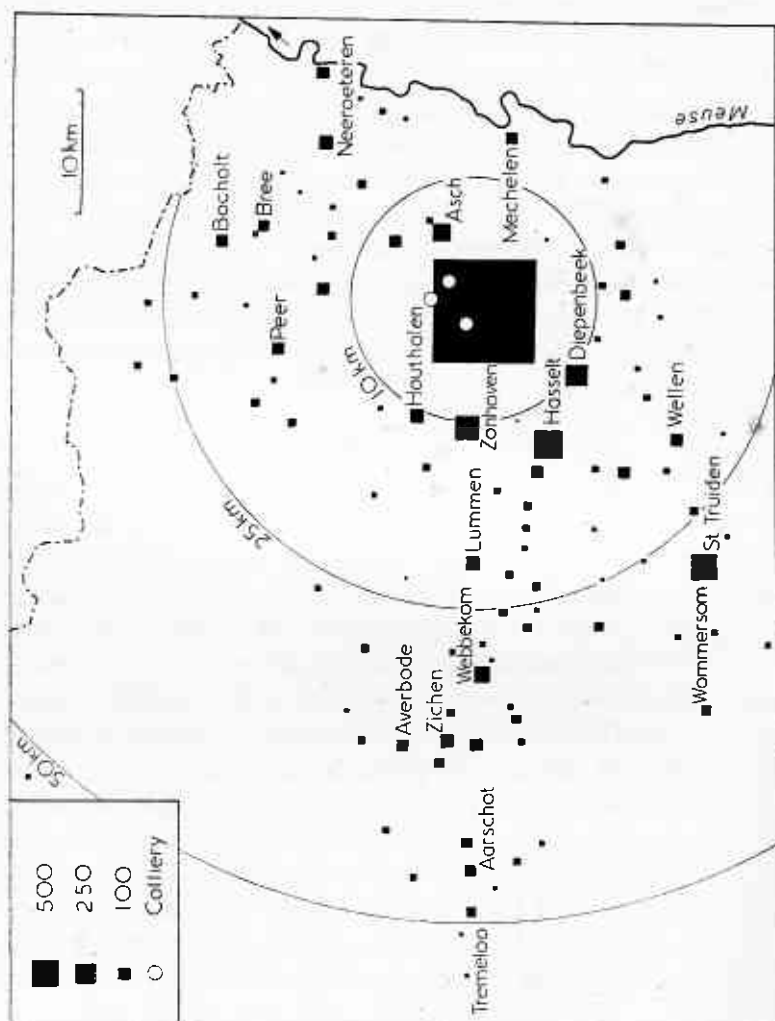
further to Gent. Notable consumers were the Schoten, Hoboken and Willebroek coke-ovens, although these used a large proportion of imported coal. About half a million tons were transported to the coke-ovens north of Brussels, mainly to the great *Cokeries du Brabant* at Pont-Brûlé, to Marly and to Vilvoorde.

A surprisingly small proportion of the output of the Kempen field is used in the Kempen industrial area itself. The chief industries, zinc-smelting and other metallurgical works, pottery works, brick-yards and cement works, use for the most part short-flame *maigre* coals. Only a small amount of this type of coal comes from the Kempen, and much has to be brought from the Sambre-Meuse field. The long-flame Kempen coals, however, are suitable for glass-works, and some of the chemical firms make use of these coals in their own coke-ovens and by-products plant.

LABOUR

One of the earliest problems facing the colliery companies was an ever-increasing demand for labour, for development was in fact taking place in Limburg, one of the least densely populated provinces of Belgium. Labour therefore had to be imported. The effects of this are to be seen in the very striking changes in the density of population, especially in Genk and its neighbourhood (see pp. 211-12). Most of the original administrative and engineering staff in the new coalfield came from the Sambre-Meuse field, and the supply has been maintained by a steady flow of trained engineers from the mining schools, notably from those at Liège and Leuven. During the initial stages, the drilling firms brought their own technicians and most of their labourers. In 1911, only 201 men were employed in the whole field, by 1913 there were 747, of whom only 120 were actually working underground, and by 1919 the total had risen to 2,275. It was clear in 1919 that within the next twenty years the labour force had to be increased at least tenfold.

There were several possible sources of labour. In the first place, a small number of Walloon miners could be brought from the Sambre-Meuse field, as uneconomical mines there closed down. But actually



imported miners were few in number, as the Walloons preferred to live in their own part of the country, rather than among Flemish-speaking people. The redundant mining labour either found employment in the metallurgical, glass and chemical industries of the south, or simply remained unemployed.

In the second place, there was in 1920 a considerable number of Limburgers, who because of the poverty of the soil of their own province were living and working in other parts of Belgium. Some drifted back with the prospect of steady work and relatively high wages, while there was less need as the collieries developed for others to leave Limburg from sheer economic necessity. So workmen were attracted from neighbouring centres of population, such as Hasselt and Maaseik, and from villages along the railway line between Diest and Bilzen, and from even further away. Fig. 44 indicates the permanent domiciles in 1943 of the men employed at the three Genk collieries of Winterslag, Zwartberg and Waterschei. The total labour force there was 12,715, of whom just over half lived within the commune of Genk, most of them in the new housing-estates built by the colliery companies (see pp. 227-30 and Figs. 70-1). The remainder lived in various parts of north-eastern Belgium, with concentrations at Hasselt (561), Sint-Truiden (439), Zonhoven (371) and Diepenbeek (305). The most outlying centres were Turnhout, fifty-five kilometres away, from whence came nineteen miners, and Tremeloo, which, a further kilometre away, was the home of twelve miners. These figures, it will be realized, refer only to the three collieries in the commune of Genk. Of the others, Beringen-Koersel, Helchteren-Zolder and Houthalen

FIG. 44. THE LOCATION OF THE PERMANENT DOMICILES OF MINERS EMPLOYED IN THE THREE GENK COLLIERIES, 1944

The area of each square is proportional to the number of miners working in the collieries of Winterslag, Waterschei and Zwartberg in the commune of Genk, living permanently in the various communes; the centre of each square is placed as nearly as possible over the commune centre. The statistics used were obtained from the *Technisch Dienst* of the commune of Genk. The circles are drawn concentrically, representing distances from the centre of Genk commune.

The largest square represents the number of miners who were actually living in Genk commune itself, mostly in the colliery housing-estates, totalling 6,947.

also drew on the towns and villages lying to the west of Hasselt, while Eisden derived much labour from the Meuse valley—from Maaseik, Eelen, Dilsen, Lanklaar, Vucht and Mechelen. In order to attract this labour, the mining companies offered such inducements as free transport from their homes to the collieries. New main-line railways and light railways were built, and the services of motor-buses were extended.

Foreign Labour

It was evident, however, that Limburg and other Belgian sources of labour would alone be quite inadequate to supply the rapidly increasing needs of the colliery companies. In the decade following 1918, there was in fact a marked shortage of labour in most branches of Belgian industry, especially in the less attractive of these, and this had to be met by the importation of foreign labour. So, by 1939, more than four per cent of the population of all Belgium was of foreign origin, that is, about 340,000 people.

From 1922 onwards, train-loads of foreign workers arrived in Genk. By 1930, there were over six thousand foreign miners in Limburg, more than two-thirds of them living in the *arrondissement* of Hasselt, where six of the collieries are situated, and most of the others in Tongeren, which contains the Eisden colliery.

Foreign Miners in Limburg Province, 1930

	<i>Hasselt</i>	<i>Maaseik</i>	<i>Tongeren</i>	<i>Province</i>
Poles	1,651	28	457	2,136
Czechs	1,057	22	469	1,548
Jugoslavs ..	457	—	386	843
Italians	429	2	123	554
Hungarians ..	259	—	183	442
Dutch	191	14	48	253
Austrians ..	119	3	94	216
Germans	118	2	62	182
Others	Not separately specified			364
Total				6,538

The total number of people gainfully employed in 1930 in the coal-mining industry in the Kempen was 20,579 ; thus foreigners formed about three-tenths of the total and a higher proportion, about three-sevenths, of the underground workers. Most of them lived in the colliery housing-estates.

The industrial depression of 1931 caused the problem of unemployment in Belgium, as elsewhere, to become acute. For some years a series of stringent regulations controlling the importation of foreign labour was enforced, and as a result during 1932-3 only skilled labour was admitted. In 1935, efforts were made in the Belgian coalfields to replace gradually some ten per cent of the foreign miners with unemployed Belgians. But the recruitment of the latter proved so unsatisfactory that the scheme was not carried out fully in the south, and never even attempted in the north. In 1937, moreover, the mining industry was so short of labour that the Belgian government was once more obliged to authorize the importation of Polish miners.

The Post-War Labour Supply

The problem of coal production in post-war Belgium has been as acute as that in other countries of western Europe. The fundamental necessity of increasing coal output, which had fallen so markedly in 1944-5, to a figure considerably greater than the pre-1939 production, was one of the most essential aspects of Belgian national recovery. The mining labour force had therefore to be stepped up considerably. Large numbers of "dispossessed" and "stateless" people were employed, and many prisoners of war and Belgian political prisoners were used underground. A convention was signed on 23 June 1946, whereby Belgium agreed to export coal to Italy in return for mine-workers. The initial agreement provided that Italy should purchase five thousand tons of Belgian coal a month, in return for each thousand Italian workers. By the end of 1946, some twenty thousand Italians had arrived in Belgium, and a year later the total had reached thirty thousand ; about a tenth of these were sent to the Kempen collieries.

Detailed total figures are not available of the post-war mining labour

force for the Kempen as a whole, but the figures for Winterslag colliery in August 1947 are representative.

Miners at Winterslag, 1947

Belgians	2,280
Italians (under the convention) ..	238
Other foreigners ..	699
Prisoners of war ..	340
Belgian political prisoners ..	316
Total	3,873

The following Table shows the growth of the labour force employed in each of the seven collieries at five-yearly intervals from 1920 to 1945 :

Miners employed at the Kempen Collieries, 1920-45

	<i>Winterslag</i>	<i>Beringen-Koersel</i>	<i>Eisden</i>	<i>Waterschei</i>	<i>Zwartberg</i>	<i>Helchteren-Zolder</i>	<i>Houthalen</i>	<i>Total</i>
1920	2,004	356	210	289	73	19	—	2,951
5	4,191	2,799	1,685	2,092	698	206	—	11,671
1930	3,845	3,867	3,709	5,181	3,116	1,169	124	21,011
5	3,131	3,279	3,321	3,363	3,447	2,041	75	18,657
1940	3,071	3,390	4,581	3,109	3,172	2,604	1,276	21,203
5	3,489	3,705	4,884	3,786	3,843	3,061	1,976	24,744

Wages

In 1947, the miners in the Kempen, whether Belgian or foreign, received an average wage of from 200 to 260 francs per day, i.e., the equivalent for a six-day week of £6 to £8 10s. Overseers and

foremen received 350 to 400 francs per day, about £12 to £14 a week. Those workers living in the housing-estates rented houses at from 100 to 200 francs per month, about eleven to twenty-two shillings. These low rentals, together with cheap electricity from the collieries' own power stations, ample water supply, and such services as medical attention provided in the companies' clinics and hospitals, made conditions of life and remuneration compare favourably with those of any other industrial region in Belgium. All these facilities were, in fact, part of the policy of attracting labour to the coal-mining industry.

THE KEMPEN MINING CONCESSIONS

Name of Concession (French form)	Colliery Company	Date of Concession	Area of Concession (hectares)	Customary Name of Colliery
1. Winterslag	S.A. des Charbonnages Winterslag	23 Nov., 1912	960	Winterslag
2. Genck-Sutendael	S.A. des Charbonnages Winterslag	3 Nov., 1906, merged with Winterslag in 1929	3,003	—
3. Beeringen-Coursel	S.A. des Charbonnages de Beeringen	26 Nov., 1906	4,950	Beringen- Koersel
4. Concessions d'Anes Saint- Barthé et Guillaume Lambert Meuse	S.A. des Charbonnages de Limbourg-	29 Nov., 1906 modified 1919	4,910	Eisden
5. André Dumont- sous-Asch	S.A. des Charbonnages André Dumont- sous-Asch	1 Aug., 1906,	3,080	Waterschei

THE KEMPEN MINING CONCESSIONS—*Continued*

Name of Concession (French form)	Colliery Company	Date of Concession	Area of Concession (hectares)	Customary Name of Colliery
6. <i>Les Liégeois</i>	.. S.A. John Cockerill, Division du Charbonnage des Liégeois	25 Oct., 1906 modified 1929	4,269	Zwartberg
7. { <i>Helchteren</i>	.. S.A. des	25 Oct., 1906,	{ 3,732	Helchteren-
8. { <i>Zolder</i>	.. Charbonnages d'Helchteren- Zolder	merged 1919	{ 3,328	Zolder
9. <i>Houthaelen</i>	.. S.A. des Charbonnages Houthaelen	6 Nov., 1911	3,250	Houthalen
10. <i>Oostham- Quadmechelen</i>	Société campinoise pour favoriser l'Industrie minière	4 Oct., 1924 abandoned 1931	3,640	—

There is often some confusion in the various appellations given to these concerns; thus No. 4 may be referred to as *Saint-Barbé et Guillaume Lambert* (after the company holding the concession), or as *Limbourg-Meuse* (the colliery company), or more commonly as *Eisden*, in which commune the colliery is situated. In the Kempen, the usual custom is to refer to the colliery by its location; thus the *André Dumont* colliery is nearly always known as *Waterschei*. This spelling is the Flemish form, although the full title of the concession is invariably given in French.

CHAPTER VI

INDUSTRIAL DEVELOPMENT

SMALL-SCALE industries are carried on in every town and large village in the Kempen, as in other parts of the country, for a characteristic feature of Belgian industry is its wide dispersal, which is to some extent a reflection of the dense population of the country as a whole. Most of these minor industrial establishments are little more than artisan workshops, serving the limited needs of a village and its neighbourhood, or small factories processing foodstuffs and other locally produced raw materials—brick-yards, tanneries, flour-mills, distilleries, tobacco factories and textile mills. But in some of the towns larger factories are to be found, often owned by old-established companies of some reputation, and manufacturing for wider distribution. Sometimes there seems to be no obvious reason for the original introduction of these particular industries, but they have continued because of their established reputations, using a local but often highly specialized labour supply. In contrast to these old-established industries, some very large factories are to be found, often in isolated situations among the heathlands (Fig. 46). Relatively few in number, these factories employ more than half of the industrial personnel (excluding colliery workers) of Limburg province. Most of the present buildings are products of the post-1919 period of economic reconstruction, as a result of which the Kempen may now be described as one of the industrial regions of Belgium.

HISTORICAL BACKGROUND

The Nineteenth Century

The first industrial survey of the new kingdom of Belgium was made in 1846, and the results were published as *Industrie : Recensement Général*. It is of interest to examine the summary returns for the nine provinces and for Belgium as a whole.

Industrial Workers, 1846

Province	No. of Industrial Workers	No. of Industrial Workers per 100 of Population
Antwerpen ..	23,058	5.67
Brabant	36,080	5.21
Hainaut	76,483	10.70
Liège	53,651	11.85
Limburg	6,997	3.76
Luxembourg ..	4,629	2.48
Namur	14,257	5.41
Oost-Vlaanderen ..	55,186	7.00
West-Vlaanderen	44,501	6.96
Belgium	314,842	7.25

The figures for the provinces of Antwerpen and Limburg reflect in part the state of Kempen industry in 1846. It must be remembered, however, that while the Limburg returns were fairly representative of the eastern Kempen, which comprises a considerable proportion of that province, the figures for Antwerpen were considerably swollen by the inclusion of the city of Antwerp itself. It is clear that the industrial importance of the Kempen itself in 1846 was small, for there were but 3.76 industrial workers per hundred of the population in Limburg, and even in Antwerpen the proportion was only 5.67. These figures contrast markedly with those for Hainaut and Liège, where the "heavy" iron and steel industries were located along the

Sambre-Meuse coalfield, and with those for the textile-manufacturing provinces of Oost- and West-Vlaanderen.

In Limburg at the time of the census it is recorded that there were 172 breweries, employing 238 people ; 40 distilleries, nearly all in the town of Hasselt, with 150 workers ; 183 flour-mills, with 274 workers ; 65 brick-works, mostly in the Meuse valley, with 411 workers ; 267 builders' establishments, with 415 workers ; and a number of small textile mills (making blankets, lace and coarse linen), rope-works, hat-factories and sugar-refineries. In Antwerpen, apart from the city of Antwerp, there was a more varied assortment of industries, mainly carried on in the small towns and large villages, at Turnhout, Lier, Broechem, Berchsem and Herentals ; they comprised small establishments for the production of linen, hemp, blankets, lace, chemicals, bricks, tobacco, flour and sugar. But the great majority of industrial workers in both provinces were essentially village-craftsmen and artisans—carpenters, "*sabotiers*," wheel-wrights, tanners and leather-workers, millers, stone-masons, builders and smiths. Compared with agriculture, in fact, nineteenth century Kempen industry was of small importance.

For the greater part of the century there was little change in Kempen industry. This is illustrated by the fact that in Limburg 6,997 people were employed in industry in 1846, while fifty years later the total had risen only to 7,287. Towards 1900, however, some indication of the future industrial development appeared. A number of new factories was established in the heathlands, some by firms from Liège seeking to extend and enlarge their activities, some by newly formed companies, often with considerable foreign, usually German, interests. These new factories included zinc foundries (major concerns were established in 1889, 1890, 1900 and 1912), chemico-metallurgical works (1890, 1900), explosives factories (1873, 1881), and cement works (1889, 1912).

The War of 1914-18 and Post-War Reconstruction

During the war of 1914-18, Belgium was almost completely occupied by the German forces. The material losses were enormous ; not only

did compulsory purchase and requisition decrees systematically dismantle many industrial installations and plunder resources, but the general economic life of the country was inevitably disrupted. The industrial activity which continued was almost entirely subordinated to German requirements. After the armistice, therefore, Belgium was faced with a great programme of industrial reconstruction and re-equipment, the most important aspect of the country's economic recovery. As in the case of north-eastern France, however, certain positive advantages and opportunities did result from this enforced reconstruction. Not only could factories be rebuilt on modern lines and installed with modern plant, but also industry need no longer be tied to the old-established districts on the southern coalfield by reason of the capital values of plant and site. The years of reconstruction, therefore, saw the development of new industrial areas, notably along the banks of the Scheldt and the Rupel, in the neighbourhood of Brussels, and in the Kempen. The last offered very considerable advantages. The cheapness of factory sites in the heathland, the wide unpopulated areas available for the lay-out and segregation of noxious or dangerous industries, the gradual development of the new Kempen coalfield with its obvious future significance, and the proximity of the port of Antwerp, were all encouraging factors. The region was reasonably well served with railways and waterways, even before the construction of the great Albert Canal ; it is a striking fact that of the seventeen major factories shown on Fig. 46, all but two lie on the banks of a waterway, and most of them are at a rail-water intersection.

Capital for industrial reconstruction, derived partly from German reparations, partly from foreign and internal loans, was made readily available to industrial companies through such government-supported sources as the *Société nationale de Crédit à l'Industrie*. Some of the metallurgical and chemical firms which had established factories in the Kempen during the twenty years before the outbreak of war, took advantage of this availability of capital to rebuild or enlarge their works. Other factories, largely under foreign control before 1914, were taken over and renovated by newly-formed Belgian companies ; these, for example, included the chemico-metallurgical works at Overpelt and

Lommel. In addition, a number of completely new factories was built ; the most notable included the chemical works at Tessenderloo (built in 1919), the great metallurgical refinery at Oolen (1922), and the Mol-Gompel glass-works (1922-3).

The chief disadvantage in the years following 1919 was the absence of skilled labour. The new factories met the problem in much the same way as the collieries (see pp. 125-30), which were the main employers of labour in the Kempen. The administrative and technical staffs were brought by the companies from their Meuse valley factories, and from the universities and technical colleges. The small towns and villages of Limburg and of eastern Antwerpen provided a reserve of unskilled labour, which before 1914 was migrating to other parts of Belgium because of the limited opportunities in the Kempen itself. There was, in addition, a considerable influx of foreign workers (see pp. 128, 208-9), although less to these various industries than to the collieries. As a result, the total industrial labour force in Limburg rose from 7,287 in 1896 to 62,845 in 1930, that is, more than an eight-fold increase in thirty-four years. There was probably a considerable rise in the western Kempen too, but the figures for Antwerpen province include the very great growth in the industrial population of Antwerp itself and of the towns along the Scheldt estuary.

Development was steady during the inter-war years, in spite of the several financial crises experienced by Belgium and of course the effects of the world economic depression. Like all manufacturing-exporting countries, Belgium was indeed affected by the limitation of world markets, but perhaps less so than many others, because of her own large internal market. The varied and specialized industries of the Kempen were on the whole less adversely affected than the "heavy" industries of the Meuse-Sambre valley. Even so, the output of zinc, other metals, chemicals and glass was lower between 1931-4 than at any other time in the inter-war years. After 1935 both industrial output and the volume of exports increased steadily. The pre-war production figures for the various Kempen factories are discussed later.

Industrial Organization, 1937

In 1937, a detailed survey of the industrial and commercial life of Belgium was made by the *Ministère de l'Intérieur*, and published as the *Recensement Economique et Social*. From these results some impression of the industrial organization may be derived in the years immediately before the second German occupation. It must be noted, however, that the statistics derived from the *Recensement Economique et Social* of 1937 differ appreciably from those which may be extracted from the occupational returns of the decennial population censuses, the last of which was held in 1930. The *Recensement Economique* included only industrial establishments which employed wage-earning personnel and excluded all independent artisans and craftsmen employed on their own account. It omitted too all persons engaged in *industries à domicile*, that is, those who worked in their own homes on a piece-work basis, and it excluded all workers in State establishments and on the railways. On the other hand, the occupational returns of the decennial population censuses included every person "gainfully employed" in industry in the widest sense. The differences in these two returns for the provinces of Antwerpen and Limburg were quite marked :

	Antwerpen	Limburg
<i>Recensement Général de la</i>		
<i>Population, 1930 ..</i>	287,311	62,845
<i>Recensement Economique</i>		
<i>et Social, 1937 ..</i>	169,148	37,314

The *Recensement Economique*, however, is extremely valuable, for not only is it the most recent survey of the industrial population, but also it gives much detailed information about industrial organization and establishments, with which the decennial census is not concerned. The 1937 survey classified all industrial establishments into four groups, namely, I. *Klein-industrie* (concerns with less than five workers) ; II. *Middel-industrie* (five to forty-nine) ; III. *Groot-industrie* (fifty to 499) ; and IV. *Zeer groote industrie* (over five hundred).

A consideration of the returns for the provinces of Antwerpen and Limburg reveals some interesting results.

Analysis of Industrial Establishments in Antwerpen and Limburg, 1937

Category	ANTWERPEN				LIMBURG			
	Establishments		Personnel		Establishments		Personnel	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
I Klein-industrie	8,548	70.31	17,423	12.11	1,444	78.60	2,770	7.42
II Middel-industrie	3,218	26.47	46,141	32.07	336	18.34	4,644	12.45
III Groot-industrie	372	3.06	52,448	36.45	43	2.35	7,335	19.66
IV Zeer groote industrie	19	0.16	27,870	19.37	13	0.71	22,565	60.47
Total	12,157	100.00	143,882	100.00	1,836	100.00	37,314	100.00

(Note. The total figure for Antwerpen differs from that given in the Table on p. 140, which includes the very variable number of dock labourers at Antwerp under the category of "Transport." The above Table excludes these workers).

The figures for Limburg, in particular, summarize the essential feature of Kempen twentieth century industrial development. About two-thirds of the industrial population were employed in only sixteen major establishments—the collieries, metallurgical refineries and chemical works. On the other hand, more than three-quarters of the establishments consisted of small workshops, employing little more than seven per cent of the total industrial personnel of the province. The same differences can more or less be seen in the case of Antwerpen province, but there was a much greater proportion of the

industrial population employed in Groups II and III, and the relative importance of Group IV was less marked. The absolute numbers and percentages of the totals employed in each of the main categories into which Belgian industries are customarily divided, are given for each of the two Kempen provinces.

Analysis of Industrial Categories in Antwerpen and Limburg, 1937

Industrial Category	Antwerpen				Limburg			
	No. of Establ.	Per cent of Total	No. of Workers	Per cent of Total	No. of Establ.	Per cent of Total	No. of Workers	Per cent of Total
Mines ..	5	0.04	582	0.34	14	0.76	22,113	59.26
Quarries ..	19	0.15	935	0.55	21	1.14	134	0.36
Metal-lurgical industries } ..	1,065	8.69	25,973	15.35	171	9.31	4,225	11.32
Pottery and bricks } ..	196	1.60	5,633	3.33	50	2.72	642	1.72
Glass ..	25	0.20	3,644	2.15	—	—	—	—
Chemicals ..	192	1.57	12,539	7.41	31	1.69	3,094	8.29
Foodstuffs ..	1,924	15.69	18,778	11.10	495	26.96	1,947	5.22
Textiles ..	126	1.03	3,105	1.84	5	0.27	157	0.42
Clothing ..	1,640	13.38	8,637	5.11	140	7.63	610	1.64
Building ..	2,191	17.87	13,135	7.77	371	20.21	1,634	4.38
Timber ..	1,678	13.69	11,069	6.54	295	16.07	1,255	3.36
Leather ..	301	2.46	2,991	1.77	60	3.27	309	0.83
Tobacco ..	105	0.86	3,092	1.83	50	2.72	557	1.49
Paper ..	66	0.54	4,277	2.53	1	0.06	92	0.25
Books and printing } ..	320	2.61	4,269	2.52	36	1.96	179	0.48
Art and precision } ..	1,621	13.22	14,694	8.69	19	1.04	137	0.37
Transport ..	784	6.40	35,795	21.17	77	4.19	229	0.61
Total ..	12,258	100.00	169,148	100.00	1,836	100.00	37,314	100.00

These figures emphasize rather more specifically the conclusions already drawn, that in Limburg the collieries and chemico-metallurgical works dominated the industrial scene, for they employed in 1937 nearly eighty per cent of the workers. In Antwerpen, as a result of the manifold industrial activity of the Antwerp conurbation (i.e. the non-Kempen part of the province), the workers were distributed rather more widely among a greater variety of industries.

The Second Occupation and After

Belgium was occupied for the second time in a generation between 1940 and 1944. Unlike the previous occasion, relatively little material damage was done to industrial installations. The tide of war swept rapidly over the country during both active phases in 1940 and in 1944, while damage from aerial bombardment was remarkably slight, and German pillaging of installations was negligible as compared with that in 1914-18. The only Kempen factory to be destroyed entirely was the chemical works at Tessenderloo, although some, such as the *Glaver* glass-works at Mol-Gompel, were damaged. Moreover, for the most part Belgian industry was not switched over by the Germans to war output, but was allowed to continue production to supply the German civilian home market, and so provide Belgium's contribution to the new European economic order visualized by her conquerors. Of course, output declined steadily during the occupation. Apart from the direct and indirect activities of the resistance movement, many Belgian workers were sent to Germany, while supplies of raw materials for most industries gradually dwindled. The production trough was reached in 1944, the invasion year, when many factories were idle for several months. The index number of industrial production stood at 31 at the beginning of 1945, compared with 100 in 1937.

Recovery was incredibly rapid, in fact more so than in any other European country. The relative absence of material damage to installations meant that most industries could leap into almost immediate production. Damaged or destroyed factories were speedily made good; thus the Tessenderloo chemical factory was completely rebuilt in 1945. There were wider favourable factors which cannot be

developed here, such as the government policy of encouraging the output of consumer-goods as incentives to general production, and the fact that Belgium as the main Allied base in 1944-5 earned large "hard

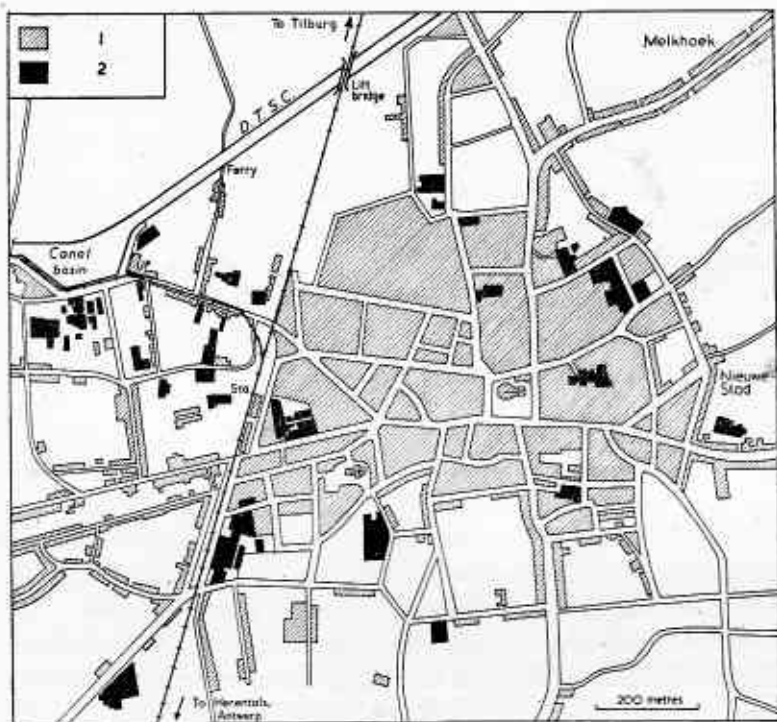


FIG. 45. FACTORIES IN TURNHOUT

The numbers in the key are as follows : 1. approximate extent of the built-up area of the city ; 2. factories.

The abbreviations are as follows : D.T.S.C. Desschel-Turnhout-Schoten Canal ; Sta. Station. The main-line railway between Antwerp and Tilburg in the Netherlands is shown by a heavy barbed line.

currency" credits, as did also the valuable Congo Colony. The most serious immediate problems were the disruption of the transport system, which however for the most part had been remedied by the

end of 1946, the shortage of coal (with the resultant stepping-up of the Kempen output already discussed), and the shortage of man-power. Nevertheless, the general index of industrial production reached 82 by October 1946 (as compared with 100 in 1937), and by December 1947 it was 91, so exceeding considerably the 1938 figure of 81. Full statistics are not available of Kempen industrial production in the post-war years, but it seems that many factories in 1946 and 1947 exceeded their 1938 output figures. Thus, to give but two examples, the *Vieille-Montagne* zinc-works at Balen produced 8,000 tons of zinc spelter in 1938 and 11,400 tons in 1946, while the Mol-Gompel glass-works increased its output from about 45,000 tons of sheet glass to 57,000 tons in the same years.

URBAN INDUSTRIAL CENTRES

The first group of industries to be described comprises those factories situated for the most part in the larger Kempen towns. Four of these towns appear again and again in every list of industries: Turnhout, Hasselt, Mol and Herentals. These must therefore be considered in detail.

Turnhout

Turnhout (Fig. 45) is the chief market town of the northern Kempen and an important centre of communications. There are two main groups of factories. One group, many of them owned by old-established companies, sometimes with a world reputation, is situated within the city itself, in blocks among the houses and shops, often with frontages along the city streets. Several of these factories carry on Turnhout's leading industry: the manufacture of paper and paper articles, including cardboard and cardboard boxes, drawing-paper and stationery, fancy, glazed, marbled and patterned papers, and high-quality paper for Bibles, Testaments and fine books. Printing and book-binding are important corollaries. It is an interesting fact that the town is the world's largest centre for the manufacture of playing

cards. The biggest firm is *Brepols*, founded in 1797, which now has three factories, employing some eight hundred workers, and there are seven other paper-mills. Other long-established industries include the manufacture of coarse linen, of twill, of sacking, ticking and canvas, and of lace. The last is noteworthy in that it is entirely a domestic industry, carried on by women working on a piece-work basis. No Turnhout lace appears in the Belgian market and none is to be seen in the shops, for it is all bought by agents for export to the United States. Other industries within the town include the manufacture of cigars, pottery, leather and leather goods, and a variety of foodstuffs at several small factories. There is a small diamond-cutting and -polishing industry, carried on by a branch of an important Antwerp firm.

A second and newer group of factories has been built to the north-west of the town, near a large basin on the Desschel-Turnhout-Schoten Canal. These factories for the most part produce bulky commodities, and so are dependent on cheap water transport. There are several timber-yards and saw-mills, a factory producing cement castings, a small chemical works and a large flour-mill. A small steel-works, a branch of a Liège firm, makes agricultural implements and other steel articles, using billets imported by canal from Liège. To the east and west of Turnhout, there is an almost continuous line of brick-yards and cement-works along the canal banks (Fig. 48, and see pp. 156-8).

Hasselt

Hasselt, the chief town of Limburg province (Fig. 68), is the market centre of the agricultural country around, and as a result it has a variety of food-processing industries. Most of the factories lie in the north-western suburbs, either near the railway station, or along the west side of the long canal port (see p. 179). The main establishments are flour-mills, distilleries producing a varied range of spirits, tobacco factories, breweries and gelatine works. Other industries include a brick- and tile-works, timber-yards, several tanneries, a glue-works, fertilizer factories and a soap works.

Mol

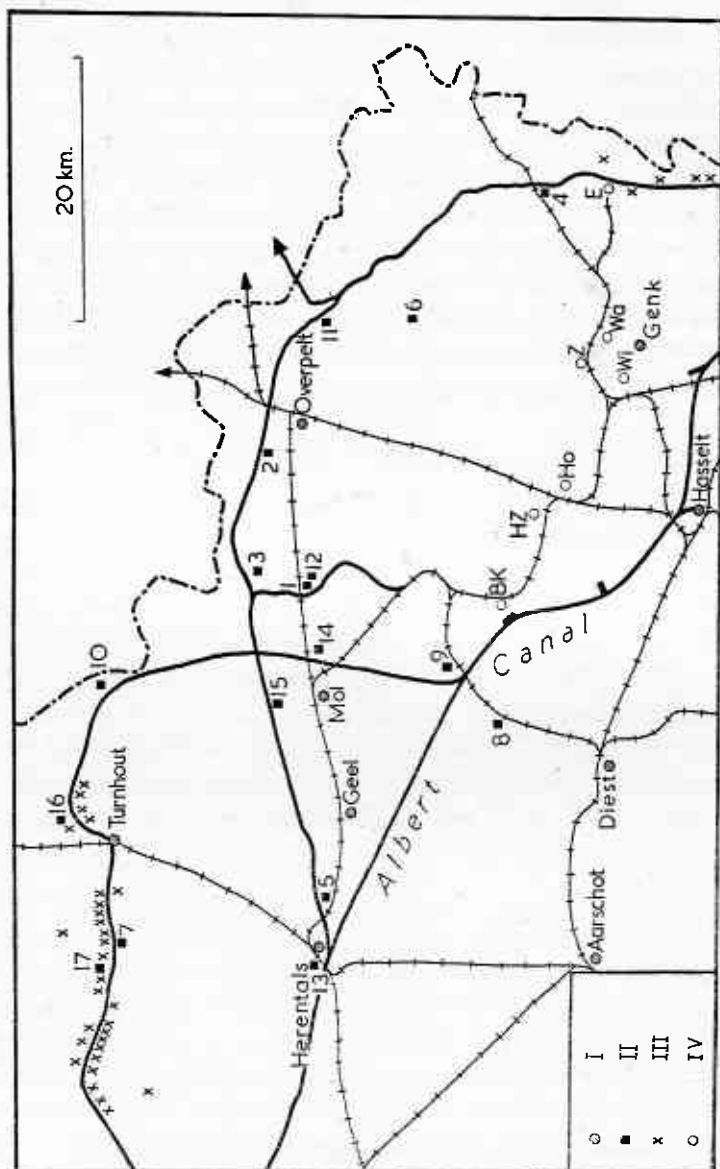
Mol is a small industrial and market town on the main-line railway from Antwerp to Neerpelt. There is a number of large industrial establishments within a radius of ten kilometres, notably the *Glaver* glass-works near Gompel (see p. 155) and the *S.A. Cie. des Verreries du Pays de Liège et de la Campine* (see pp. 155-6), for which Mol and the neighbouring villages supply labour. Within Mol itself there are several old-established factories making cigars, leather goods, pottery, small articles of metal and of wood, textiles and clothing. Three small mills specialize in the production of patterned blankets, employing altogether some three hundred workers; the frontages of the buildings lie along the main street.

Herentals

Herentals, in the western Kempen, is a railway centre, near the junction of the Herentals-Bocholt and the Albert Canals. Like Mol, there is a number of large factories in the countryside within a few kilometres of the town centre, notably the great metallurgical refinery at Oolen (see p. 152), and an explosives factory (see p. 154), for both of which Herentals supplies labour. The factories in the town itself make clothing, blankets, small metallurgical articles (as, for example, of bronze and copper), glass-ware, wooden articles, tobacco and processed foods. They are scattered throughout the town, but with a concentration to the west and south-west near the railway station.

The Kempen Border Towns

No mention has been made of the towns strung out in a line eastward from Antwerp along the borders of the Kempen. Not only are they market towns for the southern Kempen, but they manufacture consumer goods for the same area. Mechelen (Malines), a flourishing town since medieval times, has today a wide range of industries—food-processing, textiles, metallurgical goods (notably of copper), tanning and printing. Diest is a centre of flour-milling, various other forms of



food-processing, brewing and distilling. Aarschot carries on food-processing, Lier manufactures textiles and chemicals, and Duffel has textile and metallurgical works.

OTHER INDUSTRIES

The second group of industries comprises the large modern units, dispersed among the heathlands. It is convenient to consider them under the categories of (a) zinc refineries; (b) other non-ferrous refineries and chemical works; (c) explosives factories; (d) glass-works; (e) brick-works; and (f) cement-works. The major factories are numbered in the text from (1) to (17) to correspond to Fig. 46.

(a) Zinc Refineries

Belgium is one of the world's leading producers of zinc; in 1938, the total output amounted to about 200,000 tons of spelter (the raw commercial metal which contains some ninety-seven per cent of raw

FIG. 46. THE LOCATION OF THE MAJOR INDUSTRIAL ESTABLISHMENTS IN THE KEMPEN

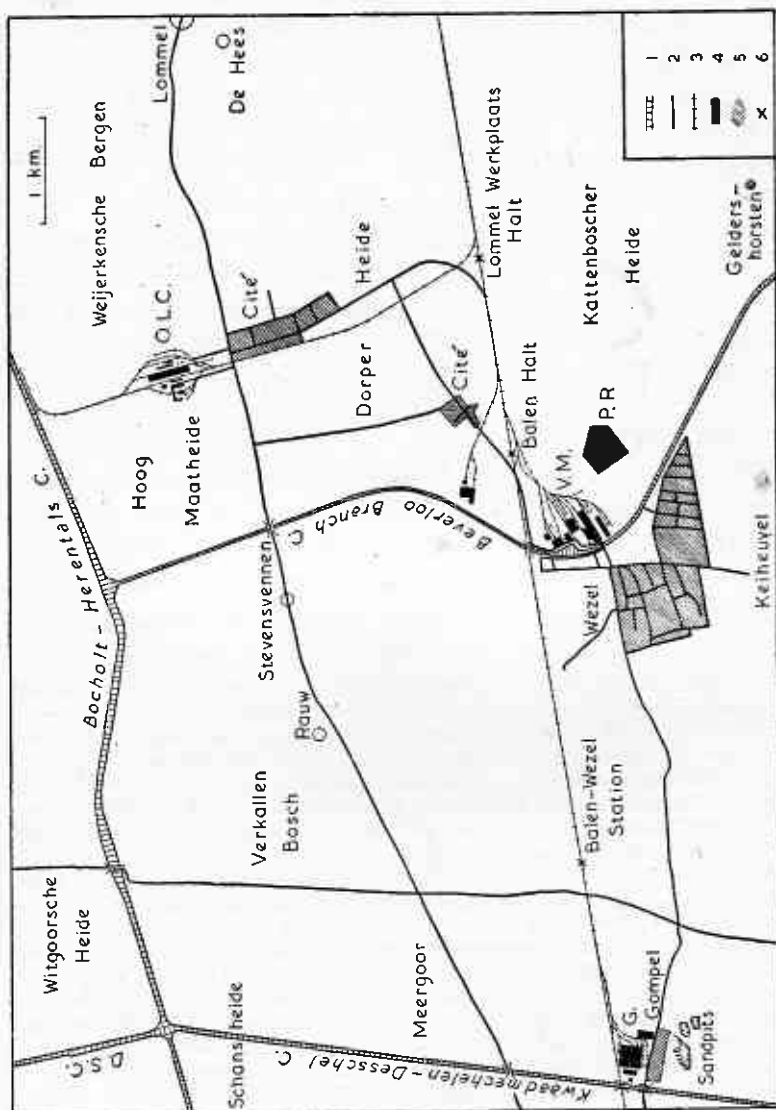
The factories were located exactly from large-scale maps and from information supplied by the various companies, and plotted on a small-scale map.

The symbols in the key are as follows: I. towns with miscellaneous industries; II. major individual factories; III. brick-works; IV. collieries.

The numbers on the map indicate individual factories, and correspond to the list as follows: 1. S.A. des Mines et Fonderies de Zinc de la Vieille-Montagne; 2. Cie. des Métaux d'Overpelt-Lommel et Corphalie (Overpelt); 3. Cie. des Métaux d'Overpelt-Lommel et Corphalie (Lommel); 4. S.A. de Rotem; 5. Société Générale Métallurgique de Hoboken (Oolen); 6. Société Générale Métallurgique de Hoboken (Overpelt); 7. S.A. la Métallo-Chimique (Beerse); 8. Produits Chimiques de Tessenloot S.A.; 9. Produits Chimiques du Limbourg S.A.; 10. La Société d'Arendonck; 11. La Poudrerie Royale de Wetteren, Coopal et Cie. (Kaulille); 12. S.A. Poudreries Réunies de Belgique (Balen); 13. S.A. Poudreries Réunies de Belgique (Herentals); 14. S.A. Glaces et Verres (Glaver); 15. Compagnie des Verreries du Pays de Waas et de la Campine S.A.; 16. S.A. Cimenteries et Briqueteries Réunies de Bonne-Espérance, Ranclets et Loën; 17. S.A. North's Portland Cement.

The collieries are indicated by abbreviations, as follows: BK. Beringen; E. Eindhoven; Ho. Houthalen; HZ. Helchteren-Zolder; Wa. Waterscheid; W. Watersling; Z. Zwartberg.

The railways are shown by barbed lines, navigable waterways by solid lines.



zinc) and about 50,000 tons of sheet zinc, second only to the United States which produced about twice as much of each. There was, of course, a marked decline in the Belgian output during the second German occupation, mainly due to the cessation of ore imports, and in 1944, during the invasion year, production of spelter had sunk to a mere 8,660 tons. By the end of 1947, symptomatic of Belgian industrial recovery, the output had attained the equivalent of 162,000 tons a year.

The Belgian zinc-smelting foundries are found in two main districts—near Liège and in the Kempen. The first group is of course the older; there were indeed six small foundries in operation in 1845, then using local deposits of ore mined in the Meuse valley. The first Kempen foundry was built by a Liège firm in 1889, followed by others in 1890, 1900 and 1912, and each has several times been rebuilt or enlarged. All four have been in operation since those dates, except for short periods during the two German occupations. Normally they produce about one-third of the total Belgian output of spelter, using almost wholly imported ore. While the major sources of the blend and calamine ores are Mexico, Australia and Yugoslavia, it is interesting to note that the main firm in the old mining district of Alston Moor, in north-eastern Cumberland, is a branch of the Belgian *Vieille-Montagne* firm, which exports the semi-refined ore from Alston, via Newcastle and Antwerp, to its Belgian refineries in the Kempen and near Liège. The nine Belgian rolling-mills for the production of sheet zinc are situated, with only one exception, in the Liège area, to which the

FIG. 47. FACTORIES IN THE GOMPEL-BALEN-LOMMEL DISTRICT

The numbers in the key are as follows: 1. waterways; 2. roads; 3. railways; 4. main industrial buildings; 5. built-up areas of the housing-estates (generalized); 6. railway stations and halts. The commune centres are indicated by open circles.

The factories are indicated by abbreviations, as follows: *G. Glaver*; *O.L.C. Cie. des Métaux d'Overpelt-Lommel et Corphalie* (Lommel); *P.R. Société Industrielle Réunies de Belgique* (Balen); *V.M. S.A. des Mines et Fonderies de Zinc de la Vieille-Montagne*. The small establishment north of the *Vieille-Montagne* works is a disused glass and bottle factory.

The abbreviation *D.S.C.* indicates the Desschel-Turnhout-Schoten Canal.

Kempen spelter is transported by rail or waterway. Only one Kempen zinc works, that at Rotem, has a rolling-mill attached to its foundry.

No. 1. *S.A. des Mines et Fonderies de Zinc de la Vieille-Montagne*. This company, founded in 1837, has its parent establishments near Liège, at Angleur and at Hollogne-aux-Pierres. The original Kempen factory was built in 1889 on the banks of the Beverloo Branch Canal, in the Dorper Heide, one of the most desolate of the heathlands, on a site chosen for its communication facilities (Fig. 47). An extensive housing-estate has been built to the south-west of the factory to accommodate its workers, who totalled over eighteen hundred in 1947; there are few other nearby settlements. The factory produced in 1938 and 1947 respectively 8,189 and 11,408 tons of zinc, as well as a wide range of other non-ferrous metals and of chemicals, which in point of fact considerably exceeded the output of zinc.

Nos. 2 and 3. *La Cie. Métaux d'Overpelt-Lommel et Corphalie*. The two factories were built near Overpelt in 1890 and near Lommel in 1900 by independent companies, created by combined German and Belgian interests, but with the former distinctly prominent in each case. In 1913, the two companies merged and established their joint head office at Frankfurt-am-Main. The technical staffs were part Belgian, part German, but their workmen were almost exclusively Belgian. In 1919, when all German interests were of course expelled, the present Belgian company was formed. Like the *Vieille-Montagne* company, the Overpelt-Lommel factories produce, in addition to spelter, many other non-ferrous metals and associated chemicals.

The extensive buildings of the Overpelt factory (No. 2) are situated among the dunes of the Houtmolensche Heide, on the south bank of the Herentals-Bocholt Canal. While this large factory draws much of its labour from the scattered hamlets of the north-eastern Kempen, it has its own nearby housing-estate. The Lommel works (No. 3) is situated about three kilometres west of the commune centre of the same name, in the lonely heathland of the Hoog Maatheide, and about two kilometres south of the Herentals-Bocholt Canal (Fig. 47). Its small housing-estate lies to the south of the factory.

No. 4. *S.A. de Rothem*. This zinc-works was built in 1912-13, near

the eastern border of the Kempen plateau, on the low terrace above the Meuse flood plain. The Zuid-Willems Canal has been widened at this point to form a basin. The factory draws its labour from the numerous Meuse valley villages to the east, and has no housing-estate of its own. It produced 15,648 tons of zinc in 1938, including both spelter and sheet-zinc; in 1946 this total had fallen to 3,526 tons, although there was a considerable recovery in 1947.

(b) *Other Non-Ferrous Refineries and Chemical Works*

A wide range of non-ferrous metals—base, precious and rare—is refined in Belgium, which is in fact one of the world's leading producers of several of these. Much of the output is exported, but there is a considerable demand from the home market, especially from electro-metallurgical and chemical firms. For the most part, the various branches of the industry are controlled by a few large combines, producing both non-ferrous metals and a range of associated chemicals. For example, in the Kempen the zinc-refining companies also produce considerable amounts of other metals and chemicals, as illustrated by the detailed production figures of the *Vieille-Montagne* company :

	1938	1946
Lead	28,000 tons	11,822 tons
Silver.. .. .	64,313 kgs.	4,240 kgs.
Cadmium	183 tons	897 tons
Copper sulphate ..	3,342 tons	3,485 tons
Sulphuric acid ..	129,512 tons	112,278 tons

The Rosin works in 1938 produced over seventeen thousand tons of sulphuric acid and its concentrate, oleum; although this output fell in 1946 to 12,360 tons, the post-war industrial recovery is again exemplified by the 1947 production of about thirteen thousand tons. Apart from these ~~works~~, however, there are five other important chemico-metallurgical factories in the Kempen.

Nos. 5 and 6. *Société Générale Métallurgique de Hoboken*. This great organization, founded in 1908, has its parent company and administrative centre at Hoboken, to the south-west of Antwerp, and owns two large factories in the Kempen, at Oolen and at Reppel. The company works in close conjunction with the *Union minière du Haut-Katanga* in the Belgian Congo, which is an important source of a wide range of non-ferrous ores. Using these and other ores imported from Yugoslavia, Bolivia, Chile, Mexico and elsewhere, the company produces a variety of refined metals and their chemical derivatives.

The factory at Oolen (No. 5), which was built in 1922, is situated about three kilometres east of Herentals, near the Herentals-Bocholt Canal. A small housing-estate to the south of the factory accommodates some of the work-people, which total over two thousand. One block of this factory produces uranium and radium from Congo pitchblende; much of the output is sold to the United States. The other block produces mainly electrolytic copper and cobalt. The factory near Reppel (No. 6), acquired by the present company in 1919, specializes in the production of various arsenic derivatives; these include an insecticide for use against the cotton boll-weevil, which is exported in large quantities to America.

No. 7. *S.A. la Métallo-Chimique*. This factory is situated about five kilometres west of Beerse, on the south bank of the Desschel-Turnhout-Schoten Canal. It specializes in the production of copper and its derivatives—copper sulphate, Paris green (aceto-arsenic), copper nitrate and a wide variety of other salts. The major product is the "Bluet" brand of copper sulphate, of which in 1939 some six hundred tons a month were manufactured, mostly for sale in France and Italy to spray in solution on vines. The factory employs about 125 workmen.

No. 8. *Société des Produits Chimiques de Tessenderloo*. The factory was built near the village of Tessenderloo in 1919, when the present company was reconstituted. Destroyed during the war of 1940-44, it was rebuilt in 1945. It employed nearly a thousand workers in 1947, almost exactly the same number as in 1938. The rapid post-war recovery is shown by the Table on the following page.

	1938	1946	1947*
		(Tons)	
Salt cake	36,767	24,060	31,908
Potassium sulphate ..	26,658	5,806	19,682
Muriatic acid	95,406	44,386	79,572
Dicalcium phosphate ..	32,877	5,962	22,673
Caustic potash	3,547	5,718	9,117
Bleaching powder ..	173	1,060	795
Hypochlorite	598	2,172	1,277
Liquid chlorine	323	—	244

* Up to November 30 only.

No. 9. *Produits Chimiques du Limbourg S.A.* This company has a factory at Kwaadmechelen, built in 1930, which employs more than five hundred work-people. It manufactures sulphuric acid, potassium sulphate, hydrochloric acid, dicalcium phosphate and osseine.

(c) *Explosives Factories*

The wide expanses of the Kempen heathlands are obviously suitable for the location of potentially dangerous industries such as the manufacture of explosives. Factories can be segregated in uninhabited open land behind lines of protective sand-dunes.

No. 10. *Société d'Arendonck.* This company was founded in 1872, only a few years after the discovery of dynamite. The factory was built in 1873 in the north of the country, not far from the Dutch frontier. The company was incorporated in 1880, and was re-formed in 1913 under its present name. The output consists of industrial explosives, such as dynamite, blasting gelatine and gelignite, totalling 750 tons in 1938 and over five hundred tons in 1947. There were about seventy work-people employed in 1947, drawn from a ring of small hamlets which lie within a radius of five to eight kilometres.

No. 11. *La Poudrerie Royale de Wetteren (Coopal et Cie.).* The factory, built in 1880 near the Herentals-Bocholt Canal, is one

of the three establishments of this firm, founded in 1778 ; the others are at Wetteren and at Havre. Its various departments are spread out for nearly three kilometres along the banks of the canal, each separate building being isolated and surrounded by high parapets and moats. It was pillaged by the Germans during the war of 1914-18, but was restored in 1920 with modern installations, and now produces nitric acid, gun cotton, rifle- and shot-gun cartridges and various smokeless powders.

Nos. 12 and 13. *S.A. Poudreries Réunies de Belgique*. This company, incorporated in 1896, has two factories in the Kempen, at Balen and at Herentals. The Balen factory (No. 12), which lies in the desolate heathland of the Dorper Heide (Fig. 47), was built in 1884 by the French *Compagnie de la Forcité*. It was bought by the present holding company in 1919 and modernised. It manufactures not only nitro-glycerine and various dynamites, but also a number of chemicals, such as nitric acid, various pharmaceutical nitrates and sodium bisulphate, which are used in the company's other factories. It employed 140 workers in 1938, but as a result of its post-war expansion, particularly in the output of pharmaceutical products, the labour force had risen in 1947 to nearly six hundred. The Herentals factory (No. 13) was built in 1887 by an English company ; it was later sold to the *S.A. des Poudreries belges*, and passed to the present company in 1914. It was modernized after the war of 1914-18, and now makes industrial explosives and rifle cartridges. The various departments are spread out among the sand-hills to the west of the railway station, alongside which it has its own sidings.

(d) Glass-works

Belgium has been one of the leading world producers of glass and glassware since the famous Val-St-Lambert factory was built in 1825 at Seraing. In 1938, the country produced no less than one-quarter of the world's output of glass, mostly for export. Before the war of 1914-18, the industry was located almost exclusively near Liège, where there were supplies of fuel. More important, highly skilled labour for the mouth-blowing processes of the time was concentrated there ; this

was then the vital factor in the continuation of the industry in that district.

After 1919, glass-making became for the most part mechanical, the result of the invention of the Libbey-Owens process. The main difficulty of establishing the industry in a new locality, absence of the necessary skilled labour, was thus obviated. In the Kempen there were certain definite advantages, apart from those common to all industrial development there, such as cheap and extensive land for factory sites. There are large deposits of pure glass-sands, regarded almost as highly as the famous deposits of Fontainebleau near Paris; in the past quantities have even been exported from Belgium to the United States and to Italy. The chief deposits which have been worked are in the communes of Mol and Lommel. Further, the long-flame coals suitable for glass-kilns have been produced in increasing quantities as the Kempen coalfield was developed.

No. 14. *S.A. Glaces et Verres (Glaver)*. After the war of 1914-18, a Belgian-American group, the *Compagnie internationale pour la Fabrication mécanique du Verre (Procédés Libbey-Owens)*, was created to introduce the new mechanical process of glass-making into several European countries from America. As a result, the Mol-Gompel factory (Fig. 47) was built in 1921-3. The company was enlarged and incorporated in 1931 as a wholly Belgian concern, and now owns four other factories in various parts of Belgium. The main product at Mol-Gompel is sheet-glass. The factory, damaged during the war of 1940-44, rapidly increased its output in the post-war years; in fact, while the monthly production of sheet-glass was 3,750 tons in 1938, this had been stepped-up to nearly five thousand tons in 1946. It employed 1,350 workers.

No. 15. *S.A. Cie. Verreries du Pays de Liège et de la Campine*. This factory, built in 1921 in the heathlands some three kilometres north of Mol, is considerably dispersed, for its buildings are arranged in a right-angle, with one limb along the Herentals-Boholt Canal and another along the main road. A net-work of mineral-lines connects the several departments and the sand-pits to the west of the factory. It employs over four hundred workers, and produces a wide variety of glass-ware,

mainly bottles, glass insulators and laboratory ware. The output here has also increased rapidly, from about ten thousand tons in 1938 to more than twice that figure in 1947, in which year it employed 425 workers.

(c) *Brick-works*

The manufacture of bricks requires the bringing together of large quantities of heavy raw materials and coal, and entails the dispersal of bulky finished products. In Belgium, therefore, the industry is found almost entirely along the waterways. The Kempen manufactures about a quarter of the total Belgian output of bricks, as well as a considerable number of tiles. Most of the companies are subsidiaries of the *S.A. Cimenteries et Briqueteries Réunies de Bonne-Espérance, Raevels et Loën (Visé)*, but there are also about twelve other independent units. There are twenty-nine brick-yards along the Desschel-Turnhout-Schoten Canal (Figs. 46, 48). The kilns stand near the canal banks, fronted by open spaces on which the stacks of the characteristic thin Belgian bricks await removal by barge. Some bricks are despatched by lorry for more local use. The canal between Eindhoven and Turnhout crosses rather desolate heathland, unpopulated except for a few large villages such as Sint-Lenaarts, Meer and Beerse, where live most of the workers in the brick-yards. On each side of the canal, beyond the kilns, lie numerous large pits, some abandoned and water-filled, others still in operation, from which is excavated the fine clay, or *terre glaise*, the raw material of the yards. The pits are usually connected with the kilns by narrow-gauge lines, sometimes by aerial ropeways with buckets. The overlying layer of sand is stripped off, and the clay dug out by large mechanical shovels in a series of great steps or terraces.

In addition to these, grouped in one major area, small brick-yards are to be found widely distributed in the Kempen. Most are small-scale, but a few larger yards are to be found near the towns, such as at Hasselt, Maaseik, Neerpelt and Mol. They mainly supply local needs, in contrast to the Turnhout yards, which manufacture for more distant markets. Some small specialized firms at Hasselt, Kontich and Berchem make glazed and ornamental bricks and tiles. There is

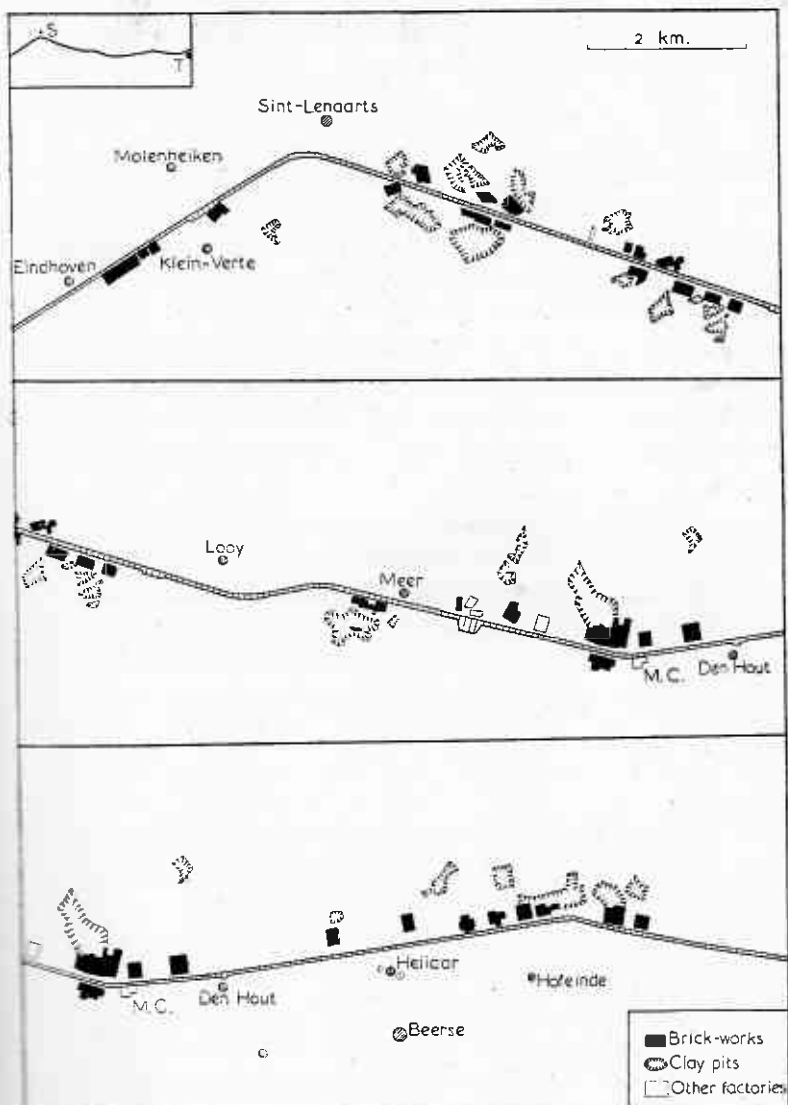


FIG. 48. BRICK-WORKS NEAR TURNHOUT

There is a small overlap between each of the sections, the whole of which are based on the diagram in the top left corner.

The abbreviation **M.C.** indicates the factory of the *S.A. la Métallo-Chimique*. On the location diagram, the abbreviations are **S.** Sint-Lenaarts ; **T.** Turnhout.

another small group of brick-yards in the Meuse valley to the south of Eisden, beside the Zuid-Willems Canal.

(f) *Cement-works*

Cement is manufactured in the Beerse-Turnhout district, for the most part by the brick-making companies. The *S.A. Cimenteries et Briqueteries Réunies*, which produces nearly two-thirds of Belgian cement, has two large factories to the north-east of Turnhout and another near Beerse. The Ravels-Bonne-Espérance works (No. 16) was built in 1912 on the banks of the Desschel-Turnhout-Schoten Canal, and acquired by the present company in 1922. It has its own fleet of barges, to bring lime from the kilns near Visé, which burn the soft Cretaceous rocks quarried in the Meuse valley. Barges return with clay from the pits near Ravels to the Visé-Loën works owned by the same company, while others ship the cement to Antwerp. In 1938, the Ravels works produced about a million tons of Portland cement. The second big factory (No. 17) stands among the brick-yards on the north bank of the Desschel-Turnhout-Schoten Canal. It was built in 1889 by an English company, and enlarged and modernized in 1923.

CHAPTER VII

THE DEVELOPMENT OF COMMUNICATIONS

THE density of the Belgian networks of roads, railways and light railways (tramways), in terms of average length per unit of area, was in 1947 the highest of any country, and that of waterways was second only to the Netherlands. This is an obvious response to the great density of population and to the agricultural and industrial productivity of the country generally; as the economic development of Belgium progressed during the last century, so necessarily were the transport systems improved and extended. This has been particularly the case in the Kempen, which in 1839 was but poorly served with lines of communication. Metalled roads between the administrative centres and the villages replaced earth tracks, and roads were built to the new collieries and factories. The waterways provided cheap transport for the fuel and heavy raw materials needed by the new industries and for their usually bulky products. The railways linked the towns and factories of the Kempen with the great port of Antwerp, with Brussels, with the cities along the southern borders of the region, and with Liège. The light railways provided cheap and efficient transport between the sources of labour in the Kempen villages and towns on the one hand, and the factories and collieries on the other. This chapter surveys the growth of these various transport facilities in relation to the economic development of which they were both cause and result.

ROADS

The roads of the Kempen, as of other parts of Belgium, may be classified according to the authority in charge of their construction and maintenance. The State is responsible for the *routes de l'Etat* (*rijkswegen*), and the various provinces for the *routes provinciales* (*provincie-wegen*); these two categories may be grouped together as "major" roads. The third category, of "minor roads" or *chemins vicinaux*, is controlled by the *Administration de la Voirie communale*, and the upkeep devolves upon the individual communes.

Length of State and Provincial Roads, 1830-1946
(kilometres)

	1830			1860		
	<i>State</i>	<i>Province</i>	<i>Total</i>	<i>State</i>	<i>Province</i>	<i>Total</i>
Antwerpen	109	75	184	267	207	474
Limburg	149	—	149	401	—	401
Belgium	2,593	514	3,107	4,548	1,507	6,055
	1900			1946		
	<i>State</i>	<i>Province</i>	<i>Total</i>	<i>State</i>	<i>Province</i>	<i>Total</i>
Antwerpen	501	220	721	769	202	971
Limburg	689	—	689	857	—	857
Belgium	7,309	1,497	8,806	9,177	1,569	10,750

(Note. A small length of private road has been included in the total for all Belgium; there is none of this category in Antwerpen and Limburg.)

Major Roads

The Table opposite indicates the growth since 1830 of the State and provincial roads in the Kempen provinces of Antwerpen and Limburg ; comparative figures are not available for the minor roads. For comparison, the total lengths in Belgium as a whole are included.

The percentage increase in the lengths of these major roads between 1830 and 1946 is interesting ; in Belgium as a whole this was 244, but in Antwerpen it was 428 and in Limburg 475. The reason for the smaller increase in all Belgium is because by that year the cities of Flanders, the capital, and the industrial towns of Hainaut and of the Meuse valley were already inter-connected by major roads ; many of these were, in fact, the sixteenth and seventeenth century *grandes chaussées*. But the Kempen provinces in 1830 had only a few main roads, and so the necessary nineteenth century developments produced a high percentage increase. The most important Kempen roads in 1830 were those converging upon Antwerp from towns in the west, such as Turnhout and Lier. Along the southern border of the region ran a road important since the thirteenth century, linking Mechelen, Aarschot, Diest, Hasselt, Maastricht and Aachen ; it was a section of the great European commercial highway between Brugge and Köln.

The State carried out a policy of construction during the nineteenth century, which aimed at covering the country with an evenly-spaced net-work of major roads. The remarkable uniformity of the result is revealed by the next Table, which gives the average length of major road per ten square kilometres of area in 1946 for each province and for Belgium as a whole (p. 162).

It will be seen that the average length of these major roads per unit of area in Antwerpen is slightly below the average for all Belgium and in Limburg slightly above, but the differences, and indeed those between all the provinces, are small. The Kempen provinces are divided by these roads into squares, rectangles and triangles, with sides of some five to twelve kilometres, and with small towns and large villages at the intersections. Many of these settlements are in fact "junction-villages," which have expanded ribbon-wise along the roads (Fig. 68).

A few larger towns form especially prominent road centres—Turnhout and Oostmalle in the northern Kempen, Herentals and Geel in the centre, Bree and Maaseik in the north-east, and Hasselt in the south-east, all of which are market-centres for their respective districts. The focal effect of Antwerp upon the main roads of the western Kempen is also evident (Fig. 49).

Major Roads in the Belgian Provinces, 1946

<i>Province</i>	<i>Total Length (kilometres)</i>	<i>Average Length per 10 square kilometres</i>
Antwerpen	971	3.39
Brabant	1,138	3.47
Hainaut	1,143	3.07
Liège	1,480	3.75
Limburg	857	3.56
Luxembourg	1,357	3.07
Namur	1,383	3.78
Oost-Vlaanderen ..	1,094	3.68
West-Vlaanderen ..	1,295	4.00
Belgium	*10,750	3.52

* This total includes 32 kilometres of *autoroute* (*autosnelweg*), not included in the provincial figures.

Minor Roads

The differences in the density of the network of minor or local roads in each province of Belgium are much more marked. These minor roads have been gradually developed to serve local needs, according to the distribution of villages, hamlets and farms, and the density of the network is a close indication of the distribution of population. The

following Table summarizes for 1936 the average length of minor road per ten square kilometres of area in each province.

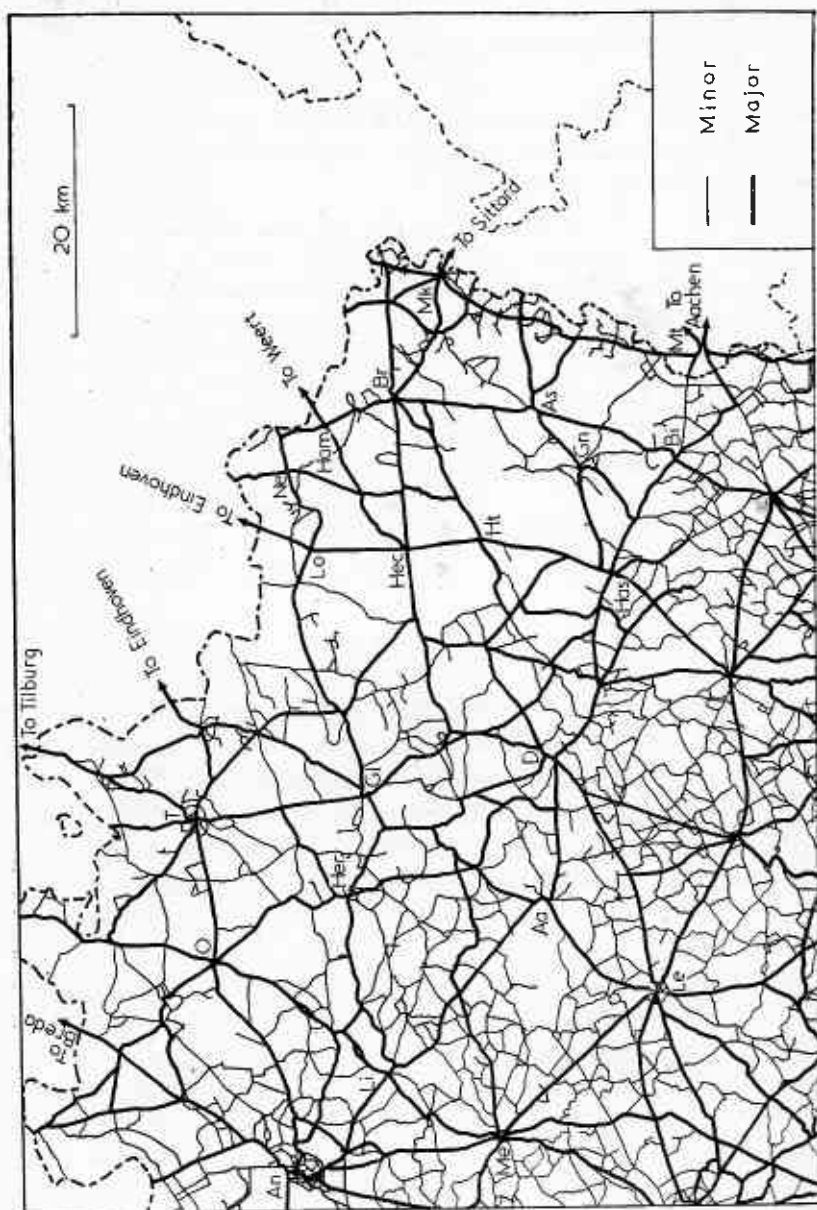
Minor Roads in the Belgian Provinces, 1936

Province	Total Length (kilometres)	Average Length (per 10 square kilometres)
Antwerpen	1,727	6.0
Brabant	4,806	14.7
Hainaut	5,716	19.2
Liège	4,783	12.1
Limburg	1,446	6.0
Luxembourg	5,016	11.4
Namur	4,501	12.3
Oost-Vlaanderen	3,642	12.3
West-Vlaanderen	3,694	11.4
Belgium	35,331	11.5

It will be seen that the two Kempen provinces had average figures markedly below the rest of Belgium, lower even than the Ardennes uplands in Namur and Luxembourg. This low density of the network in the Kempen stands out strikingly on Fig. 49, as compared with that of the Brabant and Hesbaye areas to the south of the Demer valley road, and also with that of the Antwerp district to the west. In the eastern Kempen especially, minor roads are comparatively few. While the major roads run straight across the heathlands, unfenced for much of their length, to join the widely separated villages, there are few of the small settlements, hamlets and farms which, in the more prosperous parts of Belgium, are interlinked by a maze of minor roads.

Tracks

There is a vast length of tracks, some surfaced with hard earth, others with bare sand, the thin white or yellow ribbons of which stand out



against the sombre background of the heathland. Some of them form a network round each village, others run to outlying farms, to sand- and gravel-quarries, to railway halts, to plantations and to grazing grounds on the heathland. Many just wind indeterminately on to the heathland and fade out among the dunes. The plantations of conifers are divided by "rides" into blocks for ease of exploitation.

The Roads of Genk Commune

The roads of Genk commune illustrate in more detail the variety of surfaces used, and indicate the nature of the road-pattern of a heathland commune (Fig. 50). This pattern contrasts markedly with that of 1846 (Fig. 62), when there was only one major road, the paved *Route de Hasselt*, which ran from Hasselt to Genk along a low ridge rising gently above the meres and marshland of the Stiemerbeek valley to the south. The other commune roads were then merely tracks, roughly levelled, sometimes loosely surfaced with a layer of pebbles, otherwise consisting only of two ruts in the compacted sand. These tracks ran to the outlying hamlets. But the population of Genk in 1846 was only 1,776 and there were little more than three hundred houses in all this area of 87.8 square kilometres. The empty heathlands to the west and north and the marshlands to the south-west were almost without roads.

FIG. 49. THE KEMPEN ROAD PATTERN

Based on the *Carte Routière de la Belgique*, 1 : 320,000, produced by the *Service-Cartographie de Belgique (Société Royale)* (Bruxelles), with post-war revisions made from various unpublished sources, and on the *Carte Michelin de la Belgique*, 1 : 250,000 (Clermont-Ferrand, n.d.).

Major roads comprise the *routes de l'Etat* and the *routes provinciales*; minor roads comprise the *chemins vicinaux*. The map includes all roads of the former category, but in the case of the latter only the more important and better-surfaced roads are shown. Near towns and large villages there is usually a maze of other minor tracks. The empty spaces of the heathlands stand out clearly.

Towns and villages mentioned in the text are indicated by abbreviations, as follows: **Aa.** Aarschot; **An.** Antwerp; **As.** Asch; **Bi.** Bilzen; **Br.** Bree; **Ge.** Geel; **Gn.** Genk; **Ham.** Hamont; **Has.** Hasselt; **Hec.** Hechtel; **Ht.** Houthalen; **Le.** Leuven; **Li.** Lier; **Lo.** Lommel; **Me.** Maastricht; **Mt.** Maastricht; **N.** Neerpelt; **O.** Oostmalle; **S.** St. Truiden.

By 1946, the total length of roads in the commune had increased considerably, for a large proportion of rough tracks had been converted into surfaced roadway. There are several main reasons for this development. In the first place, three large collieries have been developed in the north, together with their housing-estates ; in the second place, the population of the commune has risen some sixteenfold and many new houses have been built ; and in the third place, the Albert Canal now crosses the south-eastern corner of the commune, so that the canal-port there has been linked by new roads to Genk and to the collieries it serves.

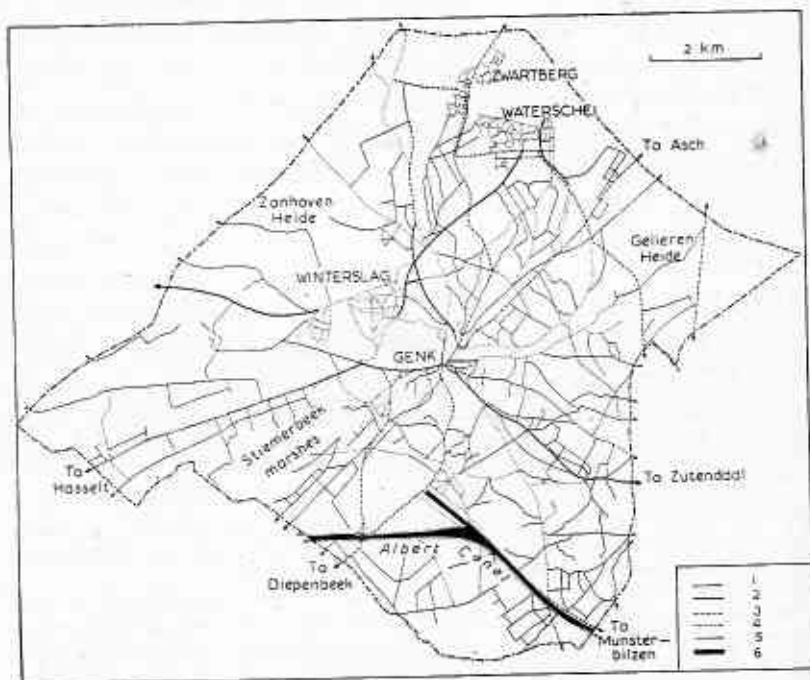


FIG. 50. ROADS IN THE COMMUNE OF GENK

Based on a manuscript map in the possession of the *Technisch Dienst* of the commune of Genk.

The numbers in the key refer to the nature of the road surface, as follows :
 1. *pavé* ; 2. concrete ; 3. tarmac ; 4. water-bound macadam ; 5. hard earth. Number 6 indicates the Albert Canal.

The roads of Genk are classified on Fig. 50 into five groups according to the nature of their surfaces : those stretches which are paved with small stone setts about fifteen centimetres square, those which are surfaced with concrete, with tarmacadam, or with rolled and water-bound pebbles, and those which are of hard earth. The *pavé* roads include the old *Route de Hasselt* which, bordered by an almost continuous avenue, a cycle-track of concrete slabs or tarmac, and a light railway track, runs south-westward from Genk to Hasselt. The streets of Genk and the first half-kilometre or so of each of the five roads radiating from the town are also paved, the setts being laid not rectilineally but in arcs. The new main roads from Genk to the collieries, to the canal-port and to the neighbouring small towns are broad, spaciouly laid-out and well surfaced, either with tarmac or concrete. The road from Genk to Winterslag, for example, which has an overall width of about ten metres, is a first-class highway, with a smooth concrete surface. The road south from Zwartberg has an overall width of about fifteen to seventeen metres, with a variety of surfaces, shown generally as follows :

Buildings
Line of trees
Bare earth
Tarmacadam
Bare earth
Cycle track (concrete or tarmac)
Bare earth
Light railway
Concrete slabs
Bare earth
Line of trees
Buildings

A substantial length of the commune roads is surfaced with water-bound macadam ; most of this consists of a layer of yellow or white pebbles rolled down hard. The housing-estates have much of their roads surfaced in this way, and although rather dusty they are good ; the patterns of these estate roads can be seen on Figs. 70-1. Some of the colliery companies have used the waste from their dumps, and when waterbound and heavily rolled this forms a satisfactory surface, although much black dust blows about ; near Zwartberg, for example, there are double-carriageway roads surfaced in this manner. Finally, a large proportion of the total length of the commune roads is surfaced merely with hard earth, compacted from constant usage, while holes and ruts are filled periodically with clay and pebbles. These roads, little more than tracks, serve the outlying hamlets and scattered farms.

WATERWAYS

Waterways are of vital importance to the industrial and commercial life of Belgium, for the length of the navigable network totals about one-third that of the rail-net, and the proportion of water-borne freight is about one-third that of rail-borne. Bulky raw materials and coal can be cheaply assembled at any point along the waterways, and this plays an important part in determining the location of factories (Fig. 46).

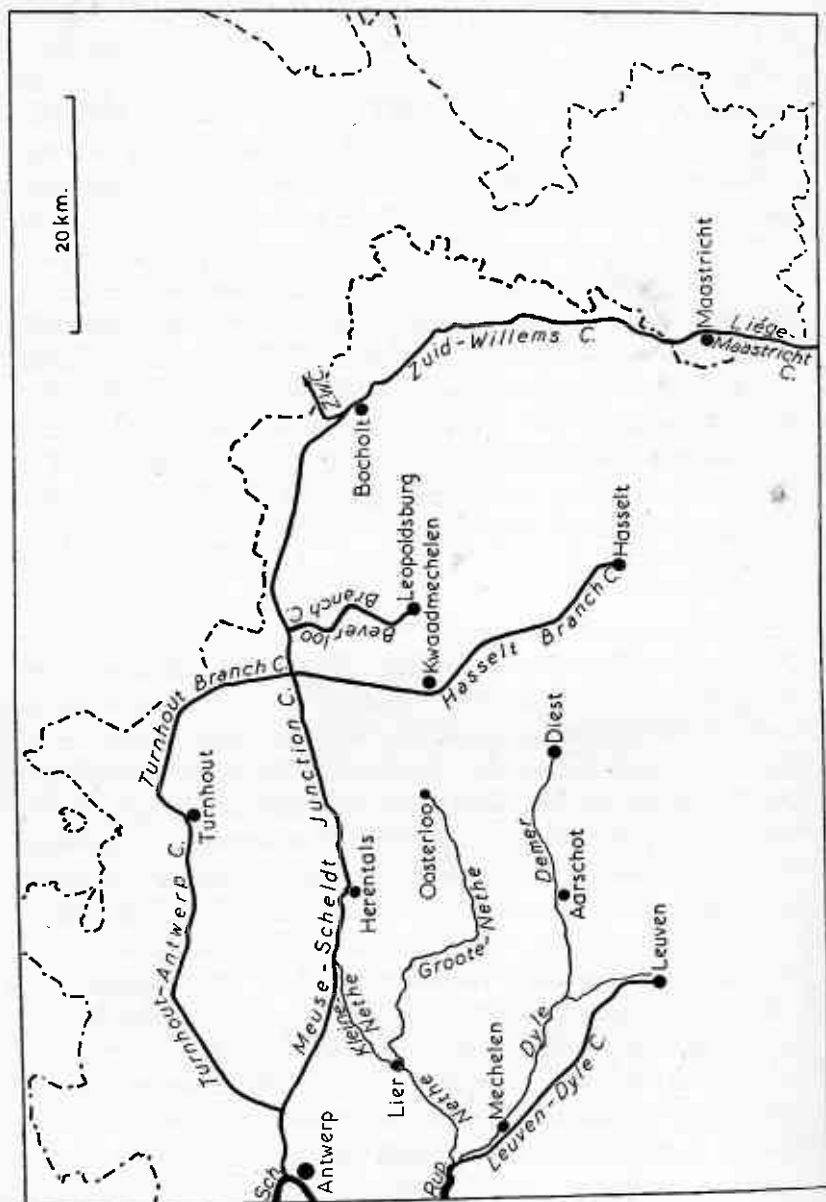
The Kempen for the most part lies in the eastern part of the basin of the Scheldt, and is drained by the numerous headstreams of the two Nethes and of the Demer (Fig. 16). Although regularized, these rivers are not much used for navigation ; they are shallow, of variable volume and impeded by sand-banks. The Demer has indeed been straightened (Fig. 17) and embanked as far as Diest, but its depth is variable, usually only about a metre. The Groote-Nethe is officially navigable for forty-four kilometres, but its depth too is extremely variable, in spite of seven locks, and it is seldom used. The Kleine-Nethe formerly provided a link between the Meuse-Scheldt Junction Canal in the north and the Rupel estuary, and was of some importance, but the river is now little used. A scheme is in progress, however, to

include the Nethe in part of a direct route between the Albert Canal and the Rupel ; it will then be unnecessary to send through-traffic, such as Kempen coal for the Rupel brick- and cement-works, via the docks at Antwerp. When completed, this new canal will leave the Albert Canal at Viersel through a locked connection, and so continue south-westward through Lier and Duffel, beyond which the route will utilize the enlarged and regularized lower Nethe.

The Meuse in the east is of no navigational importance, either to Belgium in general or to the Kempen in particular, for it is unnavigable between Maastricht and Maasbracht. The Dutch by-passed this section by the construction of the Juliana Canal, which, completed in 1936, forms a lateral waterway wholly in Dutch territory. Moreover, the Meuse valley is bounded on the west by an erosion slope (Fig. 12), sufficiently steep and high to prevent until 1930 the construction of a direct waterway along the southern margin of the Kempen between the Liège industrial area and Antwerp.

The Development of the Waterway Pattern

Before the nineteenth century there were no canals in the Kempen. During the Napoleonic period, a canal linking the Scheldt and the Meuse was planned ; Napoleon, in fact, revived an old scheme for a *Canal du Nord*, linking the Rhine with Antwerp, his base for a projected invasion of England. The ambitious line proposed ran from Grimlinghausen, on the Rhine above Düsseldorf, to the Meuse at Weselo, then via Bocholt and Herentals to Antwerp. Although work was started in 1808 at several points, the scheme was soon abandoned. Between 1815 and 1831, under the United Netherlands, several new waterways were completed. The Zuid-Willems or Maastricht-'s Hertogenbosch Canal, completed in 1826, leaves the left bank of the Meuse just below Maastricht and skirts the edge of the Kempen plateau, following the river terrace above the Meuse flood plain. Near Neeroeteren a spur of the plateau necessitates a short cutting (Fig. 14), but elsewhere the canal carefully rounds this north-western projection, continues north-westward to the neighbourhood of Breda, and then bends north-east and north to 's Hertogenbosch and



ultimately reaches the Meuse near Engelen. The final recognition of Belgian independence in 1839 divided this Zuid-Willems Canal into three parts: a short Dutch portion within the Maastricht Enclave, a Belgian section from Smeermaas to the frontier near Loozen, and a northerly Dutch portion.

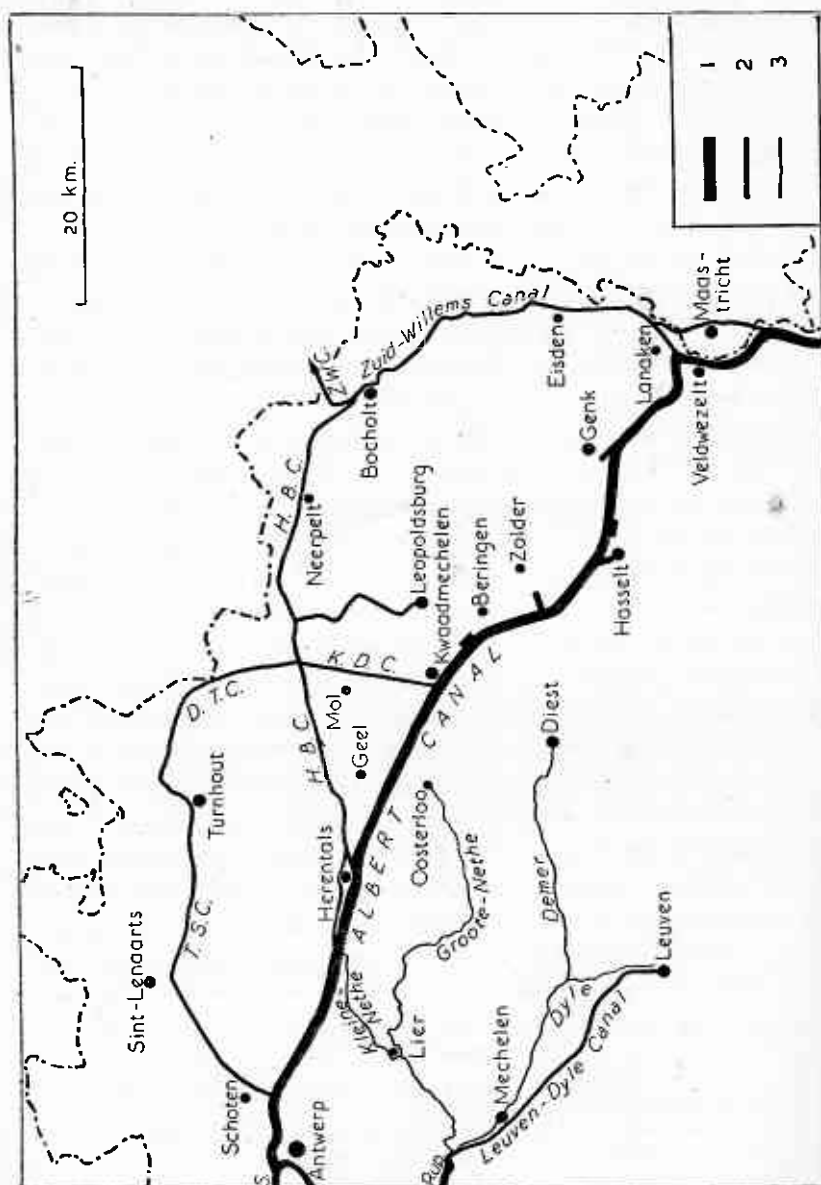
For more than a century, Belgium has been concerned with the problem of a direct water link between Antwerp and Liège, that is, between the Scheldt and the Meuse. In 1828, the city of Antwerp petitioned the United Netherlands government to construct a canal to link the two rivers, using the southern section of the recently completed Zuid-Willems Canal. But the Dutch viewed with disfavour any such scheme which might increase the importance of the port of Antwerp, for they obviously wanted as much as possible of the new joint kingdom to form the hinterland of Rotterdam. After independence had been attained, Belgium sought again to create a water-link between the Meuse and the Scheldt. It was clearly impracticable to cross the central part of the Kempen plateau, which is some forty to sixty metres above the Meuse valley. In any case, it was economical to take advantage of the existing Belgian section of the Zuid-Willems Canal, which could form the eastern part of the projected waterway. This new canal, known as the Meuse-Scheldt Junction or Kempen Canal, took fifteen years to build and was opened in 1859. From Bocholt on the Zuid-Willems Canal it curves gently north-westward through the narrow corridor between the fifty-metre contour and the Dutch frontier. Near Lommel it is contained in a shallow cutting where it crosses the water-land, and then continues westward, dropping by means of ten locks from forty metres to sea-level at Antwerp. It is embanked for a large part of its length, especially to the west of Herentals, where it has now

FIG. 51. THE KEMPEN WATERWAYS BEFORE THE CONSTRUCTION OF THE ALBERT CANAL

Based on W. Seghers, *Carte des Voies intérieures navigables de la Belgique*, 1 : 952,000 (Anvers, various editions).

The waterways are indicated by abbreviations as follows: **Rup.** Rupel; **Sch.** Scheldt (Escaut, Schelde); **Z.W.C.** Zuid-Willems Canal.

The thickness of the lines corresponds to the grading of the waterways, as indicated on Fig. 52.



been enlarged and incorporated into the western section of the Albert Canal, and the numerous headstreams of the Nethe system are siphoned beneath the embankments. The Meuse-Scheldt Junction Canal was, until the construction of the Albert Canal, the only water-route from Antwerp to Liège. But by this old waterway the most rapid voyages between the two cities took forty-three hours for a motor-barge and seventy-seven hours for a tow of four dumb-barges. There were several serious disabilities: ten locks and numerous swing- and lift-bridges had to be negotiated; the minimum depth was only 2.3 metres and therefore the maximum barge capacity was limited to six hundred tons; and barges were obliged to pass through Dutch territory in the Maastricht Enclave on their way to Liège. Nevertheless, until the twentieth century there was neither sufficient capital nor adequate technical skill to cut a more direct channel further south. Moreover, the old canal was and still is extensively used, for it serves many of the villages and towns of the central and northern Kempen, while the continuation along the Zuid-Willems Canal serves the villages to the north-east. The Albert Canal incorporated some sections of the Meuse-Scheldt Junction Canal; the remaining portion was re-named the Herentals-Bocholt Canal.

Several branch canals were constructed from the Meuse-Scheldt Junction Canal. The Beverloo Branch, completed in 1857, runs

FIG. 90. THE KEMPEN WATERWAYS AFTER THE COMPLETION OF THE ALBERT CANAL

Based on A. Delmer, *Plan du Canal Albert*, 1 : 100,000, contained in volume II of *Le Canal Albert* (Paris, 1939).

Waterways are abbreviated as follows: D.T.C. Dessel-Turnhout Canal; H.B.C. Herentals-Bocholt Canal; K.D.C. Kwaadmechelen-Dessel Canal; Bap. Ruppel; S. Scheldt (Escaut, Schelde); T.S.C. Turnhout-Schoten Canal; Z.W.C. Zuid-Willems Canal.

The grading of the waterways, as shown in the key, is as follows: 1. waterways which can accommodate large barges of 1,350 tons or over; 2. waterways which can accommodate barges of 450-1,350 tons; 3. rivers which have been regularized to accommodate small barges of under 450 tons, exceptionally larger.

Note. Recent information indicates that the loop canal to the north of Herentals, the former course of the old Meuse-Scheldt junction Canal, has been closed in; traffic from the Herentals-Bocholt Canal enters the Albert Canal to the east of Herentals.

southward across the desolate Hoog Maatheide to the west of Lommel, to end in a small basin at Leopoldsburg, near the Beverloo military camp. Its depth is only about two metres and it has never been much used. The Hasselt Branch, completed in 1858, was of rather more importance. It left the Meuse-Scheldt Canal at Dessel, to the west of the Beverloo Branch, and ran south-eastward to Hasselt. Part of this waterway, between Kwaadmechelen and Hasselt, has been enlarged and incorporated into the Albert Canal. The remaining section of waterway, renamed the Kwaadmechelen-Dessel Canal, forms a link between the central Kempen and Turnhout, for it is continued northward by the Dessel-Turnhout Canal and thence by the Turnhout-Schoten Canal in a curve through the western Kempen to its junction with the Albert Canal near Schoten. The Turnhout-Schoten Canal, embanked and raised above the countryside, forms in this area of indeterminate drainage a curious watershed between streams flowing northwards into the Netherlands and southwards to join the Nethc. It is an important canal, for not only does it serve the north-western Kempen in general and the prosperous and busy centre of Turnhout in particular, but it is lined eastward of Sint-Lenaarts with brick-yards and cement works (Fig. 48). The pattern of the Kempen waterways before the construction of the Albert Canal is shown on Fig. 51. Many of these waterways are still useful in that they serve the towns of the northern and eastern Kempen, and numerous important factories are to be found along their banks (Fig. 46).

Since before the war of 1914-18, there has been a constant pre-occupation with the problem of creating a new major waterway across the country. This would not only form a direct all-Belgian route between Antwerp and the Liège industrial area, but would also provide the necessary cheap transport for the increasing coal output of the Kempen field. In fact, the various industrial companies interested in the coalfield considered that the construction of a *Canal charbonnier* across the district would prove to be a most important factor in its development. It was argued, too, that it would have a definite strategic value as a defence line across the north-east of the country.

A proposal was first made for a waterway which would leave the

Hasselt Branch near Beringen at a height of thirty metres, ascend by means of seven locks to the Kempen watershed near Waterschei at eighty metres, and descend to the Meuse at forty-three metres by a staircase of five locks. The scheme was ambitious, as this canal was intended to take the large *bateaux rhénans* and *chalandes* of two thousand tons capacity. The plan was submitted to the government in July 1914, but the war of 1914-18 intervened. After 1920, a new project was put forward to construct a canal from the Hasselt Branch near Beringen, to run south-eastward to the Meuse valley near Visé and so to Liège. It would therefore serve the coalfield almost as well as the earlier scheme, although skirting it to the south instead of crossing it, and it would have the great additional advantage of more directly linking Antwerp and Liège, the two largest consuming districts of Kempen coal. Fifteen locks and a tunnel were to be used to negotiate the "neck" of plateau between the Demer and Meuse valleys. The construction of this canal was actually begun and cuttings were excavated in 1923 near Houthalen. But soon it was obvious that the engineering difficulties were immense and that the cost would far exceed the estimates, so the scheme was abandoned. The necessity for a new major waterway still remained, however, and this was emphasized by the fact that by 1926 several of the Kempen collieries were in production. A Government Commission was therefore set up, known as the *Commission Bouckaert*, after its president; it worked for nearly three years, reviewed all past schemes, carried out detailed field surveys and finally produced nine possible projects, with the estimated cost of each. The government considered the findings of the *Commission Bouckaert*, primarily from the financial aspect, and also reviewed objections, such as those made by the National Railway Company (S.N.C.F.B.). Finally, a route from Hasselt via Eigenbilzen to the Meuse valley at Visé was adopted. The ultimate outcome was the construction of the great Albert Canal, opened during the German occupation on Christmas Day, 1940.

This waterway between Antwerp and Liège, 130 kilometres in length, was an immense engineering project which took ten years to complete. The major obstacle of the upland "neck" linking the

Kempen and Hesbaye plateaux was negotiated by a series of great cuttings: the Tranchée de Caster was excavated through the St. Pietersberg ridge, then to the west of the Maastricht enclave is the Vroenhoven-Veldwezelt cutting, which in places is two hundred metres wide and sixty-five metres deep, and then the Eigenbilzen cutting to the west of Briegden. The canal continues westward along the Demer valley, and makes use for forty-seven kilometres of its length of enlarged sections of the Hasselt Branch and the Meuse-Scheldt Junction Canals. For the greater part of its lowland course it is contained within immense embankments, in places two hundred metres thick at the base. There is a fall of fifty-six metres between the Meuse and the Scheldt, negotiated by seven groups of triple locks. The canal can accommodate barges of two thousand tons; each group of locks can pass three barges through simultaneously, two each of two thousand tons and one of six hundred tons. Motor-barges can travel from Antwerp to Liège in sixteen hours, little more than a third of the time by the Kempen Canal.

The Albert Canal is primarily a through-route between Liège and Antwerp, but it is also of great importance to the colliery district, for it skirts the south-western border of the Kempen coalfield and several coal-ports have been built. The significance of the canal in relation to the collieries is shown on Fig. 46. For example, Kempen coal can be shipped from the Genk coal-port to Liège in about seven hours and to Antwerp in about nine or ten hours, and so to a large extent will supersede imported coal in the industrial centres of the lower Scheldt estuary. The canal is also of importance to southern Kempen towns such as Hasselt, Kwaadmechelen and Herentals, to the new factories and establishments which are being built along its banks as Belgium's post-war industrial recovery and expansion progresses, and to the other towns and factories along the old Kempen canals, which are now connected with the Albert Canal.

The construction of the Albert Canal made possible another direct contribution to the Kempen waterway system. While the Zuid-Willems Canal and the Meuse-Scheldt Junction Canal together linked the north-eastern Kempen with Liège, barges had to pass through

Dutch territory in the Maastricht Enclave, an obvious disadvantage. After the completion of Section I of the Albert Canal from Liège to Briegden, which skirts the Enclave on the west, a short link canal, known as the Briegden-Neerharen Branch, was constructed in 1935 to connect the Zuid-Willems Canal, before it re-enters Dutch territory, with the Briegden basin on the Albert Canal. This therefore now provides an all-Belgian water route along the eastern side of the Kempen, and thus completes a continuous waterway round the eastern Kempen. Similarly, the Albert Canal and the Dessel-Turnhout-Schoten Canal together provide a continuous route round the western Kempen. So the present pattern of Kempen waterways has broadly the outline of a horizontal figure eight, with a double intersection near the centre at Herentals and at Kwaadmechelen (Fig. 52).

Canal Ports

There are numerous canal ports serving the small towns, villages and factories along the banks of the Kempen waterways. The more important are given in the Table on pp. 180-1. There are many others which are little more than widenings or embayments in the waterways, faced with concrete, brick or timber piles, equipped with bollards for mooring the barges, and with small areas of stacking-space. Such are the canal-ports at Sint-Lenaarts, Beerse and Ravels on the Dessel-Turnhout-Schoten Canal, at Neerpelt and Sint-Huibrechts-Lille on the Herentals-Bocholt Canal, and at Tongerlo and Neeroeteren on the Zuid-Willems Canal. They serve as unloading points for barges bringing coal, bricks, cement and timber for local use. Rather similar are the quays serving small industrial enterprises such as brick-yards, which are located mainly along the waterways because of their dependence upon cheap bulk transport. Between Eindhoven and Turnhout along the Dessel-Turnhout-Schoten Canal there is an almost continuous line of brick-yards (Fig. 48). The smaller ones merely have the stretch of canal bank opposite their kilns faced with concrete or brick, while the larger ones have embayments forming small ports, with narrow-gauge moorings alongside and occasionally with a loading-bridge. Larger

embayments serve the major industrial establishments ; example include the long quay of *S.A. la Métallo-Chimique* near Beerse on the banks of the Desschel-Turnhout-Schoten Canal, equipped with an electric crane ; the large basin, with railway sidings and an overhead loading-bridge, of the Rotem zinc-works on the Zuid-Willems Canal ; and the rail-served triangular basin of the *Vieille-Montagne* zinc-refineries on the Beverloo Branch Canal. The waterway facilities of the major Kempen factories are mentioned in the detailed description of each factory (see pp. 149-58).

There are no really large canal ports in the Kempen itself. In a sense, however, the Antwerp barge-docks serve the region, since the Albert Canal, to which directly or indirectly all the Kempen canals are joined, terminates in these docks. The importance of this is shown by the fact that in 1938 the total cargo movement to and from the port of Antwerp by inland waterway was nine million tons, only slightly less than the tonnage of cargo carried by rail. The former figures include waterways other than the Kempen canals, of course, notably the lower Scheldt and its tributaries. Of importance also to Kempen waterways is the river port of Liège, with its forty kilometres of quays ; the port of Monsin, downstream of the city, near the point where the Albert Canal leaves the Meuse, handles most of the barge traffic destined for or originating from Antwerp and the Kempen canal ports.

Special mention must be made of the canal ports of Turnhout, Hasselt, Genk, Zolder and Beringen, which are larger and more important than the numerous minor embayments already mentioned. The first two of these were created with their respective waterways in the nineteenth century, although the second was vastly increased in importance by the construction of the Albert Canal, for the port now opens directly into this great waterway. The other three were built by the colliery companies to export Kempen coal.

The canal port of Turnhout (Fig. 45) lies to the north-west of the town. It comprises a large basin, which the Desschel-Turnhout-Schoten Canal enters at the north-eastern angle and leaves at the north-western. It is lined on the east, south and west sides with concrete-faced quays, served by standard-gauge sidings, which are connected to

the main-line railway to the north of Turnhout station. The area adjoining the basin and the canal is an important industrial district (see p. 143-4).

The canal port of Hasselt (Fig. 68) was formerly just a cul-de-sac at the southern end of the Hasselt Branch Canal, lying to the north of the city. With the construction of the Albert Canal, an appendix from that waterway, with free unlocked connection, now terminates in the Hasselt port, consisting of a long rectangular basin a hundred metres broad. This basin is faced with concrete, and has paved quays set with mooring bollards. Along the east side of the port there are narrow-gauge sidings connected to the Genk-Hasselt light railway, while along the south side there are double-track standard-gauge sidings connected with the main line near the station to the west of the town.

The port of Genk was constructed jointly by the Winterslag, Zwartberg and Waterschei colliery companies, with which it is linked by rail. It is used also by the Houthalen colliery. The port is managed by the *Société du Port Charbonnier de Genk S.A.*, in which the collieries are substantial share-holders. The basin projects north-westward from the Albert Canal, with which it has free unlocked connection, at the point where the canal changes its direction. Each of the long sides of the basin is faced with concrete, although the head has merely a grass bank, and the wharves are concreted. The narrow entrance to the basin was crossed by a steel bridge, destroyed during the war and not rebuilt by 1947. The port is extremely well equipped for handling coal. There are standard-gauge railway sidings on the wharves along the east side of the basin, together with rails on which the three mobile overhead loading-bridges operate. Each of these can handle fifteen tons of coal at a time; the grabs on the bridges lift the bodies of the specially-constructed colliery tubs from the chassis, swing them out over the barges, and the coal is dropped by opening the bottoms of the tubs. There are also several cranes on this quay. The port handled during 1946 and 1947 about 100,000 tons of coal each month, fifty-four per cent of which moved westwards to Antwerp, the remainder towards Liège. The importance of the canal port to the Genk collieries

is exemplified by the fact that thirty-one per cent of the coal output of Winterslag in 1947 moved by water. From the port, railways and metalled roads run northward to Genk and to the collieries it serves.

The port of Zolder, which is used by the Helchteren-Zolder colliery, consists of a large basin with a narrow unlocked exit into a triangular embayment cut into the east bank of the Albert Canal. It is served by standard-gauge sidings on both the north and south sides, and is linked by main lines built on embankments along the Mangelbeek valley to the Helchteren-Zolder colliery, seven kilometres away. It is equipped with loading-bridges. The port of Beringen is conveniently placed where the Albert Canal approaches most nearly the coal concessional areas, and is only about two kilometres from the colliery it serves.

Traffic at the Canal Ports. Few detailed statistics are available for individual canal ports, but figures of the numbers of barges and of the total tonnage of goods loaded and unloaded at points along each waterway are indicative of their relative importance. The next Table summarizes these facts for the Kempen waterways in 1946 :

Traffic at the Canal Ports, 1946

<i>Waterway</i>	<i>Chief Ports</i>	<i>Total Tonnage of Goods handled at Ports</i>	
		<i>Loaded</i>	<i>Unloaded</i>
Albert Canal, I* ..	Liège, Visé, Lixhe, Briegden	268,215	162,547
Albert Canal, II	Genk, Hasselt, Zolder, Beringen, Kwaadmechelen	1,712,011	464,458
Albert Canal, III ..	Herentals, Viersel, Schoten, Merksem, Antwerp	57,104	402,204
Beverloo Branch Canal	Beverloo, Balen-Wezel	66,363	194,737

Traffic at the Canal Ports, 1946—continued

<i>Waterway</i>	<i>Chief Ports</i>	<i>Total Tonnage of Goods handled at Ports</i>	
		<i>Loaded</i>	<i>Unloaded</i>
Desschel-Turnhout-Schoten Canal }	Desschel, Ravels, Turnhout, Beerse, Sint-Lenaarts, Schoten	338,654	314,444
Herentals-Bocholt Canal }	Oolen, Lommel (works), Neerpelt, Overpelt, Sint-Huibrechts-Lille, Kaulille, Bocholt	592,804	409,433
River Nethe ..	Lier, Duffel, Oosterloo	2,606	26,068
Kwaadmechelen-Desschel Canal }	Mol-Gompel	7,822	105,615
Zuid-Willems Canal	Bree, Tongerlo, Neeroeteren, Rotem, Eisden, Boorsheim, Lanaken	645,357	160,836
Total		3,690,936	2,240,342

* For administrative purposes, the Albert Canal is divided into three sections: I, Liège-Briegden, 28.3 kilometres in length; II, Briegden-Kwaadmechelen, 47.5 kilometres; and III, Kwaadmechelen-Antwerp, 32.4 kilometres.

The freight loaded included coal at the three ports on the Albert Canal, Section II, and at Eisden on the Zuid-Willems Canal; zinc ~~pellets~~, other refined metals, plate-glass and chemicals at the industrial

ports along the Herentals-Bocholt Canal ; and bricks and cement at the brick-yard ports along the Desschel-Turnhout-Schoten Canal. These three waterways had markedly higher loading figures than the rest, giving some indication of the importance of the canals in both the industrial life of the Kempen and in the development of the coalfield. A considerable proportion of the freight unloaded consisted of bulky goods for local use—building materials such as bricks, tiles, timber, sand and cement, domestic coal, fertilizers, grain and flour. The considerable unloading figures for the Herentals-Bocholt Canal were due to the needs of the numerous industrial establishments served, and so coal, coke, zinc and other ores, and glass-sands formed a high proportion. Along the Desschel-Turnhout-Schoten Canal, the brick-yards and cement-works received coal and limestone. The large totals for Sections II and III of the Albert Canal indicated both the industrial activity and the denser population of the western Kempen, where there are numerous towns and large villages along or near the waterway.

Traffic on the Waterways

The detailed freight returns of the Kempen waterways are expressed not only in terms of absolute tonnages but also in "ton-kilometres," a figure which is the product of the load in tons and the distance in kilometres that the particular load is carried. It gives a more accurate impression of the activity on the various waterways than does absolute tonnage, as it obviously differentiates between long- and short-distance loads. Furthermore, by calculating for each waterway the value "ton-kilometres per kilometre," that is, a division of the total number of ton-kilometres by the length of the waterway in kilometres, a strictly comparable representation of the respective importance of each waterway is obtained. The following Table summarizes the freight conveyed in 1946, in terms of the absolute tonnage, the ton-kilometrage, and the ton-kilometrage per kilometre of waterway length.

Waterway Freight Totals, 1946

	Thousand tons (absolute)	Million ton km.	Million ton km. per km.
Albert Canal, I	4,218.5	99.65	3.53
Albert Canal, II	2,175.7	26.75	0.56
Albert Canal, III	4,051.3	98.76	1.82
Beverloo Branch Canal ..	261.1	1.66	0.11
Desschel-Turnhout- Schoten Canal	1,054.3	46.09	0.73
Herentals-Bocholt Canal ..	4,458.9	176.46	3.07
River Nethe	28.9	0.33	0.01
Kwaadmechelen-Desschel Canal	1,067.0	15.86	1.00
Zuid-Willems Canal ..	3,641.1	119.88	2.76

The Herentals-Bocholt Canal, which is essentially an internal Kempen waterway serving many towns, villages and large factories, stands second only to the Albert Canal, Section I, in terms of ton-kilometres per kilometre and actually exceeds it in the absolute tonnage of freight conveyed. The Zuid-Willems Canal, third in relative importance, is equally clearly of great value to the north-eastern and eastern Kempen. This fact is emphasized because of the Breda-Neerharen Branch, which carries Belgian traffic from the Zuid-Willems Canal southwards via the Albert Canal to Liège, and so completes the eastern Kempen waterway circuit.

It must be remembered that these freight figures include a considerable proportion of "transit" traffic, much of which merely passes through the Kempen. The transit figure is especially high for the Albert Canal, as might be expected, the section from Kwaadmechelen to Antwerp (Section III) having eighty-eight per cent of its gross tonnage classified as such. Some of the transit traffic, of course, still concerns the Kempen, where either or both of the waterway termini are actually within the region; thus the Kwaadmechelen-Desschel

Canal had ninety-five per cent of its gross tonnage classified as transit, but it forms an important link across the central Kempen between the Albert Canal and the northern waterways. The Zuid-Willems Canal carries much Dutch transit traffic, as was the original intention of its builders, but this is now much less than might have been expected, for in 1946 two-thirds of the total barge-journeys were made by Belgian vessels.

It is of further value to consider the nature of the total freight for the nine Kempen waterways in 1946, classified according to Belgian practice into ten categories.

Kempen Waterway Freight Categories, 1946

<i>Category of Freight</i>	<i>Million ton km.</i>	<i>Percentage of Total</i>
Food-stuffs	33.0	7.3
Coal, coke, briquettes	224.0	49.6
Mineral ores.. .. .	16.7	3.7
Metal goods.. .. .	8.5	1.9
Building materials, timber, glass ..	37.3	8.2
Stone, sand, clay	45.7	10.0
Textiles, skins, leather	2.8	0.6
Chemicals	14.9	3.3
Oil	2.3	0.5
Other items	66.6	14.9
Total	451.8	100.0

The outstanding item was coal, comprising practically half of the total. The significance of the Albert Canal in the development of the Kempen coalfield is illustrated by the freight figures for Section II of the canal, which skirts the southern edge of the field, and where the main coal ports are situated; of the total of 26.8 million ton-kilometres in 1946, no less than 20.8 millions represented coal, coke and briquettes. The Herentals-Bocholt Canal had an individual total of 176.5 million

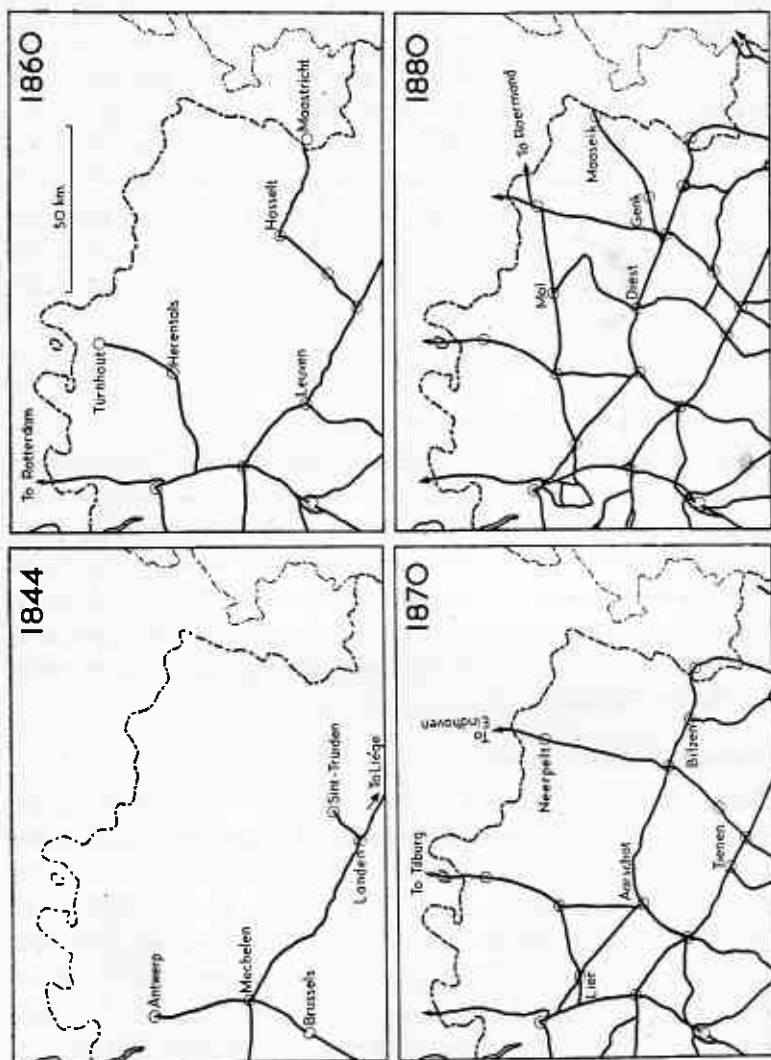
ton-kilometres, of which 88 millions represented coal, transported mainly to the large factories along its banks. No other item was as important as coal, but the percentage of eighteen for stone, sand, clay and building materials indicates the value of waterway transport to the brick-yards, cement-works and glass-works; the percentage of over seven for foodstuffs was a result not only of the rural nature of the Kempen but of the distribution of flour milled at Antwerp from imported grain; and the percentages of over three each for mineral ores and chemicals give some impression of the importance of the waterways to the chemico-metallurgical factories along their banks.

RAILWAYS

The present-day main-line railway network of the Kempen consists essentially of two lines running more or less eastwards from Antwerp crossed by three north-south lines, with one or two cul-de-sac branches serving outlying centres. This pattern encloses some large blank areas, notably the north-western angle between Antwerp and Turnhout and the region to the east of the Neerpelt-Hasselt line. It was to serve such rural areas as these that the *Société Nationale des Chemins de Fer Vicinaux* (S.N.C.F.V.), the light narrow-gauge railway or tramway system, was formed in 1884.

Development of the Network

The development of railway lines serving the Kempen began with the building of a short branch line northward from the Mechelen-Ans (Lige) line at Landen junction to Sint-Truiden (Fig. 53). By 1850 this had been continued to Hasselt, and by 1860 it had reached Maasmechelen by way of the Demer valley. This line, however, merely skirted the southern edge of the Kempen. By 1860, too, Turnhout had been linked with Antwerp by a line via Lier and Herentals (Fig. 54). During the next ten years there was a great expansion of Belgian lines (Fig. 55), mainly through the efforts of private companies. In the Kempen the Demer valley line had been completed by 1870, so forming a continuous railway route along the southern edge of the region by way



of Aarschot, Diest, Hasselt and so to Maastricht. Two lines from north to south were completed during this decade, one across the western, one across the central Kempen. The Turnhout-Herentals line was continued south to Aarschot, which had gradually become an important railway centre. The other new north-south line ran from Hasselt to Neerpelt and so into the Netherlands. All of these were single-track. This period, from 1844 to 1870, was one of private enterprise in railway building, and the Kempen lines were constructed and operated by private companies.

The next decade saw the virtual completion of the network as it exists today. A private company built the important line eastward from Herentals through Mol and Neerpelt to the Dutch frontier at Hamont. The completion of this line was followed by the erection of several new factories in the heathlands (Fig. 46) ; it was in fact a major step in the development of the Kempen as one of Belgium's industrial regions. Another private line was built across the heart of the eastern heathlands. This ascends steadily from the Demer valley at Hasselt to Genk, then it crosses the broad gentle watershed near Asch at a height of eighty-five metres and descends to the Meuse valley at Maaseik. The Kempen plateau edge is negotiated by means of a long narrow valley which projects south-westward into the upland, with the assistance of cuttings among the sand hills. The average gradient along the track from the eighty-five metre contour, which marks the approximate edge of the plateau, to the bridge over the Zuid-Willems Canal, on the Meuse terrace, is about one in seventy. The third addition during this decade was a line which runs rather circuitously southward from Mol, by way of the military camp at Leopoldsburg and then Kwaadmechelen, to join the valley line at Diest. This was actually the first line to be constructed by the State within the Kempen.

FIG. 53-6. THE DEVELOPMENT OF THE KEMPEN RAILWAY SYSTEM, 1844, 1860, 1870, 1880

Based on L. Avakian, "Le rythme de développement des voies ferrées en Belgique de 1835 à 1935," in *Bulletin de l'Institut de Recherches économiques*, volume VII (Louvain, 1935-6).

In 1871, the State, apprehensive both of the degree of foreign control in the privately owned lines and of the unco-ordinated system resulting from uncontrolled private enterprise, began a policy of repurchase. As a result, by 1910 only one Kempen line remained under private control, that from Hasselt to Maaseik, and it was ultimately incorporated into the State system after the war of 1914-18. The double-tracking of some lines was also carried out; by 1910, the Antwerp-Neerpelt and the Lier-Aarschot-Hasselt-Maastricht lines had been doubled, and also considerable lengths of sidings had been laid down.

Post-1918 developments of the network in the Kempen have almost entirely resulted from the exploitation of the coalfield. A loop was constructed from the Hasselt-Maaseik line about two kilometres west of Genk, curving northward and then eastward to serve in turn the collieries and new housing-estates of Winterslag, Zwartberg and Waterschei, so rejoining the direct line at Asch. The stations on this line are merely areas of bare earth, with timber shacks as station buildings, surrounded by wire fences. Another line runs southward from this new loop to the Genk coal-port on the Albert Canal, then on to join the Hasselt-Maastricht line at Beverst and so to Tongeren and Liège; this is used extensively for coal transport, both to the coal-port for shipment by waterway and directly by rail through to Liège. In 1947, for example, Winterslag colliery distributed sixty-five per cent of its coal by rail. The needs of the more westerly collieries of Houthalen, Helchteren-Zolder and Beringen-Koersel were met by another line, which incidentally serves a useful purpose in forming a new rail-link, if rather circuitous, across the central Kempen. It leaves the Genk loop to the north of Winterslag and crosses the desolate Zonhoven Heide to Houthalen, then continues westward past the Helchteren-Zolder and Beringen-Koersel collieries and so northward to Leopoldsburch. All these lines, with the exception of that to the Genk coal-port, are double-track. The various colliery companies have themselves constructed extensive private sidings with connections to the main lines, and the Helchteren-Zolder and Beringen-Koersel collieries have

built lines to their own coal-ports on the Albert Canal. The outlying Eisdén colliery used the Zuid-Willems Canal to export part of its coal, but there was an obvious need for rail connection to serve both the colliery and its neighbouring large housing-estate. A branch single-track line, six kilometres in length, was therefore constructed eastward from Asch, crossing the moorland at a maximum height of just over ninety metres, and then descending to its terminus on the Meuse terrace near Eisdén. It utilizes a long narrow valley projecting westward into the plateau, with deep heather-planted cuttings, to negotiate the steep edge. The value of this branch-line is shown by the fact that in 1946 the colliery sent off 430,000 tons of coal by canal and 425,000 tons by rail, and in 1947 the monthly average showed an increase in rail-borne coal, 48,000 tons as against 36,000 tons by canal.

The last change made in the main-line network of the Kempen was an enforced one in 1943, when the Germans removed the metals from the direct line through Genk to Asch and took them to the Russian front. The result has been to convert the former industrial loop through the colliery district into the present Hasselt-Asch main line, and Zwartberg is now the station for Genk. The network in 1947 is shown on Fig. 57. It carried a heavy traffic, both of passengers and freight; for example, very large numbers of miners travelled from many parts of the Kempen (Fig. 44) to Winterslag, Zwartberg and Waterschei stations. The efficient *Société Nationale des Chemins de Fer Belges* (S.N.C.F.B.) ran numerous through-trains on the various Kempen lines, and connections were carefully worked out.

There is a considerable length of private standard-gauge line, constructed as an integral part of the industrial development of the Kempen. The lines from the collieries to the canal-ports have already been mentioned. Several large factories were actually built along the Herentals-Neerpelt railway, but others lie away from the railway on the Herentals-Bocholt Canal (Fig. 46), and so private branch-lines have been built. For example, the Lommel metallurgical works and its canal sidings are connected with the main line at Lommel-*Werkeplaats* by a short branch five kilometres in length (Fig. 47).

Technical difficulties have not been serious. Gradients in the

western and northern Kempen are slight, and where the lines had to cross undulating sand-hill country, as to the west of Overpelt, shallow cuttings were easily dug. The main difficulty was the frequent need of bridges, especially over the canals, many of which are contained within embankments raised several metres above the level of the surrounding countryside. For example, the railway line to the north of Turnhout has to cross the Dessel-Turnhout-Schoten Canal by means of a lift-bridge. The water-level is some five to ten metres above the countryside, and to give the necessary clearance to barges it would have been necessary to build enormous approach embankments and a high fixed railway bridge. Instead of this, a lift-bridge was constructed, which when closed has a clearance of barely a metre, and the central section rises vertically on the approach of barges; in practice, trains are so infrequent as compared with barges that the railway bridge is normally kept raised. By contrast, the high steel or reinforced concrete bridges over the Albert Canal are fixed. Many were destroyed during the war of 1939-44, but have been gradually replaced; for example, the great steel bridge to the west of Herentals, which carries four tracks, was rebuilt in 1947.

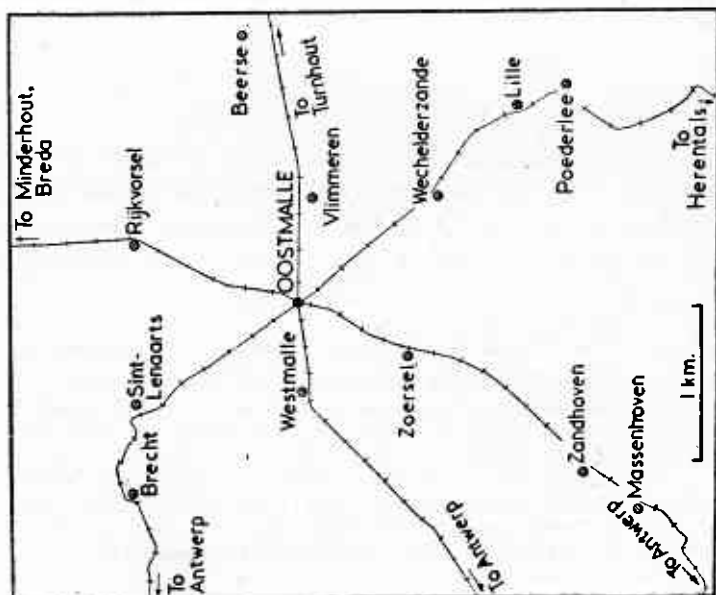
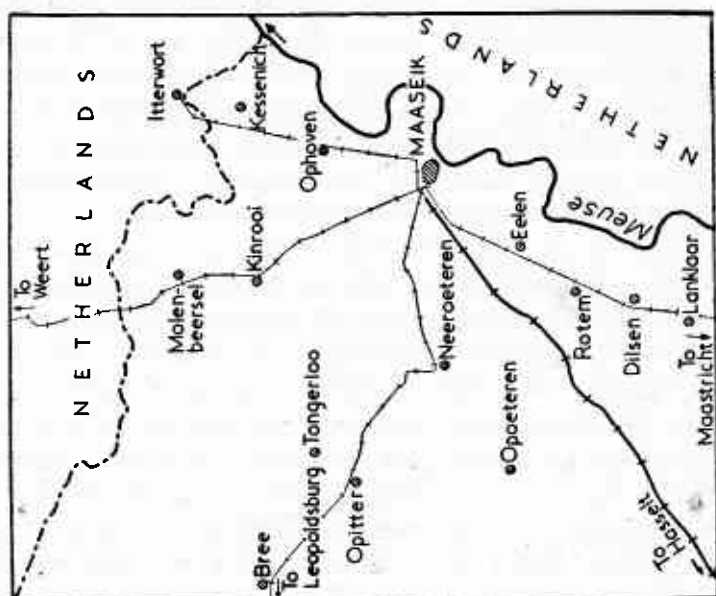
LIGHT RAILWAYS

The Kempen main-line system is from many points of view very adequate, in that the larger towns and the major factories and collieries are linked by the *S.N.C.F.B.* But the main-line railway pattern (Fig. 57) reveals considerable gaps, notably in the north-western

FIG. 57. THE KEMPEN MAIN-LINE AND LIGHT RAILWAY SYSTEMS, 1947

Based on *Chemins de Fer Belges; Indicateur Officiel* (Bruxelles, 1947).

Towns and large villages are indicated by abbreviations, as follows: A. (west) Aarschot; A. (east) Asch; An. Antwerp; Ba. Balen; Be. Beringen; Bi. Bilzen; B. Bree; Br. Brussels; D. Diest; E. Eisden; Ge. Geel; Gn. Genk; Ha. Hasselt; He. Herentals; Hk. Herk-de-Stad; Hl. Halen; Ht. Helchteren; K. Kwaadmechelen; Leu. Leuven; Li. Liege; Ma. Maaseik; Me. Mechelen; Mo. Mol; Mt. Maastricht; N. Neerpelt; Oo. Oostmalle; Ov. Overpelt; P. Poppel; S. Sint-Truiden; Ti. Tienen; To. Tongeren; Tu. Turnhout; W. Wijkmaal; Z. Zonhoven.



Kempen which is crossed only by a single line between Herentals and Turnhout, in the region to the south-west of Mol, and in the segment of heathland in the north-eastern Kempen. These rural areas, with their numerous villages, were in 1880 most inadequately served with communication facilities, an inadequacy increasingly felt as the newly established factories sought to draw on the labour supply which the villages offered. The distinction between industrial and agricultural workers in Belgium is rarely clear-cut (see p. 204), and many workmen live considerable distances from their work. Fig. 44, for example, shows the wide range of centres drawn upon by the Genk collieries for their labour supply. The *Société Nationale des Chemins de Fer Vicinaux* was created in 1884 to co-ordinate the numerous organizations, financed either by the State, by the provinces or by the communes, the purpose of which was to construct and operate narrow-gauge railways or tramways (*Buurtspoorwegen*), which would provide cheap transport for the rural areas. A network of these lines gradually spread over the Kempen, filling in the gaps between the main-line railways (Fig. 57). By 1945, there were over a thousand kilometres of light railway in the two Kempen provinces, of which about one-third was electrified. The actual figures for 1945 were :

Province	Electrified Lines (kilometres)	Steam Lines	Total	Passengers conveyed, 1945
Antwerpen	237	477	714	143,272
Limburg ..	62	313	375	39,527

The lines were obviously built to converge upon the small towns. In the western Kempen, six lines focus upon Oostmalle (Fig. 58) and five

FIGS. 58, 59. THE LIGHT RAILWAY CENTRES OF OOSTMALLE (LEFT) AND MAASEIK (RIGHT)

The single-track standard-gauge line from Hasselt to Maaseik is shown by a ~~thicker~~ barbed line.

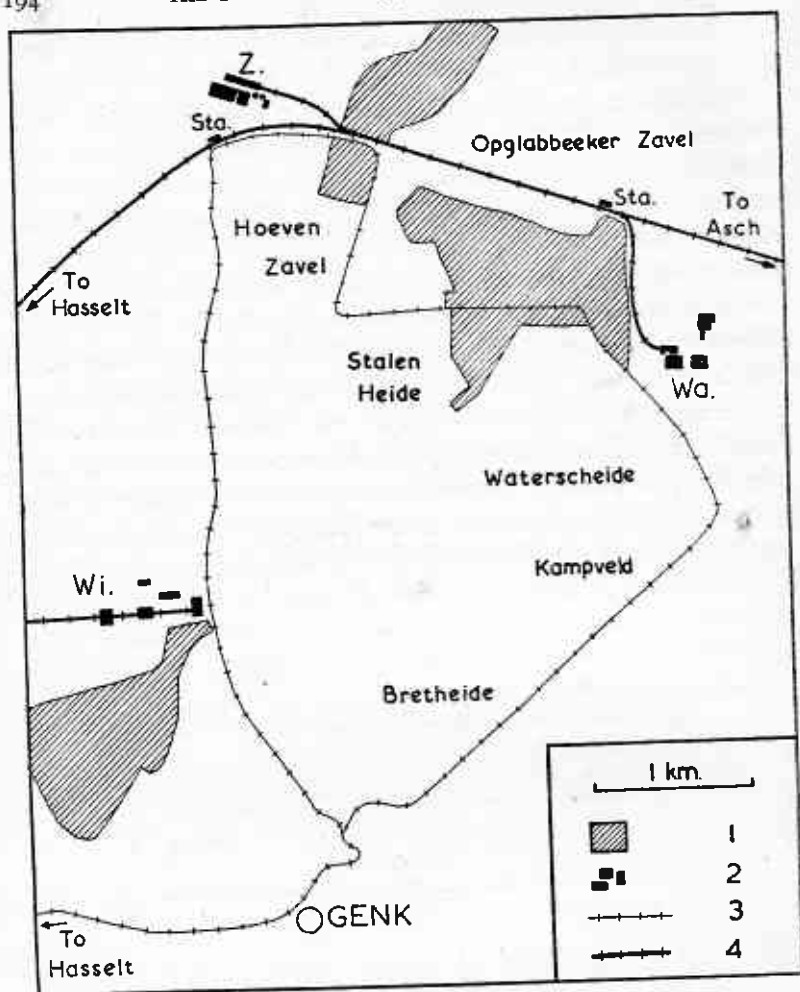


FIG. 60. THE LIGHT RAILWAY SYSTEM OF THE GENK COLLIERY DISTRICT
Based on a manuscript map in the possession of the *Technisch Dienst* of the commune of Genk.

The numbers in the key are as follows: 1. generalized outline of the colliery housing-estates (these are shown in greater detail on Figs. 70-1); 2. colliery buildings; 3. light railways; 4. main-line railways (the ramifications of the colliery sidings are not shown). The centre of Genk commune, comprising the small town and the commune administrative offices, is represented diagrammatically by an open circle.

The collieries are indicated by abbreviations, as follows: Wa. Waterschei; Wi. Winterslag; Z. Zwartberg.

upon Turnhout, while in the eastern Kempen four lines radiate from Maaseik (Fig. 59).

The most recently constructed of the light railways is that serving the Genk colliery district, with its numerous scattered hamlets and three large housing-estates (Fig. 60). The line runs from Hasselt to Genk for twelve kilometres along the side of the paved highway, and then forms a circuit of about sixteen kilometres on which trains run alternately in either direction. The single line, electrified from overhead cables, has passing places at various points. It runs sometimes unfenced across the open heathland, sometimes along the sides of the new roads, in Waterschei actually through the streets of the housing-estate. At Zwartberg the light railway approaches closely to the main line, and as a result at this point is the *S.N.C.F.B.* station for Genk. There is a considerable passenger traffic, partly because of the dense population of Genk commune, for which Hasselt is the main shopping centre, and partly because from the neighbourhood of that city many miners travel into Genk to their work.

CHAPTER VIII

POPULATION AND SETTLEMENT

THE DISTRIBUTION OF POPULATION IN 1846

THE results of the first census held in the independent kingdom of Belgium in 1846 showed that the average density of population over the whole country was 142 per square kilometre. The province of Antwerpen, with a total population of 406,354, had practically the same average density as had all Belgium, for although the heathland communes in the north and east of the province were very sparsely inhabited, the city of Antwerp contained 88,487 people and the three towns of Lier, Mechelen and Turnhout together had a further 45,580. But Limburg province had only 185,913 inhabitants, with an average density of seventy-seven per square kilometre, little more than half that of all Belgium. Indeed, the density in Maaseik *arrondissement*, in the north-east of Limburg, was only forty-three, while large areas of the heath-covered plateau were completely uninhabited.

The distribution of population in 1846 in the Kempen and its marginal lands, calculated in terms of the density per square kilometre for each commune, is shown on Fig. 61. On this map, a line drawn roughly from north-west to south-east between the densities of above and below a hundred people per square kilometre indicates the approximate southern boundary of the Kempen proper. To the west and south of this line are the more densely populated communes of the Antwerp region, of northern Brabant and of Hesbaye. These areas comprised closely settled agricultural land, with numerous large villages and several towns, notably Antwerp itself, which even then

was spreading rapidly outwards to draw neighbouring communes within the conurbation. Many urban communes in the area between Antwerp and Mechelen had a density exceeding a thousand per square kilometre. Other communes containing small towns, so raising the average density, were strung out along the southern margin of the Kempen—Aarschot, Diest and Hasselt.

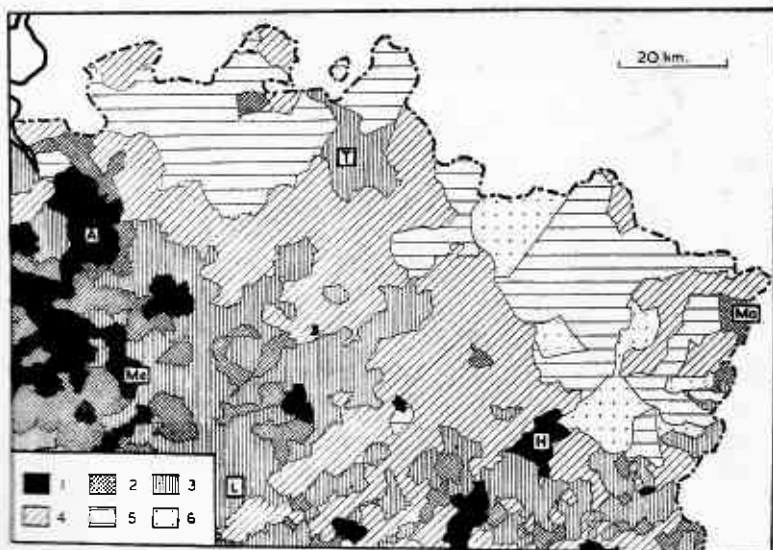


FIG. 61. THE DISTRIBUTION OF POPULATION, 1846

Based on statistics obtained from *Recensement Général de la Population, 1846* (Bruxelles, 1850).

The figures in the key indicate the average distribution of population per square kilometre, calculated on the basis of communes, as follows: 1. over 200; 2. 150 to 200; 3. 100 to 150; 4. 50 to 100; 5. 25 to 50; 6. under 25.

The main towns are indicated by abbreviations, as follows: A. Antwerp; H. Hasselt; L. Lier; Ma. Maaseik; Me. Mechelen; T. Turnhout.

These communes lie outside the borders of the Kempen proper. Within that region itself many of the northern and eastern communes averaged less than fifty people per square kilometre, while those in the central part had from fifty to a hundred. As a general rule, each commune comprised a number of villages and hamlets, surrounded by

small areas of arable land and sometimes with meadows in the valleys, but with much intervening heathland. Isolated houses were comparatively rare. As an example of this distribution, Fig. 62 depicts Genk commune at the time of a cadastral survey made in 1846 in conjunction with the first census, which provided detailed figures of houses and population for each individual hamlet within the commune.

The Distribution of Houses and Population in Genk Commune, 1846

	<i>Houses</i>	<i>Population</i>
Bret	3	23
Drijhoven ..	10	45
Gelieren ..	42	250
Genk	81	386
Heide	14	81
Hostart ..	14	84
Kamerloo ..	12	66
Kattevenne ..	2	9
Kijlen	4	20
Langerloo ..	29	163
Sledderloo ..	30	152
Terbokt ..	26	117
Waterschei ..	32	184
Winterslag ..	34	196

A few communes in the Kempen itself stand out on Fig. 61 with densities of population markedly higher or lower than the general average ; eleven, in fact, each had a density exceeding a hundred per square kilometre, and five of these had over 150. The little commune of Zoerle-Parwijs, to the north-west of Diest, was outstanding, for it had an average density of 328 per square kilometre. Unlike most Kempen communes, nearly nine-tenths of its area consisted of arable land, and it had practically no woodland, heathland or marshland ; the village of a hundred houses, strung out along the main road from Aarschot to Herentals, backed by gardens, orchards and small-holdings,

occupied the entire area of the commune. Hoogstraaten in the north had an average of 175 per square kilometre. Like Zoerle-Parwijs, the village consisted of a continuous row of houses, extending along the main road northward from Oostmalle, while thirty-five per

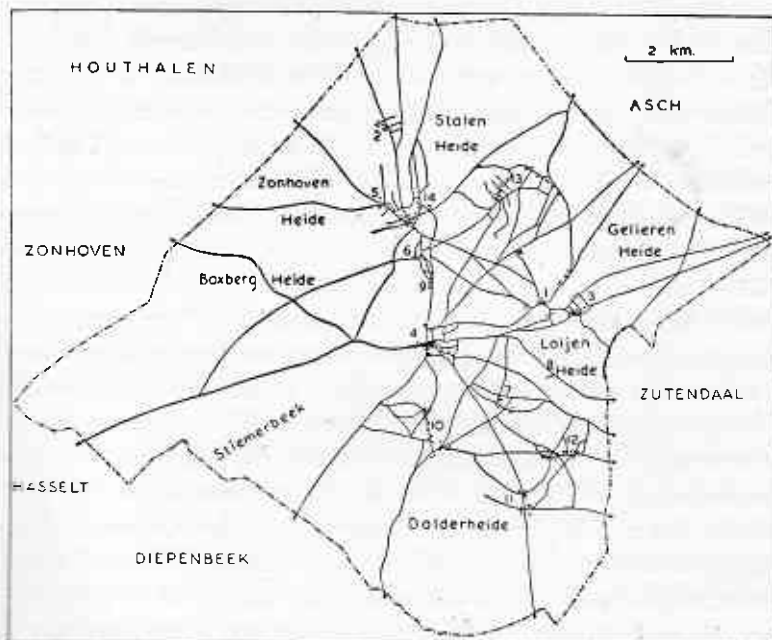


FIG. 62. THE DISTRIBUTION OF HOUSES IN GENK COMMUNE, 1846

Based on a manuscript map in the possession of the *Technisch Dienst* of the commune of Genk.

The numbers indicate hamlets, as follows : 1. Bret ; 2. Driehoven ; 3. Gelieren ; 4. Genk ; 5. Heide ; 6. Hostart ; 7. Kamerloo ; 8. Kattevenne ; 9. Kijlen ; 10. Langerloo ; 11. Sledderloo ; 12. Terboks ; 13. Waterschei ; 14. Winterslag.

Roads and tracks are indicated by thin lines.

Roads and buildings are not shown in adjacent communes because of the incomplete data.

most of the area of the commune was under arable land and ten per cent under pasture, mostly along the valley of the small river Mark in the west. It is true that twenty-two per cent comprised heathland and sixteen per cent woodland, or the average density would have been higher still. Beringen, in the east-centre of the Kempen, an important

junction-village on a low spur above the fertile valley of the Zwartbeek, had exactly half of its area under arable land, a further quarter under pasture along the Zwartbeek and Helderbeek valleys, but only four per cent under heathland. So, in spite of the marshlands bordering the courses of these rivers, the commune had an average density of population of 167 per square kilometre. In the east, Maaseik (160) and Stokkem (161) each exemplified the closer settlement of the fertile Meuse valley, although their western lands extend up the steep slope which borders the Meuse valley on to the Kempen plateau. The small walled town of Maaseik, the "chief place" of the *arrondissement*, had an urban population of about three thousand. Six other communes exceeded a hundred per square kilometre. Of these, Turnhout and Oud-Turnhout (a single commune in 1846) had a total population of nearly fifteen thousand. The urban population of Turnhout itself, a prosperous market town and regional centre, was 9,723, which accounts for the commune average of 139, in spite of the fact that a quarter of the whole area was under heathland. Further south, two narrow lines of communes with an average density exceeding a hundred project north-eastward into the Kempen from the southern margin lands. These communes coincide for the most part with the alluvial-floored valleys of the Kleine-Nethe and Groote-Nethe, and even in 1846 they had water-meadows along the rivers, extensive arable land on the lower slopes, and only a small area of heath on the higher land beyond the valleys.

In contrast, there were seven communes with average densities below twenty-five per square kilometre, all of them in the eastern Kempen. They comprised, in fact, the real heathland communes. Lommel, Helchteren and Gruitrode each had an average density of twenty-three, Genk had twenty and Wijshagen fifteen; all these had nearly two-thirds of their areas covered with heath. On the eastern plateau edge, Lanklaar had a density of nineteen and Opgrimbe of only nine, the lowest figure for any Kempen commune; each had three-quarters of its area under either heath or woodland. Their territories do not extend eastward down the plateau edge into the more fertile Meuse valley, as do those of the communes immediately to the north and south, such as *Maaseik and Stokkem*.

POPULATION CHANGES, 1846-1945

During the ninety-nine years which elapsed between the first census and the 1945 estimates, the population of Belgium almost doubled. The two Kempen provinces, however, increased much more strikingly, as shown in the Table overleaf. It will be seen that up to 1900 there was a steady but not particularly marked growth of population in five of the six *arrondissements*. By contrast, the outstanding increase in the *arrondissement* of Antwerpen was the result of the development of the city and port of Antwerp and of its neighbouring communes; a similar expansion in Brussels and in the other great cities, particularly those of the Sambre-Meuse industrial region, accounted in large measure for the total rise in all Belgium.

Between 1900 and 1945, on the other hand, all the Kempen *arrondissements* had increases substantially greater than that for all Belgium. In fact, the only Belgian *arrondissements* with an increase of fifty per cent between 1900 and 1945 are in Antwerpen and Limburg provinces. Hasselt indeed more than doubled its population and Maaseik almost did so. These figures must be compared with an increase for Belgium as a whole of only fifteen per cent during the same period, while some *arrondissements* showed an actual decline (Fig. 63). This trend has been even more marked in recent years. The percentage increase in Limburg province between 1930 and 1945 was 20.7, and in Antwerpen it was 7.0, but in Belgium as a whole it was only 3.1, while four provinces showed a considerable decline. In fact, while some parts of Belgium reached their population peaks in the nineteenth century, some before 1914 and others in the 1920-29 decade, the Kempen population has continued to grow and has not yet reached its peak.

Occupational Changes

The year 1900, used as a dividing line in the Table above, is no arbitrary date chosen for convenience. Before then the Kempen was predominantly agricultural. In 1846, the census revealed that in Limburg province 69,158 people, or nearly two-fifths of the total population,

Population Changes in the Kempen Arrondissements, 1846-1945

Arrondissement	Total Population			Percentage Increase, 1846-1900	Total Population, 1945	Percentage Increase, 1900-45	Percentage Increase, 1846-1945
	1846	1880	1900				
Antwerpen	189,590	323,251	504,097	166	767,619	52	305
Mechelen ..	116,223	143,038	179,703	55	246,290	37	112
Turnhout ..	100,541	110,943	135,359	35	241,851	79	141
Antwerpen province ..	406,354	577,232	819,159	102	1,255,760	53	209
Hasselt ..	77,832	88,856	102,118	31	207,907	103	168
Maaseik ..	36,993	41,950	51,104	38	101,920	99	176
Tongeren ..	71,088	80,045	87,574	23	133,931	53	88
Limburg province ..	185,913	210,851	240,796	29	443,758	84	139
Belgium ..	4,337,196	5,520,009	6,693,810	54	8,344,534	15	92

were engaged in agriculture ; this figure included owner-cultivators, labourers and those members of farmers' families who more or less permanently worked on the land (see pp. 83-5). On the other

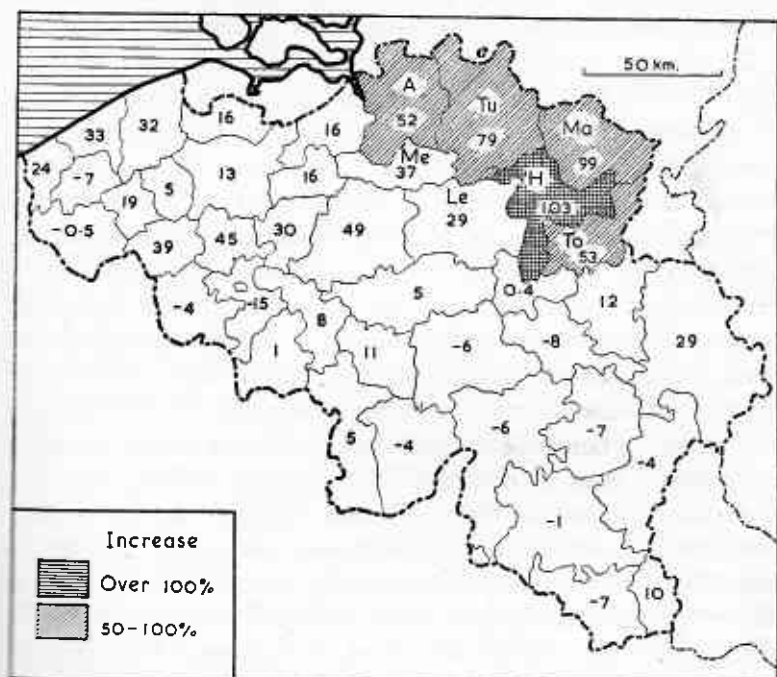


FIG. 63. PERCENTAGE CHANGES IN THE POPULATION TOTALS OF THE BELGIAN *arrondissements*, 1900-45

Based on statistics derived from the 1901 and 1946 volumes of the *Annuaire Statistique* (Gand and Bruxelles respectively).

The abbreviations indicate the *arrondissements* which are included in the Kempen region, as follows : A. Antwerpen ; H. Hasselt ; Le. Leuven ; Ma. Maaseik ; Me. Mechelen ; To. Tongeren ; Tu. Turnhout.

and, the number of people engaged in industry in the same year was only 6,997 (see p. 134).

Between 1846 and 1900, the numbers engaged in agriculture and industry each rose only very slightly, while the balance between them

remained more or less the same, for as yet the Kempen had little new employment to offer. The small increase in population that did take place was due in part to the fact that some heathland was cleared and so the numbers of farms and workers did rise slightly, while in addition some of the market towns developed minor industries.

By contrast, after 1900, and more especially after 1920, came the exploitation of the coalfield and the rapid development of the Kempen as an industrial region. Great and increasing supplies of labour were therefore needed (see pp. 125-30). As a result, the population of those communes which contained the collieries and the new factories expanded enormously. In Limburg, industrial workers increased from 6,997 in 1846 to 62,845 in 1930, and with their dependents they account for the total increase of 257,845 in the province during this period. The number of people engaged in agriculture, on the other hand, decreased from 69,158 in 1846 to 53,406 in 1930. Moreover, it must be remembered that many of the agricultural workers comprised the families of farmers, so that the total number of people dependent upon those "gainfully employed" in agriculture was very much less than those dependent upon industrial workers. A few farmers abandoned the land in the neighbourhood of the new collieries and factories, frequently realizing high prices by the sale of their holdings to the new companies, and then became industrial workers, attracted by the higher wages and shorter hours of industry. This complete abandonment of the land was not however common; the nineteenth century Kempen peasant was attached to his land, and his whole life-work was devoted to the increasing of this holding by pushing back its perimeter as the enclosure and improvement of additional heathland took place. Many farmers went into industry, but retained their holdings and worked them on a part-time basis. It is, of course, a very characteristic feature of the Belgian way of life for workers in industry to possess their own small-holdings or even farms, cultivated by their families for the most part, while the men-folk work in a factory or in a colliery, perhaps some kilometres away. The distinction between agriculture and industry is consequently not as clear-cut as the occupational statistics might indicate. The actual reduction in the

number of agricultural workers has been mainly due to the decline in the number of hired labourers (see pp. 84-5) ; without the ties of land-ownership, a powerful factor in the stability of rural population, many of these drifted into industry. It is, therefore, clear that the continued increase in the population of the Kempen in the twentieth century has been mainly the result of its striking change from an agricultural to primarily an industrial area.

Natural Increase

The growth of population in any area is the result of the balance between (1) natural increase or decrease, and (2) migration to or from the area. The Table below summarizes the numbers of births and deaths for four individual years between 1840 and 1945 in the two Kempen provinces, ignoring for the moment the external factors of migration.

	1840			1870		
	<i>Births</i>	<i>Deaths</i>	<i>Excess</i>	<i>Births</i>	<i>Deaths</i>	<i>Excess</i>
Antwerpen	12,034	9,198	2,836	16,977	12,405	4,572
Limburg	5,315	4,228	1,087	6,166	4,331	1,835
Belgium	138,142	103,902	34,240	164,572	118,359	46,213
	1900			1945		
	<i>Births</i>	<i>Deaths</i>	<i>Excess</i>	<i>Births</i>	<i>Deaths</i>	<i>Excess</i>
Antwerpen	27,589	15,335	12,254	21,453	17,698	3,755
Limburg	7,730	4,960	2,770	10,569	4,593	5,976
Belgium	193,789	129,046	64,743	127,245	121,155	6,090

These figures are of considerable significance. During the nineteenth century the excess in Limburg contributed but little to the great increase in the Belgian total, but in 1945 the excess in Limburg was almost as great as the net Belgian increase. Several other Belgian provinces in that year showed a marked deficit, that is, deaths exceeded births.

The death-rate has declined steadily in Belgium, as in other west European countries, from 25.07 per thousand inhabitants in 1840 to 14.5 (provisional figure) in 1945. No detailed figures are available for each province, but it is probable that the death-rate in the Kempen provinces declined at a similar rate as the result of general national improvements in medical science and hygiene. Figures of the birth-rate, however, are available for each province. During the nineteenth century, the birth-rate for Limburg was slightly below that for all Belgium; the respective figures for 1840 were 31.3 and 33.8, and for 1870 they were 30.8 and 32.3. In 1900, however, the rates were reversed, 32.1 and 28.9 respectively, and in 1945, while both showed the decline common to western Europe, the Limburg birth-rate was 23.8, while that for Belgium was only 15.3. In other words, the average Kempen family in the post-1918 period has been much larger than in other parts of Belgium; at the time of the 1930 census, the number in the average family in the *arrondissements* of Maaseik, Turnhout and Tongeren was respectively 3.64, 3.20 and 2.99. No other Belgian *arrondissement* had figures as high as these, and indeed fifteen of the forty-one had under 2.0. As a result, while the rate of natural increase has declined throughout all Belgium, this fall has been very much less marked in the Kempen.

The Balance of Migration

The balance between emigration and immigration may have a considerable influence upon the total population. These movements may be internal, that is, from one administrative unit to another within the country, or they may be to and from foreign countries.

Internal Movements. Figures similar to those provided in British censuses, from which population movements to and from each

county may be calculated, are unfortunately not available for the Belgian provinces. The Belgian figures indicate only for each province (1) the numbers of people residing habitually within the communes where they were born, (2) the numbers born in another province of Belgium, and (3) the numbers born outside the country. However, by comparing the absolute totals for any province given in two successive annual estimates with the excess of births over deaths during the same period, it is possible to discover with a fair degree of accuracy the change due to migration. For example, the population of Limburg on 31 December 1899 was 242,434, and on the same date in 1900 it was 240,796, a net decline of 1,638. During the same period, there was an excess of 2,770 births over deaths. The foreign movement was not great—590 immigrants and 453 emigrants, a gain on balance of 137 people. It may be estimated, therefore, that nearly 4,500 people must have moved in a single year from Limburg to other parts of Belgium. The cadastral registers provide further definite evidence in that many houses and holdings were abandoned during the nineteenth century; thus in the province of Limburg there were 945 unoccupied houses in 1846, 1,445 in 1856, 2,233 in 1866 and 2,414 in 1880.

This serious loss of population was the result of the inadequate economic opportunity within the Kempen, and of the complementary attraction of industry in the Brussels, Antwerp and Scheldt estuary districts. Of course, when the new collieries and factories began in the twentieth century to seek supplies of labour, one possible source was those people who would otherwise have left Limburg, and this drain of migration ceased almost entirely.

Foreign Movements. In the nineteenth century, the movements of population between the Kempen and foreign countries were small. This is shown by the figures for Limburg province; those for Antwerpen are not indicative of the Kempen, for the city and port, like all great commercial centres, developed a considerable foreign population. The Limburg figures for the last forty years of the nineteenth century are summarized in the Table overleaf.

	1861-70	1871-80	1881-90	1891-1900
Immigration	258	279	263	590
Emigration	254	255	274	453

Some five thousand foreigners lived in the Kempen in the nineteenth century, most of them Dutch who were permanently domiciled.

After the war of 1914-18, a very different state of affairs came about, for the development of the coalfield was to a large extent only made possible by the introduction of foreign labour (see pp. 128-9). The various foreign elements in the population of Limburg can be summarized for three particular years.

Foreigners in Limburg, 1920-39

	1920	1930	1939*
German ..	261	771	557
French ..	328	399	221
Dutch ..	2,757	5,258	4,292
Poles ..	7	5,984	4,041
Czechs ..	Not specified	3,363	1,802
Jugoslavs ..	Not specified	2,414	1,174
Italians ..	16	1,310	855
Others ..	85	2,364	1,143
Total ..	3,454	21,863	14,085

* The 1939 figures include only those foreigners of fifteen years of age or over.

Between 1921 and 1925, the average annual immigration of foreigners into Limburg was 2,623, and between 1926 and 1930, when the collieries were attaining full development, it reached 4,672. After a

fall to only 645 during the depression years of 1931-5, when because of Belgian unemployment foreign immigration was rigorously restricted, it rose again to 1,267 during the period 1936 to 1940. No figures are available for the post-1945 years, but it is known that "stateless" workers, prisoners of war, Italians sent to the Kempen under agreement and various other displaced peoples have increased the total still further (see pp. 129-30). The effect of this foreign element on the total population of Limburg province as a whole has been considerable. By 1930, at the time of the last detailed census, there were nearly 22,000 foreigners out of a provincial population of 367,642, representing nearly six per cent of the total. Limburg, in fact, had the highest percentage of foreigners of any Belgian province. In 1945, the total was probably about 25,000.

But the results were locally very much more striking, for most of these immigrants came specifically to work in the collieries, and so settled mainly in Eisdën, Zolder, Koersel, Houthalen and above all in Genk, which therefore had their population totals swollen enormously. In fact, in 1939 out of a population of 26,975 in Genk commune, no less than 7,830, or about twenty-nine per cent, were of foreign origin. Of these, Poles (3,920), Czechs (1,081), Italians (765) and Jugoslavs (712) made up the greater part.

Detailed Commune Changes, 1846-1945

The changes in population in the communes of the Kempen and its margins are summarized on Fig. 64. A few communes in the area covered by the map experienced a decline, it is true, but these lie well outside the Kempen proper. To the south and west of its margins, the agricultural lands of Brabant and Hesbaye had an increase which was generally less than fifty per cent of the 1846 total. But, by contrast, some three-quarters of the Kempen communes had more than doubled their 1846 figures. Of course, this contrast is to some extent the result of the scanty Kempen population and of the relatively dense population of Brabant and Hesbaye in 1846; a small absolute rise in the Kempen would therefore produce a considerable percentage increase.

The population of a few communes in the Kempen proper, however, increased by less than fifty per cent of the 1846 total, namely Tongerlo (20) in the east, Stokrooie (48) and Hersselt (36) in the centre, and Wortel (45) adjoining the Netherlands frontier in the

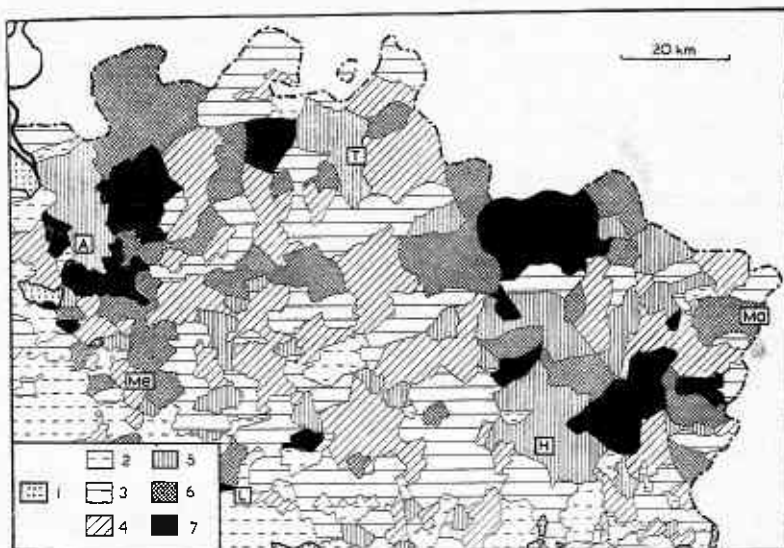


FIG. 64. CHANGES IN THE DISTRIBUTION OF POPULATION, 1846-1945

Based on statistics derived from *Recensement Général de la Population, 1846* (Bruxelles, 1850), and the 1945 estimates of population published by the *Ministère des Affaires Economiques* in the official *Moniteur Belge* (*Belgisch Staatsblad*) (Bruxelles, 4 August, 1946).

The figures in the key indicate the percentage change in the absolute population total of each commune during the ninety-nine years, as follows: 1. decrease; 2. increase less than 50; 3. increase of 50 to 100; 4. increase of 100 to 150; 5. increase of 150 to 200; 6. increase of 200 to 300; 7. increase exceeding 300.

The main towns are indicated by abbreviations, as follows: A. Antwerp; H. Hasselt; L. Lier; Ma. Maaseik; Me. Mechelen; T. Turnhout.

north. Stokrooie and Hersselt, communes in the valleys of the Groote-Nethe and Demer respectively, already had in 1846 average densities exceeding a hundred per square kilometre; neither had much heathland then, and they have since remained wholly agricultural communes with as much as half of their land under arable. Wortel and

Tongerloo, both small agricultural communes, have changed little in their ways of life ; heathland has indeed been converted into pasture, but this does not make for any great increase of population.

Eleven communes had an increase exceeding three hundred per cent of their 1846 totals, as shown in the list below.

Commune	1846		1945		Percentage Increase of Total Population
	Total	Density per square kilometre	Total	Density per square kilometre	
Eisden ..	385	48	8,752	1,091	2,173
Genk ..	1,776	20	29,140	332	1,541
Leopoldsborg (In Beverloo)		69*	6,880	533	673*
Asch ..	414	28	2,438	165	489
Lanklaar ..	299	19	1,619	102	441
Lommel ..	2,486	23	13,129	128	428
Heusden ..	1,373	67	6,924	340	404
Neerpelt ..	1,271	43	6,092	205	379
Opglabbeek ..	604	24	2,756	91	356
Overpelt ..	1,511	37	6,845	165	353
Rijkevorsel ..	1,449	30	5,945	126	310

* Estimated.

All these communes in 1846 had sparse populations, considerably below the average density of 142 per square kilometre for Belgium. Most had extensive heathlands ; all except Heusden and Lanklaar then had over forty per cent and five of them more than half of their area under heath, while Lanklaar had more than half under woodland. The agricultural population has risen as a result of schemes of improvement and clearance, but only slightly. The outstanding increase by 1945 in nearly every case is the result of industrial development. In Rijkevorsel there are ten brick-yards along the banks of the Desschel-Turnhout-Schoten Canal ; in Lommel, Overpelt and Neerpelt there are

great chemical and metallurgical works; Heusden contains the Berkenbosch housing-estate, where live many of the miners from the Helchteren-Zolder colliery in the adjoining commune of Voort; Genk and Eisden each have large housing-estates owned by the several colliery companies. In Genk, which has had an enormous absolute rise in population, there are six of these housing-estates, containing nearly three thousand houses, wherein live a considerable proportion of the miners employed in the three collieries within the commune (see pp. 227-30 and Figs. 70-1). Eisden shows the greatest proportional increase of any Kempen commune, for its population has grown almost twenty-three fold during the ninety-nine years. In 1846, the village consisted of only eighty-one houses with 385 inhabitants, grouped near the bank of the Zuid-Willems Canal in the east of the commune, which lies on the edge of the Kempen plateau and extends down to the banks of the Meuse. The heathlands in the west and the marshy floor of the flood-plain in the east of the commune were alike in 1846 almost uninhabited. By 1945, while the old village itself had but little changed, there had grown up in the west of the commune the Eisden colliery and its large housing-estate (Fig. 39). Finally, of the remaining communes listed above, Lanklaar now has many inhabitants who work in the nearby Eisden colliery, others employed in Genk live in the neighbouring communes of Asch and Opglabbeek, and Leopoldsburg owes its increase to the growth of the Beverloo military camp.

THE DISTRIBUTION OF POPULATION IN 1945

It remains to survey briefly the distribution of population at the time of the estimates of 31 December 1945, in the light of the changes described (Fig. 65). In the west the great Antwerp conurbation stands out; it has a total population of some half a million, and the densely populated area extends southward through Kontich, Lier, Duffel, the Rupel estuary towns and Mechelen. To the south-east of this urban area are the fertile agricultural lands of Brabant, together with the large towns along the southern borders of the Kempen which

swell the averages of their respective communes—Lier, Aarschot and Hasselt. The last of these, the administrative centre of Limburg and the regional centre of the eastern Kempen, had a population in 1945 of

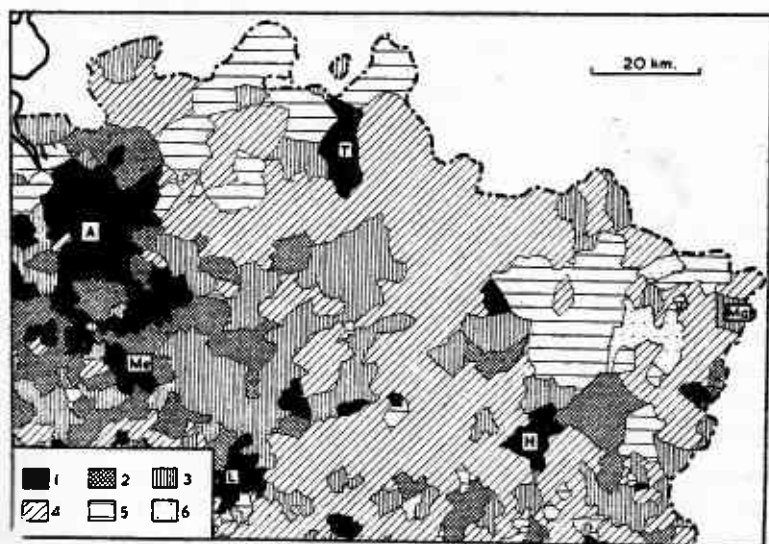


FIG. 65. THE DISTRIBUTION OF POPULATION, 1945

Based on statistics obtained from the 1945 estimates of population published by the *Ministère des Affaires Economiques* in the official *Moniteur Belge* (*Belgisch Staatsblad*) (Bruxelles, 4 August, 1946).

The figures in the key indicate the average distribution of population per square kilometre, calculated on the basis of communes, as follows: 1. over 500; 2. 300 to 500; 3. 200 to 300; 4. 100 to 200; 5. 50 to 100; 6. under 50. It will be noted that this scale of densities differs from that used on Fig. 61; this change was unfortunately necessary, otherwise, with a single range common to both, significant features in each map would have been obliterated.

The main towns are indicated by abbreviations, as follows: A. Antwerp; H. Hasselt; L. Liege; Ma. Maaseik; Me. Mechelen; T. Turnhout.

20,000, with the result that the density per square kilometre over the whole commune exceeded seven hundred.

If the Kempen proper is considered, it will be seen that in 1945 a very large part had an average density of between one and two

hundred per square kilometre. This general average typifies the region—an area still with much heathland, with an increasing extent of woodland and much pasture, but with numerous large villages and small market towns scattered uniformly over the countryside. Thus the commune of Mol, the largest in Belgium, 114.2 square kilometres in extent, with almost half of its area still under heath, had a density of 165, which is as high as it is because the town of Mol is a market and minor industrial centre. Lommel, another large commune, had a density of 128; forty-six per cent of its area is under heath and there are extensive areas of sand-dunes, yet to compensate there are several large factories with their adjacent housing-estates (Fig. 69). Similarly, Overpelt and Balen have large tracts of empty heathland, but also local concentrations of population near the new factories. Other communes owe their densities to the growth of the collieries—Zolder (131), Koersel (209), Houthalen (93) and Genk, the last of which had an average density of 332, in spite of having half its area still under heath and woodland.

From this appearance of uniform density over the Kempen in 1945, three communes stand out on Fig. 65 with average densities exceeding five hundred per square kilometre, and conversely three which have less than fifty per square kilometre. In the first category are Eindhoven (1,091) in the east, Turnhout (563) in the north and Leopoldsburg (533) in the centre. Eindhoven has its colliery and housing-estate; Turnhout contains a prosperous market, industrial and administrative town (Fig. 46), which compensates for the extensive tracts of heath and bog in the north of the commune; and Leopoldsburg has the great barracks of the Beverloo military camp.

The three communes in the second category, with densities markedly lower than the general average, are Wijshagen (36), Gruitrode (47) and Beek (45). All are in the eastern Kempen and have much heathland and woodland. Wijshagen, the most sparsely populated of all Kempen communes, has an area of fourteen square kilometres, more than half still covered with heath and plantations, and its population of little more than five hundred live in the three widely separated hamlets of Wijshagen, Soetebeek and Plokkroie.

URBAN AND RURAL POPULATION

The census figures of some European countries make an important distinction between the urban and rural sections of their population. In France, for example, the "grouped" or "agglomerated" population of each commune is separately specified from the remaining inhabitants in that unit. Any commune in which this grouped population exceeds two thousand is classified as urban in the census returns; this however tends to exaggerate the urban population, for a settlement of two thousand people is after all little more than a large village. Again, in the Grand-Duchy of Luxembourg, twelve places have the official status of towns, and their census figures are returned under the heading *population municipale*; the misleading nature of this classification is revealed by the fact that several "urban agglomerations" in other communes exceed some of the official towns in size.

No distinction of such a nature has been attempted in Belgium since the first official census of 1846, when figures were given for each of the *villes*, that is, places with the official status of towns. In Antwerpen and Limburg provinces there were then twelve *villes*, but mostly on the borders of or outside the Kempen proper. The true Kempen *villes* themselves comprised only Turnhout (9,723 people), Hasselt (6,236) and Maaseik (3,224); their total commune populations at the same census were 14,396, 9,613 and 4,356 respectively. After 1846, however, the status of *villes* was dropped, and population returns have since been given on a commune basis only. A large city, therefore, like Antwerp, the commune population of which in 1945 was 256,332, must be considered as an agglomeration of seven communes, with a total population of 468,019. On the other hand, the figures for

the agglomeration of Genk (29,140) or Geel (21,788) give a misleading impression of the size of the actual towns of the same name, for both are separated from the surrounding countryside and apart from the two small towns themselves

in relatively small settlements. There is, it is true, a string of important towns along the western and southern borders of the Kempen—Antwerp, Lier, Aarschot and Diest. Hasselt too lies well to the south in the Demer valley, but, as the “capital” of Limburg province, it is none the less the regional centre for the eastern Kempen. Turnhout serves the same function for the northern Kempen (Fig. 45). Each of these towns had an estimated urban population in 1945 of about twenty thousand; the total commune population was 31,566 in Turnhout and 28,364 in Hasselt. More common are smaller towns of from one to three thousand inhabitants, each of which has its own local significance as the administrative centre of its commune, as a market-town, as a minor industrial centre or as a route-centre. But the most characteristic unit is the large village of from two hundred to a thousand inhabitants; numerous in the western Kempen, these villages are more widely separated in the heathlands of the east and north.

TYPES OF RURAL SETTLEMENT

In a study of rural settlement in Belgium, Mlle M. A. Lefèvre¹ distinguished three broad types. These are (1) *agglomeration*, where the houses are grouped in various numbers and arranged in a variety of patterns; (2) *dispersion*, the scattering of individual and isolated houses over the countryside; and (3) *nucleation* or *concentration*, the grouping of houses into compact villages. The broad distribution of these three types and their sub-divisions can be seen from Fig. 66. Agglomeration is found mainly in northern and central Belgium, with an extension to the south of Liège eastward to the German frontier. Nucleation can be distinguished in Hesbaye and in the Ardennes, and dispersion in western and central Flanders.

It will be seen from Fig. 66 that the Kempen is included by Mlle Lefèvre in one of the five sub-divisions of the agglomeration type, and to this was given the name “*Groupeement en hameaux et attraction des grand routes*.” Broadly, this sub-division is characterized by the location of villages at points where the State and provincial roads are

¹ M. A. Lefèvre, *L'Habitat rurale en Belgique* (Liège, 1925).

crossed by the minor local roads, and each settlement is separated from the next by sparsely inhabited heathland.

This sub-division, as all the others, is of course necessarily generalized, and there are many exceptional areas. Consider, for example, Fig. 67,

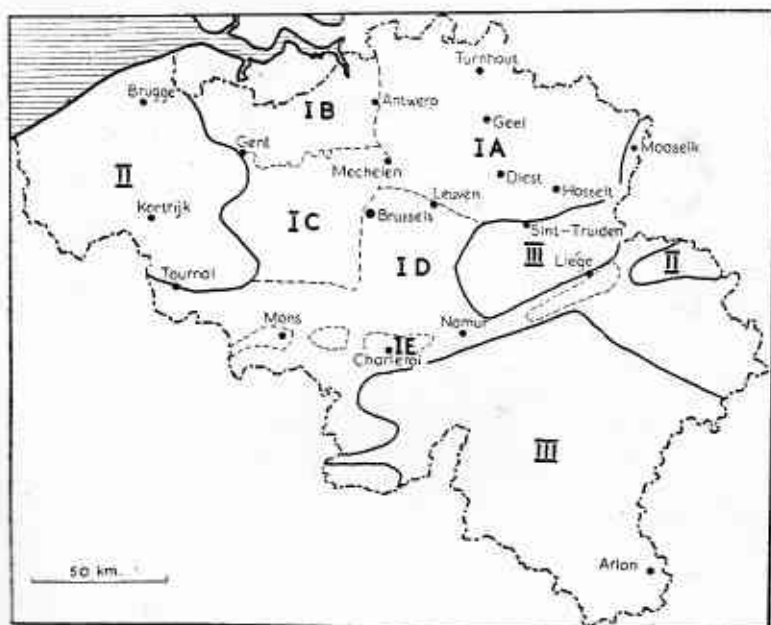
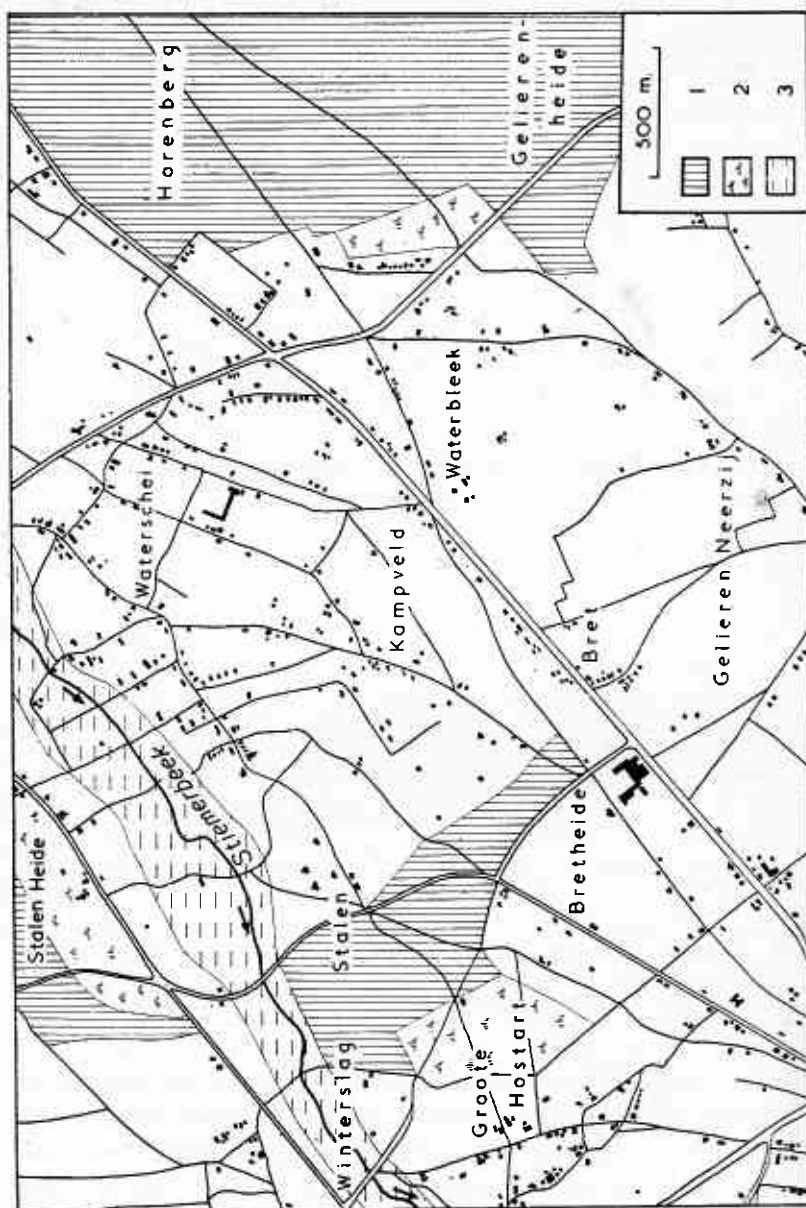


FIG. 66. TYPES OF RURAL SETTLEMENT IN BELGIUM

Based on a folder map in M. A. Lefèvre, *L'Habitat rural en Belgique* (Liège, 1925).

The main divisions are: I. agglomerated types; II. dispersed types; and III. nucleated types. The subdivisions of Group III, following M. A. Lefèvre's nomenclature, are A. *Groupeement en hameaux et attraction des grand' routes*; B. *villages-rues*; C. *agglomération le long des chemins*; D. *villages-nébuleuses*; E. *agglomération industrielle*.

which depicts the eastern part of Genk commune a few kilometres to the north-east of the town of Genk. Most of this area lies at more than eighty metres above sea-level. There is today but little heathland, although frequent *-heide* elements in the place-names indicate that it



was formerly more widespread. There are considerable blocks of pine plantations, and a belt of pasture lies on either side of the Stiemerbeek in the north-west ; these areas are entirely without houses. Elsewhere, habitations are scattered freely over the district, standing among gardens, small-holdings and fields. On the ground, the distribution of houses seems loose and indiscriminate ; on a large-scale map various patterns and principles of grouping, although admittedly rather indefinite, do emerge. While the houses are therefore mainly dispersed, this dispersion is interrupted on the one hand by minor agglomerations and on the other by completely empty areas, so differing from the areas of dispersion in Flanders, where the houses are veritably peppered over the countryside. The settlement pattern in this part of Genk commune may perhaps best be described as a form of "ordered dispersion." Many parts of the heathlands which have been improved show this same pattern.

More characteristic, however, of the Kempen generally is the tendency towards agglomeration into a number of large hamlets and villages, separated by heathland, plantation and areas of meres and bog. These settlements may be analyzed in two ways : according to the geographical and other factors responsible for their actual location, and according to the resultant pattern or arrangement of the houses.

FACTORS OF VILLAGE LOCATION

The first analysis is one fraught with complications, for even when the geographical factors are considered in their historical setting, it is frequently impossible to provide a wholly satisfactory explanation. This is especially the case in the densely populated western Kempen,

FIG. 67. THE DISTRIBUTION OF HOUSES IN THE EASTERN PART OF GENK COMMUNE

Based on a map in the possession of the *Technisch Dienst* of the commune of Genk.

The numbers in the key are as follows : 1. coniferous plantations ; 2. heathland ; 3. water-meadows. Land primarily "agriculturally productive" is left white. Major roads are indicated by double lines, minor roads and tracks by single lines.

adjoining the Antwerp conurbation. The larger villages do, indeed, tend to avoid the valleys which are liable to floods. Thus Heist-op-den-Berg clusters round the slopes of a hill rising to forty-five metres, on the summit of which is the church, while little more than a kilometre away is the floor of the Groote-Nethe valley, less than seven metres above sea-level. Similarly, Herentout is built on a low spur rising gently some five metres above the valleys of the Bouwelschebeek and the Wimpbeek to the north and south respectively, and Pulderbosch lies in the angle between two streams which converge to form the Molenbeek, a right-bank tributary of the Kleine-Nethe. In the northern part of the Kempen, villages such as Wuustwezel, Loenhout and Kalmthout avoid the marshes and meres (*Vennen*) along the valleys of the rivers which flow north into the Netherlands.

But in most parts of the western Kempen, the detailed settlement pattern reveals a well-distributed agricultural population, with large villages at road-junctions, such as Oostmalle which is at the convergence of six roads and light railways (Fig. 58), Hoogstraaten (Fig. 68), Brecht and Herentals. These are therefore all market-towns. Further east in the central Kempen, as the areas of intervening heathland increase, the nodal nature of the larger villages becomes even more apparent. Along each main road running eastward from Antwerp and Lier, villages are situated at each crossing point of a north-south road, and where several roads converge upon the main road, as at Geel, a larger centre has grown up (Fig. 49).

In the higher eastern Kempen the population is much sparser, and large settlements are fewer and more widely separated. Some of these are of relatively recent development, and house the labour needed in the collieries and at the chemico-metallurgical works. They have been built in the open heathland, conveniently near the mines or works they serve. These housing-estates therefore have profoundly altered the settlement pattern in the twentieth century (see pp. 227-30). The older villages lie, with a few exceptions, near the plateau edge on or about the fifty-metre contour. In the north Lommel, Neerpelt, Overpelt, Kaulille, Bocholt, Reppel, Bree, Tongerlo, Neeroeteren and Rotem are strung out along the line of the Herentals-Bocholt

Canal and the Zuid-Willems Canal, for which waterways the fifty-metre contour has a profound significance (see pp. 169-71). Along the west and south of the plateau are Leopoldsburg, Koersel, Heusden, Zolder and Zonhoven. But on the plateau itself, above the fifty-metre contour, the number of hamlets is small, and most of them lie on the lower slopes of the valleys which form slight re-entrants into the plateau—Genk in the Stiemerbeek valley, Opoeteren in the Boschbeek valley, and Ellikom and Meeuwen in the Molenbeek valley. Others such as Voort and Houthalen in the south-west stand on spurs of the plateau projecting into the Demer valley. Very few villages are to be found on the high central plateau itself, apart from the housing-estates in Genk commune. One village is Asch, at a height of eighty metres; it is primarily a route-focus, for the Hasselt-Maaseik road is there crossed by the important north-south road from Bree to Tongeren, while other roads converge from the Meuse valley. It is also a small railway junction, where the Eisden branch leaves the Hasselt-Maaseik line (Fig. 68).

VILLAGE PATTERNS

It is convenient to classify the patterns of the houses in the Kempen villages and small towns (Fig. 68) as follows: (1) nucleated villages; (2) "street villages"; (3) "spider-web" villages; (4) "colony" settlements; and (5) the new housing-estates.

(1) *Nucleated Villages*

The clustering of houses into small compact villages, common in the Hesbaye to the south, is infrequent in the Kempen itself. A few of the small towns, however, notably centres like Hasselt and Maaseik, are little more than large nucleated villages, formerly within a wall, which can often be traced as a perimeter road. Similarly, the old part of the large village of Bree is also nucleated, forming a compact oval of houses some 500 by 250 metres in extent, with the church and the village square in the centre. The *nieuw-stad* has developed outside the old nucleation, mainly to the west, but also to some extent along all the six converging main roads.

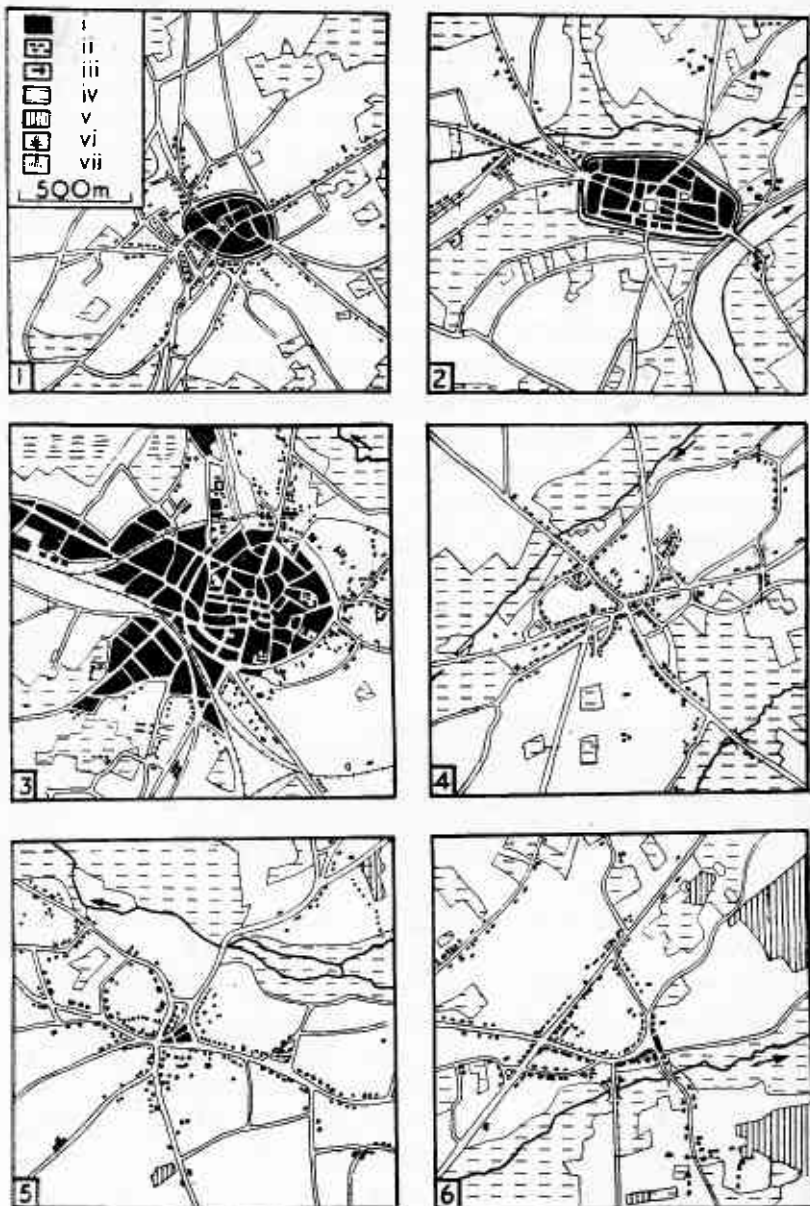
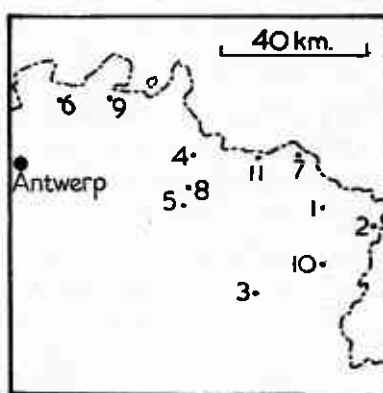
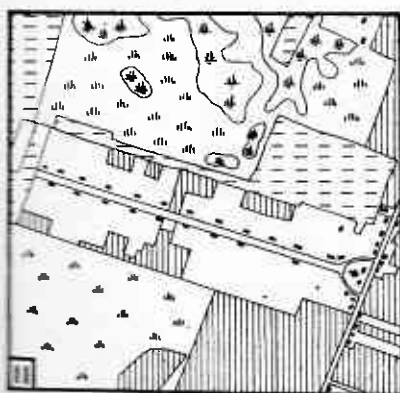
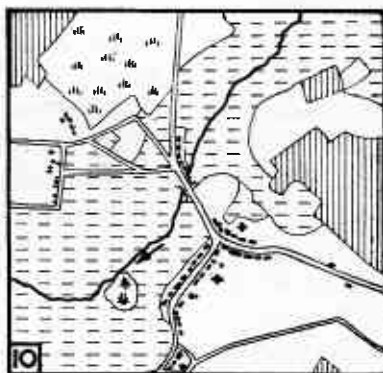
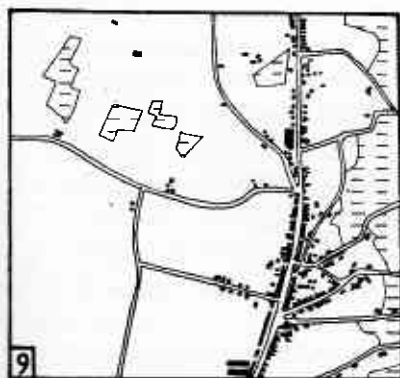
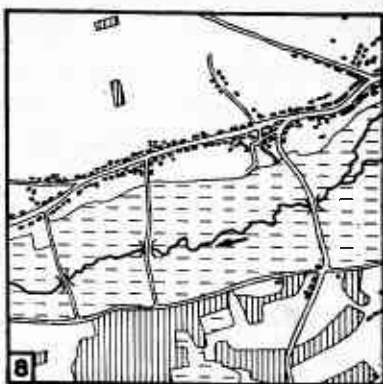
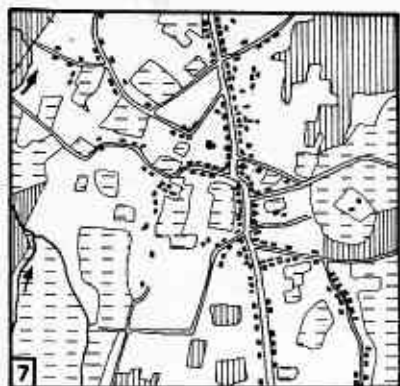


FIG. 68. SETTLEMENT PATTERNS IN THE KEMPEN

The eleven examples are located on the map in the bottom right corner. The towns and villages are numbered as follows : 1. Bree ; 2. Maaseik ; 3. Hasselt ; 4. Retie ; 5. Meerhout ; 6. Brecht ; 7. Achel ; 8. Ezaart ; 9. Hoogstraaten ; 10. Asch ; 11. La Colonie.



The numbers in the key are as follows: i. continuously built-up areas; ii. individual buildings; iii. church; iv. permanent pasture; v. pine-woods; vi. marsh; vii. heath.

(2) *Street-villages*

While this type of settlement is found most commonly in Belgium in the neighbourhood of the Scheldt estuary and in eastern Flanders, the linear arrangement of houses, facing each other on either side of a road, is common too in the Kempen. Many heathland villages have grown during the nineteenth century along a State or provincial road. Most of them have subsequently developed into "spider-web" villages, but their plans may still reveal one main double line of houses along a road which forms the axis of the village, as in the case of Meerhout. Occasionally the "street-village" pattern is more distinctive, where the original lay-out survives unobscured by lateral developments. One example of this is Achel, which is strung out for more than three kilometres along the road from Sint-Huibrechts-Lille northward into the Netherlands. Ezaart similarly lies along the main road between Geel and Mol; to the north is extensive arable land, while to the south the water-meadows on either side of the Mol-Nethe river have prevented any lateral growth of the village. Hoogstraaten is a third example, although here can be seen the beginnings of a "spider-web" pattern developing to the east behind the church. Asch, one of the few villages on the high heathland at a height of about eighty metres, is also a "street-village," but it has grown along two converging roads, with the church near the apex, as yet without any lateral roads to produce a "spider-web" pattern.

(3) *"Spider-web" villages*

This is the most common type of settlement in the Kempen. Characteristic examples are Lommel (Fig. 69), Retie, Meerhout and Wuustwezel, although almost all Kempen villages show to some extent the interlaced pattern of roads and houses. In these "spider-web" settlements, the village centre is commonly a triangular open space surrounding the church, while nearby is the *Gemeentehuis*, or administrative buildings of the commune. Beyond this central or focal part of the village, there was formerly a circle of arable land, and the heathlands lying beyond provided common grazing. Gradually,

however, houses were built along the converging roads, and along minor loops between them, and the satellite hamlets, which grew up as the surrounding heathland was reclaimed, ultimately became

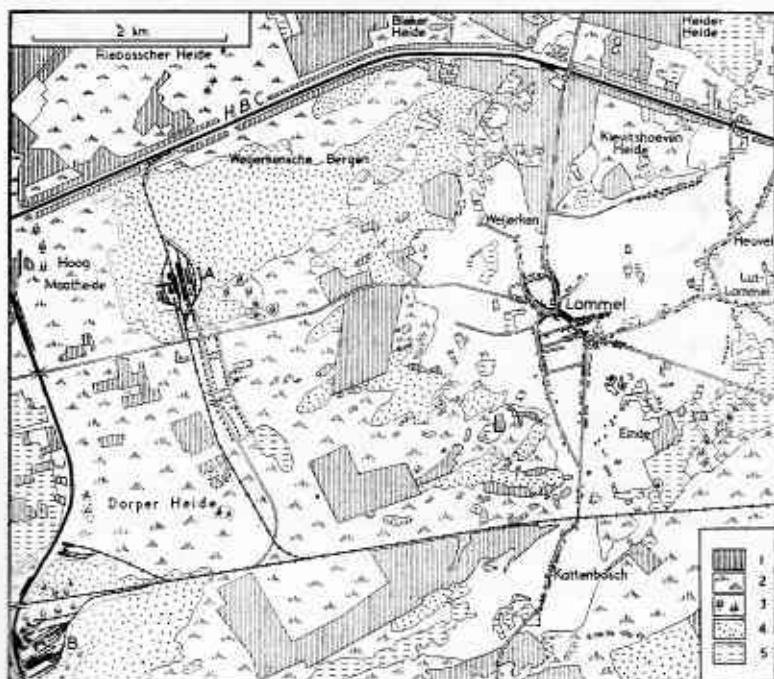


FIG. 69. LOMMEL

The numbers in the key are as follows : 1. coniferous plantations ; 2. heathland ; 3. marsh ; 4. bare sand and dunes ; 5. permanent pasture. Waterways are shown by a thick black line, roads by a double line, and railways by a single barbed line. Houses and industrial buildings are shown in solid black.

The abbreviations are as follows : **A.** factory of the *Cie. des Métaux d'Overpelt-Lommel et Corphalie* ; **B.** factory of the *S.A. des Mines et Fonderies de Zinc de la Vieille-Montagne* ; **B.B.C.** Beverloo Branch Canal ; **H.B.C.** Herentals-Bocholt Canal.

continuous with the parent village. Thus within a kilometre of the centre of Meerhout, and connected to it by an almost unbroken row of houses along the various roads, are the hamlets of Genenpas, Lill, Ruwilde, Bergerhout, Gebergte and Meiberg. The resultant

intricate pattern of roads and houses, interspersed with gardens and small fields, covers several square kilometres.

Lommel provides a most interesting example of a "spider-web" village, and indeed of the land utilization within a typical commune in the northern Kempen plain (Fig. 69). It is situated near the Netherlands frontier on the gentle slope beyond the northern edge of the Kempen plateau, at about forty-five metres above sea-level. The main part of the village has grown up at the point of convergence of five roads and along their inter-connections, and has spread along these roads towards a ring of small hamlets lying a kilometre or two from the centre of the village. Surrounding the group of houses is a series of almost concentric zones of different land utilization. First there is an area of predominantly arable land, only about a kilometre in width to the west but nearly five times as wide to the east, where it extends to the water-meadows in the valley of the Eindergat. This arable land is cultivated in small unfenced strips, while each house has a garden with a group of fruit-trees (see p. 80). There are small scattered patches of permanent pasture, and more continuous tracts in the valleys of the numerous small streams. On the edge of the cultivated land lies an incomplete belt of woodland, one to two kilometres from the commune centre. Beyond this is the heathland, which in parts is exceptionally bare and desolate; the Weijerkensche Bergen to the west forms one of the largest continuous dune areas in the Kempen. To complete this picture of a typical Kempen commune, in the extreme west there are two large zinc and chemical works, each with its housing-estate. These have both directly affected the growth of the village of Lommel, in that a considerable number of their employees live in the village.

(4) *Colony Settlements*

In many parts of the marshland and heathland regions of Germany and the Netherlands, settlements are to be found which did not grow gradually, but were built according to a single plan and laid out complete in some rectilinear pattern. Such, for example, are the "fen-colony" settlement of Papenburg in western Germany and the

numerous Dutch "high-fen" settlements in Drenthe, North Brabant and Dutch Limburg.

In the mid-nineteenth century, ambitious government plans were considered for the establishment of similar colonies in the Kempen. Between 1851 and 1860, the State built twenty identical farms, in two rows, and spaced at intervals of about a hundred metres, to the north-west of Neerpelt. Between the rows of farms there was a canal, now dry, which then joined the Meuse-Scheldt Junction Canal, and was used both for transport and to supply irrigation water for the meadows. About a hundred people from Flanders were settled there. The colony was intended to be the first of many, but actually it proved to be the only one, and still retains its original name, even in a Flemish-speaking area, of "La Colonie" (see p. 59). The scheme was not very successful, in fact many of the original settlers soon relinquished the struggle with the poor sandy soils and returned to their native provinces. The State sold the colony to a private owner in 1861, and in 1926 the land was divided into lots and sold by public auction, usually to the sitting tenants. Most of the men who live there work either in the Philips factory at Eindhoven or in the nearby zinc and chemical works of the *Cie. des Métaux d'Overpelt-Lommel et Corphalie*. The canal is dry, no irrigation is practised, and although each farm has some livestock and grows some rye and potatoes, as an agricultural enterprise La Colonie has hardly been a success. The hamlet was severely damaged in 1944 during the fighting in the vicinity.

Mention must be made of a more successful scheme of agricultural colonization, that of the Sint-Benedict monastery near Achel, on the Netherlands frontier. A colony of Trappist monks was established here in 1846, taking possession of an Augustinian foundation, and now the colony numbers about 240, of whom 150 Brothers and novices live in the monastery. The extensive red-brick buildings and modern concrete farm-buildings form a considerable settlement, the agricultural significance of which has been described on pp. 80-1.

(5) *Housing-Estates*

The development of the coalfield and of industry in the Kempen necessitated a considerable labour supply and thus produced a great

increase in population (see pp. 125-30). Most of the collieries and factories were built in what was then almost uninhabited heathland ; the companies were therefore faced with the necessity of providing accommodation for their workers, but, unlike those in the crowded Sambre-Meuse industrial area, they were able to acquire areas of land at low rates on which to build their own housing-estates. Thus there grew up the *cités ouvrières*, known in Flemish as *zwijnwijk* or *tuinwijk* (Figs. 39, 47, 70-1). They vary in size, from a group of a few villas for the administrative staff of the smaller factories, to the estates of over a thousand houses at the collieries, laid out on garden city lines.

It is of interest to consider the housing-estates in Genk commune, owned by the colliery companies at Waterschei, Winterslag and Zwartberg (Figs. 70-1). The contrast between the estates and the surrounding heathlands, uninhabited or with but a few scattered houses, is most striking. In 1910, there were only 773 houses in Genk commune ; in 1943, there were 5,721, and in 1947 about six thousand.

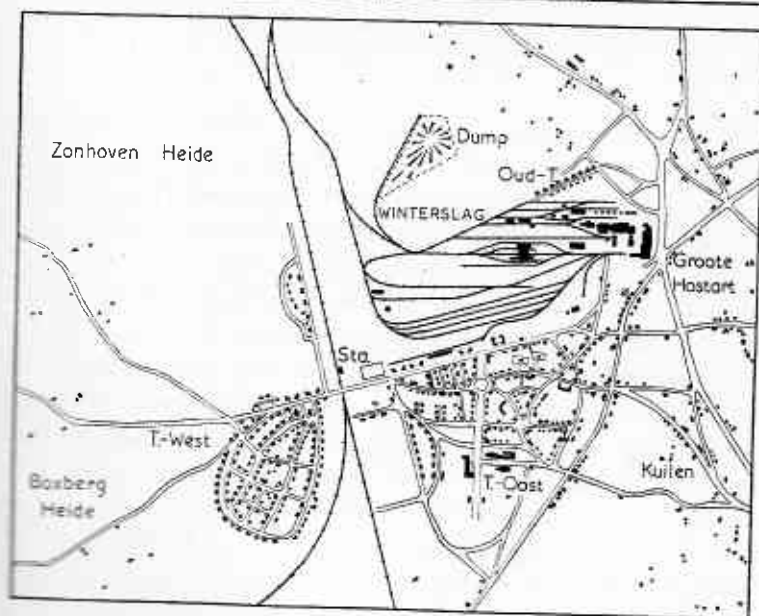
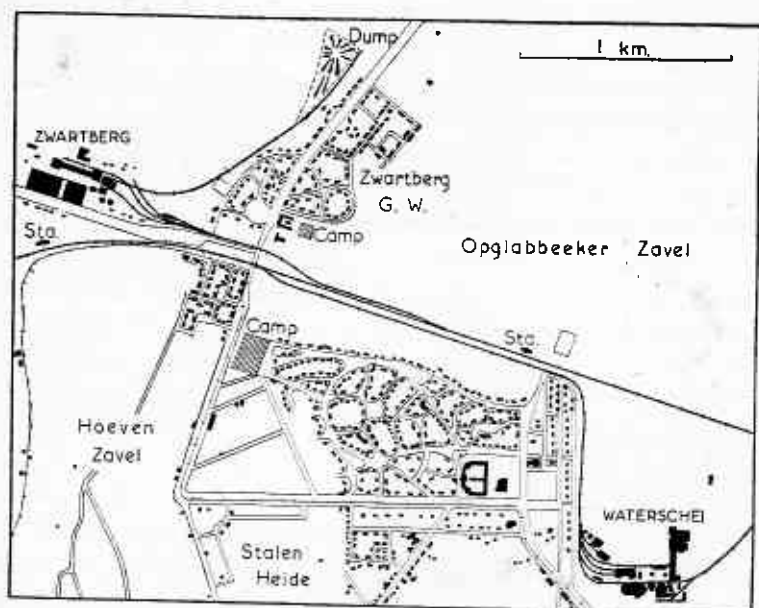
During the early years of the development of the coalfield, housing was a major problem. The small existing hamlets near the collieries were soon crowded to excess, and in 1910 living conditions were described as deplorable. The first steps in Genk to improve these conditions were taken in 1910 by the *André Dumont* company, which bought seventy-six houses in the Waterschei hamlet from the commune to house some of their workers, and by the *Winterslag* company, which built thirty-two houses in that year and a further ninety-one by

FIGS. 70-1. THE HOUSING-ESTATES IN GENK COMMUNE AT ZWARTBERG AND WATERSCHEI (ABOVE) AND AT WINTERSLAG (BELOW)

Based on a manuscript map in the possession of the *Technisch Dienst* of the commune of Genk.

The houses and industrial buildings are in solid black and the temporary camps and hutments shaded. The main-line and light railways are shown by heavy and fine barbed lines respectively.

The abbreviations are as follows : G.W. Goedkoope Woningen (Zwartberg) ; Oud-T. Oud-Tuinwijk (Winterslag) ; Sta. main-line station ; T. Oost. Tuinwijk-Oost (Winterslag) ; T. West. Tuinwijk-West (Winterslag).



1914. The war of 1914-18 hindered progress, but by 1920 the new Winterslag estate consisted of over two hundred houses. During the post-war period of Belgian economic reconstruction and development, progress was extremely rapid.

Housing-Estates in Genk Commune, 1910-43

	1910	1920	1930	1943
Waterschei (<i>Tuinwijk-André Dumont</i>) ..	76	116	857	1,029
Winterslag (<i>Oud-Tuinwijk</i>)	32	32	32	32
Winterslag (<i>Tuinwijk-Oost</i>)	—	209	663	727
Winterslag (<i>Tuinwijk-West</i>)	—	—	406	430
Zwartberg (<i>Tuinwijk</i>)	—	25	188	400
Zwartberg (<i>Goedkoope Woningen</i>) ..	—	—	269	369
Total	108	382	2,415	2,987

Note. These figures are of *logements* (i.e. individual homes), not of separate buildings, as there are several large blocks of flats.

By 1943, the collieries owned more than half the houses in Genk commune. They also built some fine churches (there is a notable example at Waterschei, with an immense dome-crowned tower), schools, cinemas, theatres, hospitals such as the *Kliniek André Dumont*, several large co-operative stores and rows of shops. The estates are very attractively laid-out. The streets are broad and tree-lined, and the houses are well-designed and built in a variety of sizes and styles—the large detached villas of the administrative and technical staffs, the semi-detached houses of the workers, the pleasant terraces and blocks of flats arranged in quadrangles and circles around lawns and gardens. There is a notable absence of the monotony so often regrettably characteristic of large-scale housing schemes. The amenities too are good. There is an excellent water-supply, the responsibility of the colliery companies, which have sunk deep wells and erected lofty

concrete water-towers. All houses receive electricity from the colliery power-stations, distributed free by the companies. The rents of the workers' houses are extremely low (see p. 131), while the administrative staffs receive villas rent-free.

During 1946-7, the labour force employed at the collieries grew considerably, as a result of the efforts to step-up the post-war production of coal. Several permanent building schemes are in progress to meet the resulting housing shortage. It was also necessary in 1947 to erect several bungalow-camps of corrugated asbestos sheeting and of prefabricated concrete construction, to house the thousand or so prisoners of war, political prisoners, and Italians recently arrived under the Belgo-Italian agreement (see p. 129).

CONCLUSION

The housing-estates, with the collieries and factories they serve, probably represent, if only locally, the most striking alteration by man of the Kempen landscape. Yet these changes are but one aspect of the unifying theme of this survey, that is, the "improvement" in one way or another, during the last hundred years, of a substantial portion of the heath which formerly covered almost all of the region, in order to make more profitable use of the land. That this improvement has in some measure been achieved is indicated by the increase of population in the Kempen. This has been proportionally higher, at any rate in the present century, than in any other part of Belgium and has not yet reached its peak. Yet the sinking of colliery shafts, the building of factories and houses, the construction of new roads and the cutting of one of the finest inland waterways in Europe, the draining of bog and the reclamation of heath, the laying down of pasture and the development of pine plantations—all these have not really detracted from the individuality of the Kempen. The main unifying feature is indeed the geological uniformity, the existence of a superficial layer of sands and gravel on which developed a heath vegetation, and which is largely responsible for the poverty of the soils and therefore generally of the agriculture too. But if there was any doubt about the individuality

of the Kempen region, it is dispelled by the fact that the inhabitants regard themselves as Kempenlanders. There are Kempen firms and societies, Kempen co-operatives, Kempen banks and insurance companies, and Kempen newspapers, many with the name "Kempen" proudly included in their official titles. This conscious or unconscious recognition by the people of the regional unit within which they live is perhaps the clearest evidence of its identity.

APPENDIX

BIBLIOGRAPHICAL NOTE

General

The *Annuaire Statistique de la Belgique et du Congo belge*, published until 1939 at Gent, afterwards at Brussels, provides a wide range of summary statistical material. It has appeared without a break since 1870, even during both periods of German occupation. The 1943 volume contained the nice understatement, "Signalons que des difficultés d'ordre divers ont retardé la publication de l'Annuaire." Additional monthly statistical summaries have been published since 1945, as the *Bulletin de Statistique*, by the *Institut National de Statistique*.

Various series of maps published by the *Institut Cartographique Militaire* in Brussels were used in the compilation of the Figures. These included the *Carte Topographique et Militaire de Belgique* (scale 1 : 20,000); the *Carte Topographique et Militaire de Belgique* (1 : 40,000); the *Carte de Belgique* (1 : 100,000); the *Carte de la Belgique* (1 : 200,000); and the *Carte de la Belgique—Comportant la Subdivision Administrative du Territoire* (1 : 320,000). The last of these gives the boundaries of provinces, *arrondissements* and communes, and formed the basis for all distribution maps plotted in terms of commune areas.

Chapter I

The present areas of the provinces, *arrondissements* and communes were obtained from the *Recensement général au 31 décembre 1930*, vol. I (Bruxelles, 1934).

Numerous monographs, as well as many articles in the periodicals of learned Belgian societies, have been written about the geology and relief of Belgium in general and occasionally of the north-eastern part in particular. The more useful of these are F. Dussart, "Le Relief de la Campine," in *Bulletin du Cercle des Géographes liégeois*, Part II, pp. 19-30 (Liège, 1934); A. de Ghellinck, M. A. Lefèvre and P. L. Michotte, *Notice sur la Carte oro-hydrographique de Belgique à 1 : 500,000* (Turnhout, 1937); F. Halet, "Contribution à l'Etude du Quaternaire de la Plaine maritime belge," in *Bulletin de la Société belge de Géologie*, vol. XLI, pp. 141-66 (Bruxelles, 1931); M. A. Lefèvre, "Le Cône alluvial de la Meuse," in *Annales de la Société scientifique de Bruxelles, Série B, Sciences physiques et naturelles*, vol. XLVIII, pp. 121-38 (Bruxelles, 1928); M. A. Lefèvre, "La Basse-Meuse : Etude de morphologie fluviale," in *Société belge d'Etudes géographiques, Mémoire I* (Louvain, 1935); C. Stevens, "L'Origine du Relief de la Belgique," in *Bulletin de la Société royale de Belgique*, vol. 58,

pp. 171-5 (Bruxelles, 1934); and C. Stevens, "Le Relief de la Belgique," in *Mémoires de l'Institut géologique de l'Université de Louvain* (Louvain, 1938).

Apart from the series of topographical maps listed above, the most convenient small-scale sheet is the *Belgique: Carte oro-hydrographique* (1 : 500,000), compiled and edited by A. de Ghellinck, M. A. Lefèvre and P. L. Michotte, and printed and published by the *Institut Cartographique Militaire* (Bruxelles, 1937).

Chapter II

Statistics relating to the area of heathland in the various communes were obtained from the Agricultural Census volumes (see below). The unpublished results of the cadastral survey of 1942, which gave for each commune the area of heath and other uncultivated land, were made available by the *Institut National de Statistique*.

Rainfall statistics are given in A. Lancaster, *La Pluie en Belgique* (Bruxelles, 1894), and in the official publications of the *Institut Royal Météorologique de Belgique*, notably in the *Annuaire Météorologique*. Mention may be made especially of L. Poncelet, "Les Caractères principaux de la Pluie en Belgique," in *Miscellanées, Institut Royal Météorologique de Belgique*, Part III (Bruxelles, 1939).

Descriptive accounts of the heathlands are contained in two articles by F. Dussart: "Un Paysage typique de la Campine," in *Bulletin du Cercle des Géographes liégeois, Annexe 12* (Liège, 1940), and "Les Landes campinoises et leur mise en valeur," in *Travaux, Cercle des Géographes liégeois*, No. 29 (Liège, 1936).

(See also works listed under Chapter III.)

Chapter III

Agricultural censuses have been held at intervals by the *Ministère de l'Agriculture*. The results of the first of these were published as *Agriculture: Recensement général (15 Octobre 1846)* (Bruxelles, 1850), and this was succeeded by others in 1856, 1866, 1880, 1895, 1910 and 1929. Each comprised several large volumes, and contained a general Introduction, articles on special features of agricultural interest, and an immense body of detailed information for every commune. Since 1939, an annual agricultural census summary, the *Recensement Agricole et Horticole*, has been produced, containing much less detailed information than the earlier publications. Up to 1945, information was presented on a *canton* basis, after that on an *arrondissement* basis alone.

The statistics for each commune in 1946, on which the summary published *Recensement* is of course based, were made available in manuscript form at the *Institut National de Statistique*.

A most interesting contemporary description of Kempen agriculture in the fourth decade of the nineteenth century is given by the Rev. W. L. Rham, "On the Agriculture of the Netherlands," in *Journal of the Royal Agricultural Society*, Series I, No. 2, pp. 43-63 (London, 1841).

A survey of agricultural development in the Kempen in the late nineteenth century is provided by the *Monographie agricole de la Campine* (Bruxelles, 1899). This is one of nine regional monographs, published 1899-1902 by the *Ministère de l'Agriculture*.

Information about the development of pasture and the seeding-down of former heathland was supplied by the *Direction Générale de l'Agriculture et de l'Horticulture* of the *Ministère de l'Agriculture*. Detailed information regarding the land utilization in the commune of Genk, including access to land returns and manuscript maps, was supplied by the *Technisch Dienst* of that commune.

Contemporary descriptions of the nineteenth century problems of heathland improvement are numerous; some of the more noteworthy include M. Beaujean, *Rapport sur le Défrichement des Landes et Bruyères* (Liège, 1844); F. X. de Beukelaer, *Défrichement des Bruyères campinoises* (Anvers, 1899); J. B. Bivort, *Essai sur le Défrichement des Terres incultes de la Belgique* (Bruxelles, 1844); and M. Constant, *Du Défrichement des Terrains sablonneux et particulièrement des Bruyères de la Campine* (Bruxelles, 1839).

Interesting accounts of the reclamation of the heathland in the nineteenth century are given by F. Dussart (*op. cit.*, Liège, 1936) and by L. Mouchamps, "L'Habitat dans le Bassin houiller de Campine," in *Bulletin de la Société royale de Géographie d'Anvers*, vol. LI, pp. 189-217 (Anvers, 1931).

An account of the mid-nineteenth century irrigation schemes is given by U. Kümmer, *Création de Prairies irrigables et Etablissement d'une Colonie agricole dans la Campine* (Bruxelles, 1851); T. Lebens, "Les Irrigations de la Campine," in *Annales des Travaux Publics de Belgique*, vol. II, pp. 695-749 (Bruxelles, 1897); and F. Dussart, "Les Irrigations en Campine," in *Association Française pour l'Avancement des Sciences*, 63 session, Liège, 1939: *Séances des sections* (Liège, 1941).

Chapter IV

Since 1870, the *Annuaire Statistique* has provided a considerable amount of information, supplied by the *Administration des Eaux et Forêts*, concerning the area and nature of the woodland, its ownership, etc. Woodland statistics are given in detail in each of the volumes of *Agriculture: Recensement général*, from 1846 to 1929. In 1899, the first detailed survey of woodland was published in vol. IV of the 1895 Agricultural Census. These various Censuses furnish the area of woodland in each commune at the various dates. Unpublished statistics of the area of woodland in each commune at the time of

the cadastral survey of 1942 were made available by the *Institut National de Statistique*.

The report of the Government Commission to enquire into the extension of afforestation in the Kempen was published as *Rapport de la Commission chargée de l'étude de la Campine au point de vue forestier* (Bruxelles, 1905).

Chapter V

Detailed articles concerning the Kempen coalfield, with statistics, are contained in the successive volumes of the *Annales des Mines* (Bruxelles), each of which comprises four quarterly sections; the first volume was published in 1900. The most recent statistics and other unpublished material were supplied by the *Ministère des Mines*. Several colliery companies, notably the *S.A. des Charbonnages Winterslag* and the *S.A. Charbonnages de Limbourg-Meuse*, supplied unpublished statistical and other information.

There are many geological and technical references in the *Annales de la Société géologique de Belgique* (Bruxelles).

Very full accounts of the technical features of shaft-freezing by sinking are given by E. O. F. Brown, *Vertical Shaft Sinking* (London, 1927).

General monographs concerning the Kempen coalfield include the following:

H. Basselman, *Das Kempenbekken und seine Bedeutung in Belgischen Kohlenbergbau* (Antwerpen, 1935); C. Demeure, *L'Industrie belge du Charbon et du Coke* (Louvain, 1930); P. Gruselin, *Le Bassin minier de la Campine* (Bruxelles, 1925); G. de Leener, *Le Charbon dans le Nord de la Belgique* (Bruxelles, 1904); and K. Pinxten, *Het Kempisch Steenkolenbekken* (Brussel, 1937).

Chapter VI

A variety of unpublished statistical and other information was supplied by the following firms:

- (a) *S.A. des Mines et Fonderies de Zinc de la Vieille-Montagne*
- (b) *S.A. Compagnie des Verreries du Pays de Liège et de la Campine*
- (c) *S.A. Poudreries Réunies de Belgique*
- (d) *S.A. d'Arendonck*
- (e) *S.A. de Rothen*
- (f) *Société Générale Métallurgique de Hoboken*
- (g) *Produits Chimiques de Tessenderloo S.A.*
- (h) *Produits Chimiques du Limbourg S.A.*
- (i) *S.A. Glaces et Verres*

Industrial censuses were held in 1846, 1880, 1896 and 1929, and the results were published as *Industrie : Recensement général*. In addition to useful Introductions and specific articles, they contain detailed statistical information for each province.

A very full economic and social census was made on 27 February, 1937, and the results were published in eight volumes as the *Recensement économique et social au 27 février 1937* for the *Ministère de l'Intérieur* by the *Office Central de Statistique*. The most valuable volumes from the point of view of the Kempen were the *Recensement des Etablissements industriels et commerciaux*, published separately for Antwerpen and Limburg provinces. They contain not only detailed statistical information, but also a long Introduction.

There are many useful industrial directories, the most important of which are : (a) *Annuaire du Commerce et de l'Industrie de Belgique* ; (b) *Comité central industriel de Belgique : Liste des Etablissements industriels affiliés* ; and (c) *Annuaire du Commerce et de l'Industrie de Belgique*.

A survey of the historical aspects of Kempen industrial development is M. Henriquet, *La Campine industrielle* (Bruxelles, 1924).

Chapter VII

Roads

Summary statistics are available in the *Annuaire Statistique*. Detailed unpublished figures were supplied by the *Institut National de Statistique* from the *Direction générale des Routes* of the *Ministère des Communications*.

Detailed information about the roads in Genk, including access to manuscript maps, was afforded by the *Technisch Dienst* of that commune.

Railways

A historical summary of the development of the Belgian railway system in general is given by F. von Roll, *Enzyklopädie des Eisenbahnwesens*, vol. II (Berlin, 1912) ; L. Avakian, "Le Rythme de Développement des Voies ferrées en Belgique de 1835 à 1935," in *Bulletin de l'Institut de Recherches économiques*, vol. VII (Louvain, 1935-6) ; and U. Lamalle, *Histoire des Chemins de Fer belges* (Bruxelles, 1943).

Detailed information concerning the transport of coal by rail from Eisden and from Winterslag collieries was supplied by the *S.A. des Charbonnages de Limbourg-Meuse* and by the *S.A. des Charbonnages Winterslag* respectively.

Waterways

Historical summaries of the development of the Belgian waterway system in general is given by O. Teubert, *Die Binnenschifffahrt : Ein Handbuch für alle*

Beteiligten, Part II (Leipzig, 1932) and by Y. Urbain, "La Formation du Réseau des Voies navigables en Belgique," in *Bulletin de l'Institut de Recherches économiques*, vol. IX p. 273 (Louvain, 1938-9).

Statistical information is contained in the *Annales des Travaux Publics de Belgique: Mouvement de la Navigation intérieure* (Bruxelles). Detailed unpublished statistics were supplied by the *Institut National de Statistique*, from the *Direction générale des Voies navigables* of the *Ministère des Communications*.

The construction of the Albert Canal is described fully by A. Delmer, *Le Canal Albert* (Liège, 1939). This comprises one volume of text and another of nineteen sheets of maps, including four sheets which cover the canal on a scale of 1 : 100,000.

An interesting general survey of the location of Belgian industry relative to the navigable waterways is by A. Delmer, "L'Influence des Voies navigables sur la Localisation de l'Industrie belge," in *Bulletin de la Société belge d'Etudes géographiques*, vol. VI, pp. 40-6 (1936). Detailed information concerning the shipment of coal from the Eisden colliery was supplied by the *S.A. des Charbonnages de Limbourg-Meuse*, while information concerning the operation of the Genk coal port was supplied by the *Société du Port Charbonnier de Genk S.A.*

Chapter VIII

Statistics referring to the early years of the kingdom are contained in *Documents Statistiques sur le Royaume (1832 à 1841)* and *Documents Statistiques de 1857 à 1869*.

Very useful summary figures are contained in the volumes of the *Annuaire Statistique de la Belgique et du Congo belge* since 1870.

Detailed population statistics are given in the volumes of the *Recensement général de la Population*. The first census was made in 1846 and repeated every ten years until 1876; it was then decided to change the censal date to the exact decade, and censuses have been made since 1880 at ten-yearly intervals, the last being in 1930.

Annual estimates of the population are published by the *Ministère des Affaires Economiques* for 31 December of each year in the official *Moniteur Belge* (*Belgisch Staatsblad*) during the succeeding year, as *Relevé officiel du Chiffre de la Population du Royaume*. The latest available of these estimates at the time of writing relates to 1945, published on 4 August, 1946. The returns of registrations of births, deaths, arrivals and departures in each commune are used to revise the last census returns. A full census was to have been held in 1940, but was abandoned because of the German occupation. The next was to be held in 1948.

Statistics relating to foreigners in Belgium, apart from the various censuses, are given in *Statistique des Etrangers: au 30 juin and au 15 septembre 1939*, published by the *Office Central de Statistique*.

Detailed unpublished information about the distribution of population in Genk commune was supplied by the *Technisch Dienst* of the commune.

The most recent general survey of the population of Belgium is by C. Mertens, *La Répartition de la Population sur le Territoire Belge: Etude de Démographie Sociale* (published by the *Société d'Etudes Morales, Sociales et Juridiques*, Louvain et Bruxelles, 1947). Apart from a most interesting study of the population of Belgium as a whole, based on the 1930 census, there is a short summary account of the population of the Kempen in part II of the book, which deals with "Aspects Economiques et Sociaux."

Two articles which deal with the population of Belgium as a whole are by H. M. Kendall, "A Survey of Population Changes in Belgium," in *Annals of the Association of American Geographers*, vol. XXVIII, pp. 145-64 (Lancaster, Pa., 1938) and V. Fallon, "La Population belge," in *Population*, vol. I, pp. 65-72 (London, 1933).

A most valuable study of rural settlement in Belgium is M. A. Lefèvre, *L'Habitat rural en Belgique* (Liège, 1925).

An account of settlement in the coal basin area is by L. Mouchamps, "L'Habitat dans le Bassin houiller de Campine," in *Bulletin de la Société royale de Géographie d'Anvers*, vol. LI, Part I, pp. 189-217 (Anvers, 1931). Information concerning the settlement of La Colonie was supplied by the commune of Lommel, and the commune of Genk rendered available not only unpublished statistical material but also several manuscript maps.

CONVERSION TABLES

In Tables 3 to 7, metric digits are printed in *italics* at the top of each. Metric tons are printed vertically from top to bottom in the left column of the table.

Table 1. *Length*

Statute mile	Kilometre	Metre	Yard	Foot	Inch	Centimetre
<i>I</i>	<i>I</i> 60934	<i>I</i> 609 34	<i>I</i> 760	<i>I</i> 5280	<i>I</i> 63 360	<i>I</i> 160 934
$6 \cdot 21372 \times 10^{-1}$	<i>I</i>	<i>I</i> 1000	<i>I</i> 093 61	<i>I</i> 3280 84	<i>I</i> 39 370 1	<i>I</i> 100 000
$6 \cdot 21372 \times 10^{-4}$	$1 \cdot 0 \times 10^{-3}$	<i>I</i>	<i>I</i> 093 61	<i>I</i> 3 280 84	<i>I</i> 36	<i>I</i> 100
$5 \cdot 68182 \times 10^{-4}$	$9 \cdot 14399 \times 10^{-1}$	$9 \cdot 14399 \times 10^{-1}$	<i>I</i>	<i>I</i> 3	<i>I</i> 12	<i>I</i> 91 4399
$1 \cdot 89394 \times 10^{-4}$	$3 \cdot 048 \times 10^{-4}$	$3 \cdot 048 \times 10^{-4}$	$3 \cdot 33333 \times 10^{-1}$	$8 \cdot 33333 \times 10^{-2}$	<i>I</i>	<i>I</i> 30 48
$1 \cdot 57828 \times 10^{-5}$	$2 \cdot 54 \times 10^{-5}$	$2 \cdot 54 \times 10^{-5}$	$2 \cdot 77778 \times 10^{-2}$	$3 \cdot 28084 \times 10^{-2}$	<i>I</i>	<i>I</i> 2 54
$6 \cdot 21372 \times 10^{-6}$	$1 \cdot 0 \times 10^{-5}$	$1 \cdot 0 \times 10^{-5}$	$1 \cdot 09361 \times 10^{-2}$	$3 \cdot 28084 \times 10^{-2}$	$3 \cdot 93701 \times 10^{-1}$	<i>I</i>

Table 2. *Area*

Square mile	Square kilometre	Hectare	Acre	Square metre	Square yard
<i>I</i>	<i>I</i> 2 58998	<i>I</i> 258 998	<i>I</i> 640	<i>I</i> 258 998 $\times 10$	<i>I</i> 30 976 $\times 10^2$
$3 \cdot 86103 \times 10^{-1}$	<i>I</i>	<i>I</i> 100	<i>I</i> 247 106	<i>I</i> 1 000 000	<i>I</i> 119 599 $\times 10$
$3 \cdot 86103 \times 10^{-3}$	$1 \cdot 0 \times 10^{-2}$	<i>I</i>	<i>I</i> 2 470 16	<i>I</i> 10 000	<i>I</i> 11 959 9
$1 \cdot 5625 \times 10^{-3}$	$4 \cdot 04685 \times 10^{-3}$	$4 \cdot 04685 \times 10^{-1}$	<i>I</i>	<i>I</i> 4046 85	<i>I</i> 4840
$3 \cdot 86103 \times 10^{-7}$	$1 \cdot 0 \times 10^{-6}$	$1 \cdot 0 \times 10^{-4}$	$2 \cdot 47106 \times 10^{-4}$	<i>I</i>	<i>I</i> 1 19599
$3 \cdot 22831 \times 10^{-7}$	$8 \cdot 36126 \times 10^{-7}$	$8 \cdot 36126 \times 10^{-5}$	$2 \cdot 06612 \times 10^{-4}$	$8 \cdot 36126 \times 10^{-1}$	<i>I</i>

Table 3. *Kilometres to Statute Miles*
1 km. = 0.621372 mile

	0	1	2	3	4	5	6	7	8	9
1	0.621	1.243	1.864	2.485	3.107	3.728	4.350	4.971	5.592	
2	6.214	7.456	8.698	9.940	11.182	12.424	13.666	14.908	16.150	17.392
3	12.427	13.669	14.911	16.153	17.395	18.637	19.879	21.121	22.363	23.605
4	18.641	19.883	21.125	22.367	23.609	24.851	26.093	27.335	28.577	29.819
5	24.855	26.097	27.339	28.581	29.823	31.065	32.307	33.549	34.791	36.033
6	31.069	32.311	33.553	34.795	36.037	37.279	38.521	39.763	41.005	42.247
7	37.283	38.525	39.767	41.009	42.251	43.493	44.735	45.977	47.219	48.461
8	43.497	44.739	45.981	47.223	48.465	49.707	50.949	52.191	53.433	54.675
9	49.711	50.953	52.195	53.437	54.679	55.921	57.163	58.405	59.647	60.889
10	55.925	57.167	58.409	59.651	60.893	62.135	63.377	64.619	65.861	67.103

Table 4. *Centimetres to Inches*
1 cm. = 0.393701 in.

	0	1	2	3	4	5	6	7	8	9
1	0.394	0.787	1.181	1.575	1.969	2.362	2.756	3.150	3.543	
2	4.331	4.724	5.118	5.512	5.906	6.299	6.693	7.087	7.480	7.874
3	8.268	8.661	9.055	9.449	9.843	10.236	10.630	11.024	11.417	11.811
4	12.205	12.598	12.992	13.386	13.780	14.173	14.567	14.961	15.354	15.748
5	16.142	16.535	16.929	17.323	17.717	18.110	18.504	18.898	19.291	19.685
6	20.079	20.472	20.866	21.260	21.654	22.047	22.441	22.835	23.228	23.622
7	24.016	24.409	24.803	25.197	25.591	25.984	26.378	26.772	27.165	27.559
8	27.953	28.346	28.740	29.134	29.528	29.921	30.315	30.709	31.102	31.496
9	31.890	32.283	32.677	33.071	33.465	33.858	34.252	34.646	35.039	35.433
10	35.827	36.220	36.614	37.008	37.402	37.795	38.189	38.583	38.976	39.370

Table 5. Metres to Feet
1 m. = 3.28084 ft.

	0	1	2	3	4	5	6	7	8	9
1	—	3.3	6.6	9.8	13.1	16.4	19.7	23.0	26.3	29.5
2	32.8	36.1	39.4	42.7	45.9	49.2	52.5	55.8	59.1	62.3
3	65.6	68.9	72.2	75.5	78.7	82.0	85.3	88.6	91.9	95.1
4	98.4	101.7	105.0	108.3	111.6	114.8	118.1	121.4	124.7	128.0
5	131.2	134.5	137.8	141.1	144.4	147.6	150.9	154.2	157.5	160.8
6	164.0	167.3	170.6	173.9	177.2	180.5	183.7	187.0	190.3	193.6
7	196.9	200.1	203.4	206.7	210.0	213.3	216.5	219.8	223.1	226.4
8	229.7	232.9	236.2	239.5	242.8	246.1	249.3	252.6	255.9	259.2
9	262.5	265.8	269.0	272.3	275.6	278.9	282.2	285.4	288.7	292.0
10	295.3	298.6	301.8	305.1	308.4	311.7	315.0	318.2	321.5	324.8
11	328.1	331.4	334.6	337.9	341.2	344.5	347.8	351.0	354.3	357.6
12	360.9	364.2	367.5	370.7	374.0	377.3	380.6	383.9	387.1	390.4
13	393.7	397.0	400.3	403.5	406.8	410.1	413.4	416.7	419.9	423.2
14	426.5	429.8	433.1	436.4	439.6	442.9	446.2	449.5	452.8	456.0
15	459.3	462.5	465.9	469.2	472.4	475.7	479.0	482.3	485.6	488.8
16	492.1	495.4	498.7	502.0	505.2	508.5	511.8	515.1	518.4	521.7
17	524.9	528.2	531.5	534.8	538.1	541.3	544.6	547.9	551.2	554.5
18	557.7	561.0	564.3	567.6	570.9	574.1	577.4	580.7	584.0	587.3
19	590.6	593.8	597.1	600.4	603.7	607.0	610.2	613.5	616.8	620.1
20	623.4	626.6	629.9	633.2	636.5	639.8	643.0	646.3	649.6	652.9
21	656.2	659.4	662.7	666.0	669.3	672.6	675.9	679.1	682.4	685.7
22	689.0	692.3	695.5	698.8	702.1	705.4	708.7	711.9	715.2	718.5
23	721.8	725.1	728.3	731.6	734.9	738.2	741.5	744.8	748.0	751.3
24	754.6	757.9	761.2	764.4	767.7	771.0	774.3	777.6	780.8	784.1
25	787.4	790.7	794.0	797.2	800.5	803.8	807.1	810.4	813.7	816.9
26	820.2	823.5	826.8	830.1	833.3	836.6	839.9	843.2	846.5	849.7
27	853.0	856.3	859.6	862.9	866.1	869.4	872.7	876.0	879.3	882.5
28	885.8	889.1	892.4	895.7	899.0	902.2	905.5	908.8	912.1	915.4
29	918.6	921.9	925.9	928.5	931.8	935.0	938.3	941.6	944.9	948.2
30	951.4	954.7	958.0	961.3	964.6	967.8	971.1	974.4	977.7	981.0
	984.3	987.5	990.8	994.1	997.4	1000.7	1003.9	1007.2	1010.5	1013.8

Table 6. *Hectares to Acres*

1 hectare (ha.) = 2.47106 acres

	0	1	2	3	4	5	6	7	8	9
1	2.471	2.47	4.94	7.41	9.88	12.36	14.83	17.30	19.77	22.24
2	4.94	27.18	29.65	32.12	34.59	37.07	39.54	42.01	44.48	46.95
3	7.41	51.89	54.36	56.83	59.31	61.78	64.25	66.72	69.19	71.66
4	9.88	76.60	79.07	81.54	84.02	86.49	88.96	91.43	93.90	96.37
5	12.35	101.31	103.78	106.26	108.73	111.20	113.67	116.14	118.61	121.08
6	14.82	126.02	128.50	130.97	133.44	135.91	138.38	140.85	143.32	145.79
7	17.29	150.73	153.21	155.68	158.15	160.62	163.09	165.56	168.03	170.50
8	19.76	172.97	175.45	177.92	180.39	182.86	185.33	187.80	190.27	192.74
9	22.23	200.16	202.63	205.10	207.57	210.04	212.51	214.98	217.45	219.92
10	24.71	224.87	227.34	229.81	232.28	234.75	237.22	239.69	242.16	244.63

Table 7. *Square Kilometres to Square Miles*

1 sq. km. = 0.386103 sq. mile

	0	1	2	3	4	5	6	7	8	9
1	0.386	0.386	0.772	1.158	1.544	1.931	2.317	2.703	3.089	3.475
2	0.772	4.247	4.633	5.019	5.405	5.792	6.178	6.564	6.950	7.336
3	1.158	8.108	8.494	8.880	9.266	9.653	10.039	10.425	10.811	11.197
4	1.544	11.969	12.355	12.741	13.128	13.514	13.900	14.286	14.672	15.058
5	1.931	15.830	16.216	16.602	16.989	17.375	17.761	18.147	18.533	18.919
6	2.317	19.691	20.077	20.463	20.850	21.236	21.622	22.008	22.394	22.780
7	2.703	23.552	23.938	24.324	24.711	25.097	25.483	25.869	26.255	26.641
8	3.089	27.027	27.413	27.799	28.186	28.572	28.958	29.344	29.730	30.116
9	3.475	31.274	31.660	32.047	32.433	32.819	33.205	33.591	33.977	34.363
10	3.861	35.135	35.521	35.908	36.294	36.680	37.066	37.452	37.838	38.224

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