CHAPTER I

INTRODUCTION

General description of the Peak District. Types of scenery. Rocks and soils. Soils and their characteristic plants. Flora and vegetation. Vegetation maps. Plant communities. Vegetation maps and floristic maps. The value of vegetation maps. Rainfall. Smoke. Temperature. The upper atmosphere; temperatures; direction of the wind; velocity of the wind; humidity of the atmosphere. Note on the use of the words "acidic" and "basic."

General Description of the District

The Peak District has no definite geographical boundaries; and, for the purposes of the present memoir, it is regarded as being co-extensive with the accompanying vegetation maps (see also figures 1 and 2). A large proportion of the district consists of unenclosed moorland and grassland; and there are numerous small vestiges of scrub and primitive woodland, besides several comparatively extensive stretches of semi-primitive woodland. Cultivated land ascends the valleys, usually up to about 1000 feet (305 m.), and occurs also as more or less isolated "intakes" up to about 1500 feet (457 m.). Most of the cultivated land is utilized as permanent pasture; and there is very little arable land. Plantations are fairly numerous; and a few of them are of moderately large size.

The highest elevation of the district is reached on an extensive, undulating plateau which bears the singularly inappropriate name of "the Peak." This plateau, the highest in England south of the mid-Pennines, is peat-clad; and it attains an altitude of 2088 feet (636 m.). North of the Peak are two summits which attain heights of more than 2000 feet (610 m.): one of these, known as Bleaklow Hill, is situated six miles

(9·7 km.) to the north of the Peak, and is 2039 feet (621 m.) in height; and the second, one mile south of Bleaklow Hill, and apparently without any special name, is 2068 feet (630 m.) high. These three are the only Pennine summits, south of the "Yorkshire giants" of Whernside (736 m.), Ingleborough (723 m.), and Pen-y-ghent (686 m.), which reach a height of 2000 feet.

The westerly slopes of the Pennines descend rather abruptly into the lowland plain of Lancashire and Cheshire; and this physiographical feature is reflected on the accompanying vegetation maps by a comparatively narrow western zone of heather moorland. On the east, the slope is more gradual; and the zone of heather moor is correspondingly wider. The higher plateaux are covered by cotton-grass moors and bilberry moors, and the steeper hill slopes by uncultivated grassland. The foot of the western slopes of the Peak District is characterized by a densely populated manufacturing district, of which Manchester is the centre; and Sheffield is the centre of another manufacturing district which lies at the foot of the eastern slopes. The Pennine moors stretch away from the Peak in a northerly direction; and it is almost but not quite possible to walk along the Pennine watershed from the Peak to the Border without leaving the uncultivated land. South of the Peak lies the sequestered valley of Edale; and to the south of this the limestone hills and dales are situated. The limestone area is flanked, both on the east and on the west, by a southern extension of characteristic Pennine moorland and grassland. The lowest altitudes occur where the streams leave the district, usually at an altitude of about 100 metres. The streams harbour a few aquatic plants; but the latter are, on the whole, poorly represented on the Pennines generally.

In pre-railway days, the Pennine hills, with their peat-clad, unfenced, and undrained summits formed an effectual barrier between the Lancashire and Yorkshire peoples. Before the construction of the turnpike roads, about a century ago, the Pennines could scarcely be crossed except by the primitive pack-horse roads. Some of these still exist as public footpaths; but others, it would appear, have been closed, and are now largely overgrown with rough grasses. At the present time, the southern Pennines may be crossed by half a dozen good roads, two canals, and four or five railways. An interesting account

of a journey across the Pennines in the early part of the eighteenth century is given by Defoe (1725: 90, *et seq.*)[1].

Portions of five counties, namely, south-east Lancashire, north-east Cheshire, north Staffordshire, north Derbyshire, and south-west Yorkshire, are represented in this district; and on the high moorlands several of the head-streams of the Mersey, Dee, Trent, and Yorkshire Ouse take their rise.

Types of Scenery

The district furnishes some interesting and distinct types of scenery, which depend primarily on the nature of the geological strata (cf. figures 1 and 2).

The lower hills of the north-west and north-east of the district are composed of sandstones and shales belonging to the Coal-measure series. It is on or near these rocks that the manufacturing areas are situated. The hills of the Coal-measures are usually cultivated up to their summits. Arable land, whilst nowhere really common, is more abundant on the Coal-measures than elsewhere; and more wheat is grown on such soils than on any other soils of the district. This is an interesting fact, as the soils of the Coal-measures are usually described as cold and backward (*e.g.*, by Lees, 1888: 66). The uncultivated parts of the Coal-measures are few and often isolated, and consist usually of heather associations on the sandstones and of grassland associations on the shales. However, on the few areas of uncultivated land of the Coal-measures at the higher altitudes, heather moors and cotton-grass moors occur, as, for example, south-west of Buxton. The differences therefore between the vegetation of the uncultivated parts of the Coal-measures and the other siliceous strata are due almost entirely to altitude, and not to any differences either in the nature of the climate or of the soil.

[1] The first number in brackets after an author's name refers to the year of publication in which the book or paper, which is being referred to, was published. The number after the colon refers to the page where the particular matter which is referred to occurs in the original work. The pages of the quoted works refer, as far as is possible, to the pages of the original memoirs, and not necessarily to the pages of the separately issued copies, as these unfortunately are often paged differently from the original. The titles, dates, and places of publication of the works quoted will be found in an appendix (pp. 222–229).

The hill slopes of the Coal-measures are rarely very steep, and are characterized by a number of typical oak (*Quercus sessiliflora*) woods which are at least semi-primitive in character. These woods occasionally spread out for a little distance on to the low, flat or gently sloping plateaux. The valley bottoms are almost filled up with overgrown, manufacturing villages, many of which have a population of twenty thousand people. The smoke from the villages and hamlets, for even every hamlet has its factory, frequently renders the sky dull and the atmosphere thick and heavy. Sandstone walls as a rule, hedgerows occasionally, separate the cultivated fields; and the stone walls and the tree trunks are permanently blackened with soot and smoke which have effectually destroyed almost all traces of mural plants, especially Cryptogams. Only in the heart of the woods, some of which retain their original sylvan character, may one, in this Coal-measure country, forget the propinquity of coal-mines and mills.

The higher hills of the central *massif* consist of sandstones and shales belonging to the Millstone Grit and to the Yoredale or Pendleside (Hind, 1897, etc.; Hind and Howe, 1901) series of rocks. Here there are fewer factories than on the Coal-measures, and no coal-pits. The higher hill summits are unpopulated, and covered with peat moors. Here and there, the moorland plateaux terminate abruptly in precipitous escarpments, locally known as "edges," formed of massive sandstone rocks. The larger and broader valleys are known as "dales," the smaller and narrower ones as "cloughs" or "deans," or, further north, as "ghylls." The upland valleys shelter woods of oak (*Quercus sessiliflora*), and rarely of birch (*Betula pubescens*); but more frequently the slopes of the steep valleys are tenanted by scrub or grassland. The bracken is a characteristic plant of the drier slopes. The upper portions of the cloughs contain numerous reservoirs (see figure 36) which are fed by the streams issuing from the peat moors of the plateaux. The lower plateaux and valleys are cultivated, chiefly as permanent pasture: arable land is decidedly scarce: wheat, in particular, is very rarely grown; and even fields of oats are uncommon. The fields are usually separated by sandstone walls; though, as in the Coal-measure country, hedgerows occur where the shales are of great extent.

In the south of the district, a third type of scenery is occasioned by the rocks of the Carboniferous or Mountain Limestone. The limestone plateaux are not so high as those of the sandstones; and they are frequently cultivated up to their summits. Limestone escarpments are frequent, and are more or less covered with plants, many of which belong to quite different species from those which characterize the sandstone escarpments. The valleys are all spoken of as "dales"; and these are much richer in species than the "cloughs" of the sandstones and shales. The valley slopes are steep, and are clothed by ash (*Fraxinus excelsior*) woods, or scrub, or calcareous grassland. The limestone country is too remote from the factories to be affected seriously by smoke. Arable land, on which oats are commonly grown, is not rare; but wheat is practically never grown on the Mountain Limestone. The fields are separated by white, limestone walls which give to the country side a very characteristic appearance.

Generally speaking, the cloughs in the shaly areas are grassy: those of the sandstone areas are bolder, more rocky, and more heathery. The prevailing hues of the cloughs are warm browns and purples, those of the limestone dales cold greys and greens, for in the latter localities, bracken, heather, and bilberry are almost entirely absent.

Rocks and Soils

The geological features of the district have been elucidated by Green (1869 and 1887), Dale (1900), and others. Still, the features of a district which are of chief interest to the geologist are not necessarily those which are responsible for the differences of the vegetation. From the latter point of view, it is the soil that is important (cf. figures 1 and 2); and this is not always directly related to the solid strata that are indicated on an ordinary geological map. In the present district, although it is largely unglaciated, there are several important soil features which cannot be inferred from any of the existing geological maps. Unfortunately, only geological maps of the old series are issued for this district; and no soil maps and no drift maps of the Peak District have been published by the Ordnance Department. In fact, the survey of the drift of this district does not appear to have

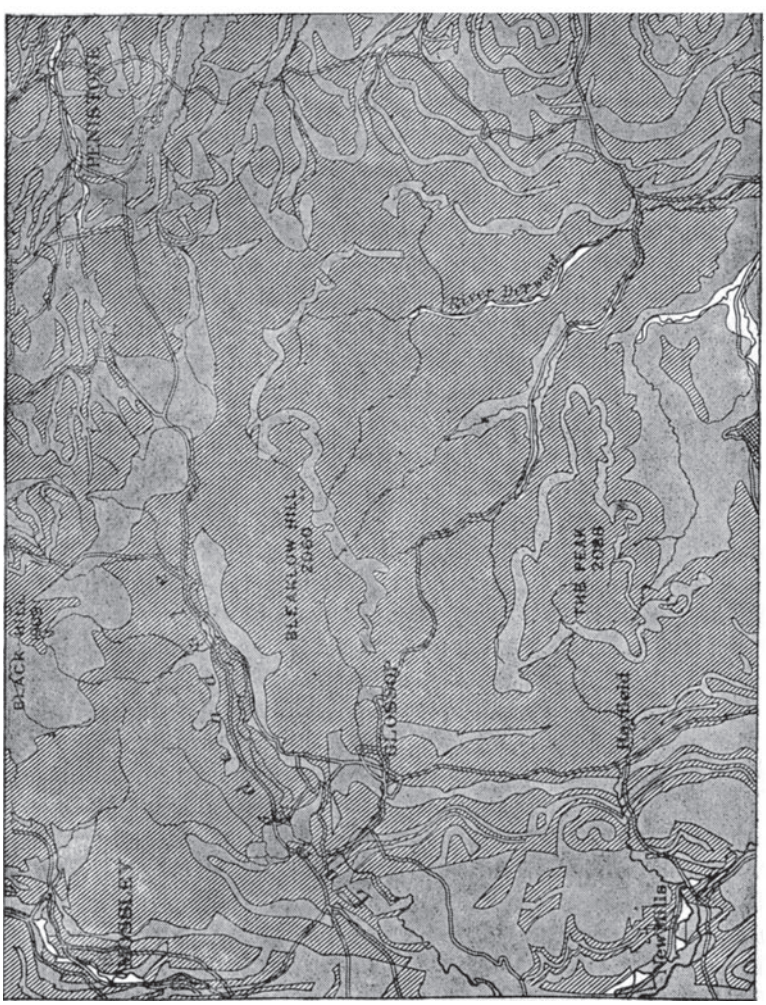

Figure 1. Subsoil map of the Peak District (northern area).

been yet commenced by the Geological Survey, though several papers on the subject have been published by various geologists.

Considering first those soils which are directly a result of the underlying strata, it is, so far as this district is concerned, necessary and sufficient to distinguish two main classes, calcareous and non-calcareous. The latter overlie the rocks of the Pendleside series, the Millstone Grits, and the Coal-measures. The calcareous soils overlie most of the rocks of the Carboniferous Limestone.

The non-calcareous soils of the Pendleside beds, the Millstone Grits, and the Coal-measures are here taken together, for the soils to which they directly give rise are essentially alike in their chemical and physical characters, and produce identical plant associations. The rocks consist largely of coarse grains of sand, of pebbles, of quartz, of pieces of decomposed felspar, and of flakes of mica.

Local floristic differences may perhaps be related to the different strata; but, in any case these differences are very slight. Linton (1903: 15) correctly states that the Coal-measures "can scarcely be said to possess a distinctive flora"; but the plants given by Linton (*op. cit.*) as characteristic of the grit are, in nearly all cases, plants confined to peat; and he gives no list of species characteristic of the Pendleside (or Yoredale) rocks, erroneously including these with the Carboniferous Limestone. The beds of all three series of rocks consist of alternating beds of sandstones and shales. In no other part of the British Isles are these strata so characteristically developed or so widespread as in the region of the Pennines. Over the shales, the surface soils weather ultimately into a kind of false clay, dark yellow in colour, and very slippery when wet. The soils produced by the weathering of the sandstones consist, when newly formed, of yellow sand; but this quickly becomes mixed with humus, when its colour is much darker. Pure sand is of very limited occurrence in the Peak District, and is almost limited to the vicinity of quarries, where a few arenicolous, as opposed to silicolous, species sometimes occur, such as *Spergularia rubra*.

Generally, the soils over the sandstones and shales are poor in soluble mineral salts, especially calcium carbonate. Woodhead (1906: 376) states that soils of this type in the Huddersfield

district only contain from 0·02 to 0·04 per cent. of lime. The soil is usually rich in humus, and therefore retentive of water. Over such soils, if left uncultivated and undisturbed, peat inevitably develops in course of time.

The sandstones and shales are usually regarded as having been originally formed from the waste and denuded material of a great tract of granite. The resulting soils are of a siliceous nature, very deficient in soluble mineral salts, whilst in texture they are intermediate between loam and clay. The soils are shallow, as in the case of practically all siliceous soils derived from the Palaeozoic rocks; and the most typical vegetation consists of grassland dominated by the mat-grass (*Nardus stricta*) and the silver hair-grass (*Deschampsia flexuosa*).

There is a popular but quite erroneous impression that the soils over the rocks of the Pendleside (or Yoredale) series of the southern Pennines are calcareous; and, in Linton's *Flora of Derbyshire* (1903), the plant records are partly arranged on this assumption. The error may perhaps be accounted for by the fact that the true Yoredale rocks of the northern Pennines are frequently calcareous, and by the additional fact that, on the existing Ordnance maps of the Geological Survey on the scale of a quarter of an inch to the mile (1 : 253,440), the rocks of the Pendleside series and those of the Carboniferous Limestone are indicated by the same colour. It is true that the Pendleside rocks of the southern Pennines occasionally show thin bands of calcareous nodules; but these bring about little or no change in the vegetation.

The soil over the Carboniferous or Mountain Limestone is, in general, strongly calcareous, as this rock is composed very largely of molluscan shells, encrinites, and corals; but it agrees with that over the sandstones and shales in often being highly ferruginous, and in giving, from place to place, a great range of variation in water content. The highest percentages of calcium carbonate occur on the steep hill slopes; and this is no doubt due to the continuous exposures of new surfaces by denudation. The lowest percentages occur on the flatter plateaux; and this is doubtless caused by the leaching of the upper layers of the soil, the lime being carried away in solution to the subterranean or telluric waters, which find a ready means of escape to lower levels by means of the open joints of the limestone.

Many of the plateaux marked on the geological maps as consisting of limestone are capped by a layer of non-calcareous chert (cf. Sibley, 1908); and such plateaux yield soils which are essentially identical with those over the sandstones and shales. Sometimes the soil contains a mixture of stones of the limestone and of the non-calcareous chert; and then lime-loving plants occur. This agrees with the observations of Stebler (1906) in Switzerland.

Contemporaneous igneous rocks (cf. Arnold-Bemrose, 1907) occur in the limestone area. Although of comparatively limited extent, they are interesting locally. For example, a small patch of bilberry (*Vaccinium Myrtillus*) and of other lime-avoiding plants occurs on an outcrop of volcanic "toad-stone" or basalt near Miller's Dale railway station, and is surrounded by lime-loving plants, *e.g.*, the salad burnet (*Poterium Sanguisorba*) growing on the limestone soil.

Of soils composed of recent deposits, there are the glacial sands, the river alluvia, and the upland peat.

The glacial drift of this district is confined to its western boundary. Boulder clay scarcely occurs; but non-calcareous, fluvio-glacial sands form rather extensive deposits, chiefly near the confluence of the rivers Etherow and Goyt. These deep and non-calcareous sands bring about a noteworthy change in the vegetation, as, in this district, woods of the pedunculate oak (*Quercus Robur* = *Q. pedunculata*) occur on this soil alone. The sands do not appear to occur much higher than about 600 feet (183 m.). To the west of the Peak District, on the plain of Lancashire and Cheshire, extensive glacial deposits are found, which consist largely of boulder clay, gravel, and sand. These deposits occur intermittently up to the crests of the hills which face the western plain, and also up the river valleys. For example, glacial boulders are to be found on the summit of Spond's Hill, at 1350 feet (411 m.); and they also occur in the valley of the Goyt, on the watershed, and in the valleys of the Wye and the Dove (cf. Dale, 1900, etc.). The boulders, however, are local in their occurrence, and bring about no appreciable change in the vegetation. Except on its western fringe, as on Tintwistle Moor, near Glossop, the general moorland plateau of the Pennines south of the Aire and Calder watershed is not glaciated. No perched blocks occur, no striae, and no *roches*

moutonnées. It is not likely that traces of glaciation once existed here and have been obliterated, as the moorland plateau consists of uninhabited and unenclosed land where there is no necessity to remove boulders. Moreover, on hills immediately to the west, *e.g.*, on the Macclesfield moors, and on the moors some miles to the north, *e.g.*, on the Ilkley moors, glacial drift, boulders, and striae are found; and it is inconceivable that all traces of glacial action should have been entirely obliterated from the moors of the central and eastern Peak District, and not from the similar and neighbouring moors of Macclesfield and Ilkley. It is highly probable, then, that the Peak of Derbyshire and the high lands to the north, east, and south of the Peak, stood up, even during the time of maximum glaciation, as a *nunatak*, and that the ice-sheet fringed the hills of the west of the district. The fluvio-glacial sands are probably attributable to material washed out at the edge of the waning ice-sheet. Barrow (1903: 42) maintains that the glaciation of the neighbouring district of Cheadle, Staffordshire, ceased much earlier than in Northumberland and Scotland.

River alluvium, consisting generally of gravels, occurs at the bottom of most of the larger valleys. The gravels are non-calcareous in the valleys of the sandstones and shales, as, for example, between Hope and Grindleford, and calcareous in the limestone area, as, for example, in lower Monsal Dale. They bring about no important changes in the vegetation. In lower Monsal Dale, a calcareous alluvial flat is uncultivated, and the plants there are such as occur on the other calcareous soils; and near Grindleford, where a non-calcareous alluvial plain is also uncultivated, the plants are such as occur on the other non-calcareous soils. At the present time, the river gravels are mostly under cultivation, chiefly as permanent pasture; but a moderate quantity of wheat is grown on the gravelly alluvium near the confluence of the two streams, the Noe Water and the Derwent. In early times, it is not improbable that these alluvial tracts were characterized by woods of the "alder and willow series" (cf. Moss, Rankin, and Tansley, 1910: 122, *et seq.*).

Peat occurs on the summits of the higher non-calcareous hills, including the plateaux of chert in the limestone area, and is fully dealt with in Chapter VII. It is remarkable that very extensive deposits of peat in this country, both lowland