

Ireland & The Landscape

Ireland : the land and the landscape

Grenville A. J. Cole

1914

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The Structure of Ireland.

The description of the country...contains a number of local details which may arouse interest, when the reader says to himself, "I have seen that," or "I know that very corner." The teacher may well begin with the country round about the school, and may mention a great many of its surface-features, aided by the Ordnance Maps, beyond what is briefly touched on here. Old traditions and historic events add greatly to the interest of such descriptions ; and the beautiful Irish place-names, which are so often ruined by the spelling on our maps, constantly remind us of the curves of hill and dale, or connect these land-forms with the move-ments of man, with fights and forays, or with the establishment of seats of learning in the past. Books like P. W. Joyce's "Irish Names of Places" and "Short History of Ireland," and J. Cooke's edition of Murray's "Ireland," readily suggest themselves as guides. But the history of Ireland goes far back beyond what man has written, and is bound up with that of the great globe itself. Those who live in Ireland should know their country well. If these few pages should help anyone to know and love it better, the author will have received his best reward.

G. A. J. C.

Carrickmines, July, 1914

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Just as Arranmore, Inishbofin, or Clare Island lie off Ireland, while the sea stretches inland to the east of them, so Ireland lies off the western edge of the enormous mass of land known as Eurasia, or Europe and Asia considered as a whole. The sea stretches eastward from it far into the heart of Europe.

The greatest mountains and the greatest ocean-depths of the world measure about 30,000 feet (say 5½ miles) respectively above and below the level of the sea. If we think how little this is in comparison with the distance from the centre to the surface of the globe, we see that the continents are in reality very small bulges on this surface. The oceans, instead of being deep basins, such as we can make by pressing our thumb on a hollow rubber ball, are in reality like basins turned upside down, on which the water is held by the attraction of the solid earth below. They are so broad in proportion to their depth that the curve of their floors is outward, like that of the earth's surface as a whole. The continents and oceans, and the chief irregularities in them, result from upward and downward movements in the earth's surface. The skin of the earth, as we may call it, wrinkles and changes its form, sometimes very gradually, sometimes more rapidly, but always slowly in comparison with our human lives. Hence a large area that is now above the sea-level may at one time have lain beneath the water. On the other hand, continental land may have formerly stretched where now the liners steam across the ocean, four thousand miles from shore to shore.

We know that these movements have gone on in the past, since we find in our solid rocks, such as the grey limestone of Ireland, abundant remains of shell-fish and corals and teeth of fishes that once must have lived in marine waters. These occur not only in low-lying plains, but

uplifted thousands of feet on mountain heights. The sea at the present day lays down shells and other relics of dead animals in layers one above another, by its continual sway and its motion on the shores. Its waves mingle *sand* with the shells, or wash out fine mud to a greater distance from the coast, where it gathers to form new beds of the rocks that we know as *clay* and *shale*. Shale is merely a clay well arranged in layers by water action. When further squeezed and hardened it becomes slate. Where the sea is pure, the shell-fish and other animals that make their hard parts of carbonate of lime leave behind thick deposits almost free from mud or sand. These deposits in time become *limestones*. Where, on the other hand, sand accumulates, consisting mostly of grains of the hard mineral quartz, which are left behind from the decay of older rocks, the deposits are likely to be preserved and hardened in the course of time as *sandstones*. In sandstones the little mineral grains are stuck together by various natural cements, such as carbonate of lime, or even silica, which sets between the grains as so much additional quartz. The rock, in the latter case, is known as quartzite, and becomes almost as splintery and hard as flint. Hence sandstones are for the most part hard resisting rocks when, by the mysterious movements of the earth's skin, they become lifted above the waters in which they were originally laid down. Clays and shales, the consolidated muds, are softer and are more easily worn away. Limestones are compact rocks, broken across by clean straight joints, and they often give rise to natural steps and terraces when they are raised to form dry land. They are, however, liable to be worn down more readily than other rocks, since their material, carbonate of lime, can be dissolved in rain-water. The gas carbon dioxide, which exists in small quantities in the air, is brought by the rain like a mild acid against the rocks. It thus enables the natural waters, as they run over the surface or down the crevices, to carry away limestone in solution. The joints are in consequence widened, the surface is lowered, and great caves and waterways are hollowed out in the limestone masses underground.

Hence there are resisting rocks and less resisting rocks for the weather to act upon when any part of the outer skin of the globe is exposed above the sea. In the process of *weathering* or *denudation*, the rainwater and the frost the battering winds, the flowing streams, and the surf of the sea, all play their part.

Besides the occurrence of rocks containing marine shells on the very crests of mountains, the arrangement of the rocks themselves shows that the skin of the earth becomes wrinkled into folds. The beds of rock, or *strata*, which were laid down fairly evenly in seas or lakes, are found to be crumpled and disturbed, and the weathering action often reveals their upturned edges. Sometimes the strata stand absolutely on end, as may be seen in parts of Bray Head or along the riverside at Waterford. Beds of *stratified* rock have been disturbed in this way again and again in the history of any country, for we find one series of rocks laid down on the uptilted and weathered edges of another series, and both these series uplifted, attacked by denudation, and perhaps again submerged

At Waterford, for instance, the purple-grey sandstones known as the Old Red Sandstone lie in thick beds across the upturned older slates. Above Leenane, in County Galway, some of the oldest rocks of Ireland are overlain in a similar way by strata older than the Old Red Sandstone. Hence Ireland was twice under water and twice lifted up again high and dry before even the Old Red Sandstone was laid down.

During such movements, molten matter may ooze in from hot places in the interior of the earth. Cracks may open in the surface, and *volcanoes* may appear, spouting forth gases and fragments of rock, and sometimes sending out the molten matter as *lava-flows* across the land or the sea-floor. Where an earth-fold has been arched up and molten matter has risen beneath it, this matter may cool very slowly under the arch, instead of breaking through and forming lava. It will then become crystalline; the various mineral substances that it contains will separate themselves out as the well-shaped bodies known as crystals, and the resulting

rock will be tough and resisting, and will often stand out on the earth's surface when the strata that formerly covered it have been removed by denudation.

Rocks that have cooled from a molten state, whether as lavas or underground crystalline masses, are styled *igneous*, from *ignis*, "fire." They play an important part in the building of a country such as Ireland. The dark lavas of Antrim, known as *basalts*, and the crystalline granites of the Mourne Mountains and the Leinster Chain, are alike igneous rocks.

Moreover, the strata themselves may become altered and crystalline by the heating and squeezing that they suffer during movements of the earth's skin, and during their invasion by molten rock from below. Clays and shales in this way pass into the gleaming rocks styled *mica-schists*. The shining platy mineral mica, which is found also in granite, develops in them and forms the great part of the resulting mica-schist. Limestones become changed into crystalline marbles, losing all traces of any shells or corals or remains of other animals that they may have contained. Strata may be penetrated by sheets of molten granite, and become changed into layers of schist, which have layers of granite between them. Granite itself may be crushed and squeezed by earth-movements until it has a streaky structure, almost like a schist. These coarsely streaky crystalline rocks are known by the old Saxon name of *gneiss*.

In Ireland, then, on the edge of a continent formed of all this variety of materials, we may expect to find many types of rock, and many kinds of scenery carved out from them by the weather. Moreover, on the edge of the great ocean that stretches westward, we may expect to find successive records of overflowing by sea-water and recovery of the land. The present outline of Ireland is due both to sinking and upheaval. In some parts, moreover, the sea is rapidly changing the form of the coast, by undermining hard rocks or washing away soft shores of clay or sand.

Where the edge of a country has been stationary for a long time in regard to the adjacent sea, a broad stretch of sand and mud is formed by the material that is washed down from the coast. If an uplift occurs, this gently sloping border appears above the sea and forms a *coast-plain*, on which the rivers run outwards from the land. The rivers cut new channels in the coast-plain, and tend to deposit the material again in the sea as they emerge on the new margin of the country. No large coast-plain exists at present on the Irish shores. On the other hand, when a country is lowered, the sea flows in up the valleys that were cut by streams, and may penetrate far into the land. There will thus be a number of *drowned valleys* on the coast. A few peaks of the sunken land will now appear off the shore as islands. These features occur frequently in Ireland.

Since the land swings up and down, even while it is sinking or rising on the whole, *raised beaches* may be found on the sides of inlets of the sea. These beaches contain shells like those in the water near at hand, and lie well above the present sea-level, perhaps a hundred feet or more. They show that the submergence was once greater than it is now, and that there has been a recovery which was sufficiently rapid to carry the beach upward and to allow the next beach to gather some feet lower down. If the movement had been very slow, a continuous beach would have been formed, stretching from the top of the uplifted portion down into the present sea. An earthquake in Alaska in 1899 raised a part of the American coast as much as 47 feet in a single stroke. Rapid uplifts or downsinkings of a few feet at a time have very likely taken place in Ireland.

The Climate of Ireland in Past Times.

.....Snow falls more often in northern Ireland than in the south, and it falls still more often and lies longer in the Scottish Highlands, and still more often, again, in Scandinavia and Spitsbergen. Near the poles, the sea itself is frozen all the year round. If from any cause the temperature of the whole earth could be lowered, the frozen sea would extend farther south in the northern hemisphere, and farther north in the southern hemisphere, and the snowy regions would also spread towards the equator. Ireland might become so cold as to be covered by snow throughout the year.

At the same time, a still deeper mantle of snow would gather in Scandinavia, and would also grow and grow in thickness. At last it would be so thick that its lower parts would be squeezed into solid ice and would be pressed out as great ice-streams or glaciers spreading into other lands. In Ireland also glaciers would form, and would flow slowly down the valleys, as they do to-day in the higher parts of Switzerland. If the cold time continued, the ice-masses would join one another in the Irish lowland, and would form a great continuous mass, squeezing out somewhere to the sea. But the same conditions would affect all northern Europe, and the ice from various places where the snowfall was greatest would meet in huge sheets and cover a great extent of country. It is difficult to imagine such a thing as occurring in our temperate lands to-day.

Yet an *Ice-age*, called in bigger terms a *Glacial epoch*, actually occurred about the time that man was beginning to establish himself in Europe. Its effects in Ireland were so profound that we must consider the climate of the country in the past as well as that of the present day.

Whatever was the cause of the cold age, it no doubt came on gradually, and gradually passed away. Sometimes, moreover, warmer years set in, and for a time the snow and ice melted from the lower grounds. But in Ireland, when the cold was greatest and most continuous, glaciers covered the hills and plains alike. The gathering-ground of the snow was mainly between Galway and Lough Neagh, and ice spread northward and westward and southward from mountainous masses of snow that became piled up in this region.

The Scottish Highlands also sent down ice that invaded the north and east of Ireland, and the ice from Scandinavia crossed the North Sea and invaded the east of Scotland and of England. Under these circumstances, the warm south-west winds from the Atlantic probably ceased to blow. The Atlantic itself was colder ; moreover, the heavy cold air over Ireland forced itself out seaward.

The Irish region by that time had long been exposed to weathering. Its surface was covered with deep soils and with blocks that had fallen from the hills. The rocks at the surface became still more broken up by the frequent frosts that set in as the Ice-age grew. The glaciers gathered all this loose material into their lower parts as they spread across the country. With this burden of clay and sand and stones, they scratched the rocks beneath them and wore down and smoothed whole mountain-sides. By movements within the ice, the blocks became also scratched and rounded. When the ice finally melted away, masses of loam full of scratched stones were left on the surface of the country. These are known as *boulder-clays*. The limestone blocks in them show the scratching especially well. Where the boulder-clay was irregularly arranged in the great glaciers, it melted out in the form of round-backed hills, about 100 feet in height, which look something like great pigs lying down. These are known by the Irish name of drumlins, which was chosen for them by the geologist Maxwell H. Close. Sometimes huge transported boulders have been dropped down on rock-surfaces of quite another character, like the Cloghvorra, east of Kenmare, which is a mass of limestone resting upon Old Red Sandstone. Material carried in or on glacier-ice and left behind when this has melted is known by the general name of *morain*.

As the ice age was passing and the glaciers grew thinner, they melted from their bottom surfaces against the warm earth, as well as from their tops against the air, and rivers ran in cracks and channels beneath the ice-sheets. Stones fell out of the ice into these channels, and were rolled along as pebbles. When the ice disappeared, the lines along which the streams flowed remained marked by ridges of sand and gravel, winding like the former courses of the streams beneath the ice. These ridges are now usually covered with grass, and roads are sometimes carried along their crests. They are called eskers, another Irish name, and are often known as “green hills” in the country. There is an old village named Esker, built on hillocks of glacial gravel, west of Dublin. The eskers in Roscommon and King’s County run like great walls across the country.

The boulder-clays rest upon scratched surfaces of rock, showing that they were laid down out of ice-sheets that moved over the land. In the Arctic regions at the present day, we find glaciers of this kind, full of stones and boulders in their lower layers. In Spitsbergen they may be seen coming down from heights of three thousand feet into the lowlands, just as they once did in Ireland, and spreading out into the sea. Where they have melted back, they have left masses of boulder-clay, exactly like that which we find so commonly in Ireland. The pebbles of limestone and shale in these Arctic boulder-clays show smoothing and scratching like those of the clay-pits in the Irish plain.

While the ice-sheets were melting from Ireland, floods of water were produced, which washed the fine clay out of many of the boulder-clays and often left only a sandy *gravel* on the surface. The water spread out these gravels in layers ; but the scratches on the stones often remain to prove that they were once held in the ice. Such gravels are seen on the sides of the Dublin Mountains and over a large part of the county of Wexford.

When a milder climate returned, forests of fir and oak grew in Ireland ; but wetter years set in from time to time, and the mosses that love watery places spread and flourished until they formed peat-bogs, both in the plain and on the hills. Many of the bogs in the lowlands arose from the choking up of lakes. At present the climate is again drier, and much of the mountain-peat is being stripped off from the higher ground by wind. Here and there you may see a little patch of peat remaining on the top of a great ice-borne boulder, which was once buried in the bog, and which has now come to light by the wasting away of the dry peat round it.

To understand, then, what we see on the surface of Ireland, we must understand some of the changes of climate in the past...the district where Ireland now lies was at one time beneath the sea and was at another time united with the Continent. Its present climate depends very much on its surroundings, and here again we have to think of Ireland as part of the great and ever-changing surface of our globe.

The Mountains.

Although the sea has covered Ireland at various times, and has laid down successive beds of rock, the weather has been so long at work upon the present surface that the groundwork of the country lies revealed. Even on an ordinary map, two distinct groups of mountain ridges can be traced. One group runs from south-west to north-east. It includes Slieve Gamph, the “mountain of storms,” from which the rain descends on Swineford and Collooney ; the Glendowan and Derryveagh Mountains in Donegal, with the great glen between them ; the ridge of granite and slate from Newry to Slieve Croob in the heart of Down ; and, most strikingly of all, the great Chain of Leinster, running from Dalkey for seventy miles to the junction of

the Barrow and the Nore. The second group runs from west to east, and gives us the Galtee Mountains, Macgillicuddy's Reeks, the steep heather-covered promontories that jut out into the Atlantic from the west of Kerry, and the Knockmealdown and Comeragh Range, which is cut off steeply by weathering north of Dungarvan.

The south-west and north-east group of mountains is made of older rocks than those of the east-and-west group. The ground of Ireland was already crumpled before the southern folds were made. Hence we find mountains belonging to the later group which interestingly follow the lines of the older group of hills. North of the Galtee Mountains we have the long upland of Slieve Felim, the Devil's Bit, and Slieve Bloom, stretching from south-west to north-east, but belonging, as we know from its rocks, to the later group of folds. The plateaus of the coalfields of Tipperary and Leinster follow the same general direction as the far older Leinster Chain

The hummocky ground from Longford to the coast of Down is a sort of expansion of the Newry and Slieve Croob range, and belongs to the older group of folds. The same rocks run on across the Channel as the Southern Uplands of Scotland.

The later group of upfolds is very largely made of the hard and resisting rock known as the Old Red Sandstone. The grey limestone of Ireland, known as the Carboniferous Limestone, [1] once lay across the ridges, and was folded with the Old Red Sandstone under it ; but it has been generally washed away from the higher ground, and remains only along the downfolds, in which the Suir and the Blackwater and other rivers run. Frequently, moreover, patches of the older slaty rocks appear in the midst of Old Red Sandstone hills ; the underlying floor of Ireland was bent up when these later folds were made, and the removal of the Old Red Sandstone from the tops of the folds allows the slates and shales to be attacked by weathering. These rocks give rise to clay soils, and the farmers thus cultivate basins, as it were, surrounded by barren sandstone hills. Such upland basins may be seen in the Ballyhoura Hills west of Galtymore, at Ninemilehouse in Tipperary, and in many of the domes of sandstone that appear in the great Central Plain.

The Central Plain and Hills left standing above it.—The Central Plain itself consists of Carboniferous Limestone, which has not been lifted sufficiently high to be dissolved by natural waters and washed away. The rocks have been crumpled, but they have been worn down nearly to a level surface, on which boulder-clay has been deposited during the Ice-age. For a long time the limestone was protected by later shales and sandstones, with coal-seams in the higher beds, which remain here and there as patches on its surface. The hills round Lough Allen stand up in this way ; and coal-seams are found on their sides at a height of 1,000 feet above the sea, showing how much coal has been lost by the long-continued weathering of the land. Another very striking mass is the plateau of the Leinster coalfield, lying between the Nore and the Barrow ; it is basin-shaped on its summit, and the highest crests are near its margins, with steep descents into the lowlands round about.

Igneous Country of the North-East.—The fine hill of Slieve Gullion, between Dundalk and Newry, and the neighbouring summits of Carlingford and the Mourne, are due to the intrusion of igneous rocks long after both the main systems of folds had crumpled Ireland. They are among the youngest additions to the structure of the country. The high plateaus of Antrim and the east of Londonderry are of the same age as the Mourne Mountains. The country hereabouts was at one time covered by a sea which laid down a pure white limestone known as chalk, formed of immense numbers of tiny shells. Then this white limestone was uplifted, volcanoes broke out, and the region was deluged with the dark lavas called basalt. As these flowed over the surface in a molten state, sheet after sheet covered one another, filling up the hollows, and producing a fairly level plain. Here and there, as at Slemish, the

fine steep hill on which St. Patrick fed his master's sheep, we find relics of the volcanoes from which the molten lavas spread.

When, in their turn, the lavas were uplifted, the edges of the plain were bent up on the east and on the west, and the central part was dropped as a broad basin. The River Bann, flowing through this from the Mourne Mountains, flooded the lowland and produced Lough Neagh, the largest sheet of water in our islands.

The upturned edges of the basalt were weathered into fine steep crags, facing outwards, and forming grim black cliffs, which rise above Belfast Lough and continue from the Giant's Causeway to Lough Foyle. Except for the hard masses that here and there fill the throats of the old volcanoes, there are no true mountains in this lava-covered country of the north. The highest land occurs along the edge of the great basaltic basin, and from it the ground falls in broad plateaus until we reach the level of Lough Neagh.

Contrasts in the Landscape.—The structure of Ireland, then, provides delightful contrasts in her scenery. The worn-down limestone of the plain lies against far older hills. Even the plain itself has an interest, when we think how it has emerged from a sea that covered nearly all the country. The grey cloudy skies, with the long sun-gleams shining through them, spread away to the horizon, above broad stretches of brown bogland. Here and there a green esker runs like a wall across the landscape, and reminds us of the colder times when the lowland was covered with sheets of ice. In Cavan and Monaghan the hummocks of the drumlins rise a hundred feet or more out of the plain, and the streams have to find a way between them, while the hollows are set with gleaming lakes. On the edge of the country we find the mountains, and from them, to north or south or east or west, we look out to the great horizon of the sea.

The Breaking in of the Atlantic.—As we have said, Ireland was not always an island. The west coast cuts right across the east-and-west group of earth-folds, and the North Atlantic has been produced by the sinking of old land. When we examine the map, we are struck by the straight line of the north edge of Mayo, and by the parallel line of the south coast of County Galway. The latter line is continued by the low ground from Galway town away to the east coast at Dublin Bay. These look very like earth-cracks ; and the edge of Ireland has no doubt been shaped by the dropping of parts of the older country beneath the sea.

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The Rivers of Ireland

When a country is lifted above the sea, as a plateau or as a mass of folded hills, the weather works away at it, the water gathers along certain weaker places, and streams run on its surface in valleys which become deeper as time goes on. The rivers in a large part of Ireland run southward. The land at one time must have had a southward slope, when many of the mountains that now stand out on it were hidden away under rocks of younger age. The rivers carved out long valleys, but at the same time removed the younger rocks. Helped by the smaller streams that ran into them, they widened their valleys to such an extent in the limestone plain that it is now difficult to see the division between one valley and the next. Since the waters can dissolve the limestone, the rivers often spread out on it as lakes, which are merely flooded portions of the plain. Lough Corrib stretches away from Oughterard like a sea, with little flat-topped islands in it, but, where it runs back into the mountains of old crystalline rock, it has steep walls and quite a gloomy aspect. Similarly, the rivers have steep-sided valleys where they cross the folded ranges, like the Shannon at Killaloe or the Blackwater from Cappoquin to Youghal. These rivers once ran on land that was higher than the present summits of the ranges. They cut down through this land, and found, as it were, the

ribs of an older Ireland underneath. They cut slowly into these ribs, removing the soft rocks between these obstacles at the same time. The result now is that the rivers run through the mountain-ranges, as if they had climbed across them, and had worked out their valleys like a saw. As a matter of fact, the rivers made these valleys when their heads and the upper parts of their courses lay on rocks that have been entirely washed away.

While the old mountain-bars, the ribs of Ireland, were appearing from beneath the younger rocks, they stood up more and more above the general surface, and gave rise to rivers of their own. Numerous streams thus flow down from both sides of the Leinster Chain, while streams run north from the Galtees into the Vale of Aherlow, and south on Clogheen to form the Tar. The streams from the northern slope of the Slieve Bloom Mountains fall into the Shannon, while those from the southern slope reach Waterford Harbour by the Nore.

The drowned valley of Cork Harbour and that of the Blackwater below Cappoquin are parts of the old system of rivers that ran from north to south. [2] The carving out of valleys by their tributaries along the bands of limestone in the downfolds of the southern ranges has, however, cut up and destroyed the surface over which their upper portions originally ran. The best remaining examples of the north-and-south rivers are the Shannon, the Nore, the Barrow, and the Slaney.

The Shannon.—The Shannon rises in the water condensed on the high moors of Cuilcagh, nearly 2,000 feet above the sea, and drops 1,800 feet to Lough Allen, among gloomy hills. When it runs out of the lake, it wanders among drumlins away into the limestone plain. There is now nothing to check it. Formerly it must have run in a great valley between walls of shale and sandstone ; these rocks have been worn away, and only the underlying limestone floor remains. In its long course southwards, it is often difficult to distinguish the river from the lakes. The water of *Lough Gara* and *Lough Key* joins it in a broad stream above Carrick-on-Shannon, and it soon widens out as *Lough Boderg* and *Lough Bofin*. Near Roscommon town the Shannon becomes known as *Lough Ree*, which sends up a broad branch, also on grey limestone, to the north-east. This branch is in reality the flooded valley of the *Inny*, coming down from the watershed of slaty rocks in central Cavan, and broadening out as *Lough Sheelin* and *Lough Derravaragh* on the way. The fine wide water of Lough Ree sends the Shannon on its course as a noble river at Athlone.

Then comes a winding stretch down to Portumna, with frequent grassy islands. The *Suck*, which rises far north near Castlereagh, and runs down parallel with the Shannon, comes in above Banagher, and adds a great flow of water from the plains of Galway. The Shannon valley at Portumna, between Slieve Aughty and Slieve Bloom, has a width of forty miles. In *Lough Derg* we find the remains of the older and narrower valley, for the river has not been able to sweep away the Old Red Sandstone and slate on either side. At Killaloe there is a picturesque passage through the hills. The drop to Limerick is fairly steep, producing the foaming rapids of Castleconnell, which prevent the steamers that run from Banagher from coming farther south than Killaloe. At Limerick we reach the drowned part of the valley, where the dropping of the west coast of Ireland has let the Atlantic run for fifty-five miles up into the land. The grain-ships from South America can thus be berthed at the city quays. The Norsemen in old days found in these quiet waters something like the long sea-inlets of the Atlantic coast of Norway.

The Nore.—The head-waters of the Nore lie in Slieve Bloom and in the north end of the Devil's Bit range. Thence the river follows the old southward slope of the country, and it has cut through the sandstones and shales of the Leinster coalfield, separating the coal-bearing beds of Slieve Ardagh from those of Castlecomer. Below Thomastown it runs in a narrower valley in the hard Old Red Sandstone and the older shales, and at New Ross the Barrow joins it at the head of a long inlet of the sea.

The Barrow.—The Barrow starts at the north-east end of Slieve Bloom, runs eastward to Monasterevan, and is there joined by the *Figile* and the *Slate Rivers*, coming down from the great bogland to the north. The Figile and that part of the Barrow which lies below Monasterevan form in reality the main southward-running stream, and this has cut its way down to the limestone between the Leinster coalfield and the Leinster Chain. It runs below Goresbridge right across the granite of the chain ; with the moorland of Blackstairs Mountain rising high upon the east, and Brandon Hill, 1,500 feet above the stream, upon the west. New Ross has been built at the head of the long sea-inlet that now represents the valley of the united Nore and Barrow. The channel of Waterford Harbour, widening out southward, was thus originally due to the cutting power of the rivers coming down from central Ireland.

The Slaney.—The Slaney rises on the slates and shales on the west side of the Leinster Chain, but evidently it once was much longer and came from ground now worn away. It cuts boldly into the granite, like the Barrow, making a passage in which the mountain-town of Tullow lies. At Newtownbarry it is out on the slates and shales of the east flank of the chain, and has made a pleasant valley, partly under rocky cliffs, to join the sea at Wexford.

The Suir.—This river is a long tributary of the Nore and Barrow valley, which it joins in the sea-inlet east of Waterford. Sea-going steamers come into Waterford, and lie close against the houses at the quay. The Suir stretches back in a beautiful valley, which has been carved out along a downfold of the Carboniferous Limestone, and its head-waters come down from the great plain near Templemore. For the first forty miles of its course it is thus one of the southward-running streams, and at one time, before the plain was worn down and lowered, it may have escaped over the Knockmealdown region to the sea. The *Tar* and the *Aherlow*, on the south and the north side of the Galtee range, show how the streams have found their easiest courses along the limestone downfolds, leaving high ridges of the Old Red Sandstone between their valleys.

The Blackwater.—There are several rivers bearing this name in Ireland ; but the largest is that which rises in the upland a few miles east of Killarney, and runs eastward to Cappoquin. At Millstreet it gets into a narrow limestone downfold, and follows this through Fermoy and Lismore. The towns have been planted close above the stream, on wooded banks which rise steeply towards sandstone moors. At Cappoquin we find that all this long stretch of river is really a tributary of one of the old southward-running series. The stream turns suddenly to the south in a picturesque and narrow valley carved right across the earth-folds. The Bride comes in, running from the west along its own special downfold ; and the lower reach of the Blackwater valley is now drowned, so as to admit the sea from Youghal to Cappoquin.

The Lee.—The headwaters of the Lee, rising in the far west of Cork, not far from Bantry Bay, have long ago washed away the covering of Carboniferous Limestone, and the river flows eastward over Old Red Sandstone moors to Crookstown. The romantic little lake of Gouganebarra, overshadowed by steep rocks, and the more open lakes of Inchigeelagh, form part of its upper waters. Below Crookstown, however, it gets into one of the ordinary limestone downfolds, and its lower part, drowned by submergence, forms the fine harbours of Cork and Queenstown. The coach-road from Bantry to Cork gets into the Lee valley near its head by the narrow pass of Keimaneigh and follows it throughout its length. The railway has chosen the same convenient hollow up to Macroom,

The Bandon.—The Bandon has the same history as the Blackwater and the Lee. The main part of the stream is a long westward-stretching tributary, and the short lower reach, entered by the sea, is part of an old southward-running stream. In this case the drowned valley gives rise to the winding and steep-sided harbour of Kinsale.

The Liffey.—The Liffey, and its very important tributary, the *King's River*, run north-westward from the high moor of the Leinster Chain, and perhaps once escaped in the same direction into the plain. At present, however, the water is drawn off southward along the freshly-cut gorge of Pollaphuca, south of Blessington, where, the torrent is still working its way down among the slaty rocks. When it reaches the limestone plain, the river wanders along the edge of the Bog of Allen, and finally reaches Dublin Bay. At Leixlip (the Norsemen's name for the "Salmon Leap"), it falls over steps of limestone, and below Lucan it has cut its present channel deeply down into the boulder-clay of the Ice-age. The *Dodder* rises near the Liffey, on the other side of Kippure, and flows north-west and then north, so as to fall into the Liffey at Dublin. The two streams thus have very different lengths.

The Bann.—There is a River Bann which runs in Wexford parallel with the Leinster granite, and which forms a tributary of the Slaney. The larger River Bann lies, however, in the north, and runs off the granite domes of the Mourne Mountains into the great basin of *Lough Neagh*. Banbridge, on the old Newry and Belfast road, is named from it, and Portadown has grown up on its banks in almost level land. The river flows out of Lough Neagh at Toome Bridge, which is noted for its eel-fisheries, and forms a smaller lake, appropriately named *Lough Beg*, amid grassy meadows ; it then continues northward in a broad valley to the sea below Coleraine.

The Erne.—The head of the Erne lies in the county of Longford, where it runs northward from the low ridge of slaty rocks, just as its near neighbour, the Inny, flows southward as part of the Shannon system. Directly it reaches the limestone, which here remains on the north slope of the slates, it widens out as *Lough Gowna*, and then makes a tangle of branching and winding water-ways, known as *Lough Oughter* and *Upper Lough Erne*. Numerous drumlins were here dumped down on the country as the last glaciers melted away, and these mounds have often blocked the old courses of the rivers, and have sent them off in curves between the rounded hills. Belturbet is built on the Erne, south of Upper Lough Erne, and Enniskillen occupies a similar position above *Lower Lough Erne*, one of the finest lakes in Ireland. The Carboniferous rocks form a steep slope, crowned by cliffs, along the south side of this lake, reaching up towards the still higher hills in which the Shannon rises. At its outlet from the lake, the Erne meets the old crystalline rocks that stretch down from Donegal. It runs in fine rapids through a little gorge at Belleek, drops over a fall at Ballyshannon, and so enters Donegal Bay. These rapids and falls at the end of the stream, like those at Leixlip near Dublin, at Ballysadare near Sligo, and at Castleconnell on the Shannon, are due to a general uplift of the country, which gives the rivers fresh work to do in cutting down their valleys to the level of the sea.

Many other rivers, like that in the wooded Ovoca valley, or the Moy, which runs parallel with Slieve Gamph and then cuts across the south end of the range, deserve description as among the most interesting features of the Irish surface. Some are very old ; others are evidently quite young and not yet certain about their courses. It seems to matter little whether water finds its way from the bogs of the great central lowland to one side of Ireland or the other. The Shannon makes a line of division between east and west, and it is probably drawing more and more water into itself as it lowers its valley by solution of the limestone floor.

Man, wherever he lives, wants water. Though in old times he had to protect himself from his neighbours by building castles upon hills, he placed his settlements by choice upon the banks of streams. The stream-cut valleys provide, moreover, the easiest ways along a country, and the great roads in many parts of Ireland have grown up from the trampled riverside tracks along which prehistoric peoples moved.

The People and Industries of Ireland.

The Celtic people who invaded Britain and Ireland from central Europe about 600 B.C., bringing with them a knowledge of iron, no doubt produced a powerful impression on the language, and the latter in time spread, as we have seen, up into the highlands of Caledonia. Though the Romans never invaded Ireland, numerous sea-faring rovers from time to time made settlements on its shores. A mixed population developed along the coasts, and there is no doubt that these hardy races brought strong blood with them to mix with that from the Mediterranean and the Celtic lands. The Normans in the twelfth century overran the country more completely than their relatives, the Danes and Norsemen, had ever done ; they brought into Ireland customs and modes of thought acquired in the Roman lands of Europe, and they soon became closely attached to the island which they first had conquered with the sword. In the same way, later settlers who crossed from England into Dublin have felt themselves devoted to Ireland, and the fact that the country is an island marks it out more clearly as the fatherland of those who are born in it than England is marked out from Scotland or from Wales.

At the same time, the whole history of the land before man entered it shows that Ireland is closely related to the British Isles and Europe. The development of steam traffic across the Atlantic has made it seem a simple matter for the men of Cork or Kerry to reach the United States ; but the daily business and commerce of Ireland are naturally with the sister island to the east. Close ties of kindred unite the people of the north-eastern counties with those of Scotland. The Norman and Norse folk in the east, mingled as they may be with older settlers, still remember northern Europe ; and the Mediterranean race, with its sympathy and natural refinement, which forms the foundation of all that we now regard as Irish, may well be proud of the adventurous wanderings that brought it to the outpost of the continent.

Just as the country has moulded the people in it, and has given us Leinstermen of the hills, farming folk in the great plain, and hardy seamen in the inlets of the west, so it has moulded their means of living and their trade. The absence of great coalfields has left the country poorer than southern Scotland or central England, but has spared it from the crowded life and smoke-laden skies that mark those wealthy lands. With an abundance of soil suited for grass and cultivation in the great plain, it is clear that agriculture must be the great industry of the country. Some of the earliest tales of Ireland relate to movements of cattle, and at the present day the immense requirements of England in the way of food-supplies provide a magnificent market close at hand. Although the area of land under cultivation has lessened, owing to the ease with which grain can be obtained from the European continent and America, the trade in cattle, butter, eggs, and even fruit is capable of still further development.

Flax is largely grown, especially in the north, to meet the requirements of the linen industry. *Barley* is usually in demand, owing to the distilling and brewing trades of the large towns. *Oats* seem less cultivated than in former times, in spite of their being suited to the damper climate of the west. *Potatoes* form an immense staple of food throughout the country, and are grown in a great variety of soils. Truly stiff unworkable clays, such as occur in some parts of south-eastern England, are practically absent from Ireland, and the immense mixture and distribution of material in the Ice-age have led to a wide prevalence of healthy loams.

Horse-breeding has been carried on with marked success in Ireland. Among the *cattle*, the small Kerry cow, with its remarkable production of milk, is probably the most specially Irish breed. *Sheep* are largely raised in the grasslands of the limestone region of Roscommon and eastern Galway. The great fields of the plain-land of Meath are mostly given over to cattle-grazing. Every county produces pigs, supplying material for the important bacon-industry, which is especially carried on in the south and west.

Fish can now be carried from the western ports by rail to meet the demand in England, and complaints are often heard that this demand is so continuous that fish cannot be had in Ireland where the population lives by fishing. In the same way, milk is often scarce where the export butter trade is flourishing. The *dairying industry*, thanks largely to the co-operative system, has grown enormously in recent years.

.....Belfast has adapted itself to the industry of *ship-building*, which now includes almost every branch of engineering and a number of highly artistic trades. *Linen* became important when the woollen trade of the country was practically suppressed by law, and it received much encouragement in return for the abandonment of wool. The climate is suitable for the growth of flax, and flourishing businesses have been established in almost all the northern towns. Cloth-mills are at work throughout the country, and the woollen homespun materials, which are especially produced in Donegal and Mayo, meet with a ready sale.

Where the population is scattered, a number of home industries have sprung up, the products being collected by buyers, who convey them to the towns. The homespun trade is thus carried on to a large extent on looms in cottages. *Lace-making* receives encouragement in the same way, and Irish lace and crochet-work have a wide reputation. Much of the sewing for the linen trade is done by workers in their own homes.

Ireland cannot be regarded as rich in minerals, though at one time *gold* must have been largely collected from the gravels near Woodenbridge in County Wicklow. A nugget weighing 22 ozs. was found here in 1795. *Copper* has been successfully mined on the Waterford coast and west of Castletown Bearhaven in County Cork, and boring may in time reveal further large bodies of ore in these southern districts. A number of iron ores were formerly worked when wood was abundant for smelting them on the spot. The bedded ores among the basalts of County Antrim are exported, and stores of nodular carbonate of iron remain in the Lough Allen area. The brown bog-iron ore is raised in places for use in the purification of gas. *Lead*, in the form of the common grey sulphide, frequently occurs in the limestone districts ; but mines are not now profitable.

Bauxite, a material looking like a clay, but very rich in alumina, occurs in layers associated with the iron ores of Antrim, and is mined at several places north of Belfast for the manufacture of alum. *Rock-salt* occurs in beds nearly 100 feet thick in the red rocks under the chalk near Carrickfergus. *Barytes* (sulphate of barium) is mined on the Leitrim and Sligo border and in the south- west of County Cork. A friable white earth known as *kieselguhr*, composed of the siliceous cases of minute water-plants, is dug from a considerable bed just beneath the soil at the outlet of Lough Neagh. It is used for bricks round cold- storage warehouses, owing to its slowness in conducting heat ; also as a polishing powder, and for a number of other purposes.

The *brick-clays* of Ireland often come from the boulder-clay ; but some of the old shales are artificially ground up again into clay, and good material is also found in the red strata of Belfast.

Ireland is rich in *building stones*. The grey Carboniferous Limestone and the yellowish sandstones of Mount Charles and of Dungannon have been largely used. Black *marble* occurs near Galway and Kilkenny, and red varieties are quarried near Cork. The streaky green serpentinous marble of the south of County Galway is greatly prized as an ornamental stone.

The nearness of the remarkable quarries in Wales prevents Irish *slates* from being widely used ; but slate has been quarried at Killaloe, at Valencia Island, and near Carrick-on-Suir.

The Irish *granites*, notably that of the Leinster Chain, have been freely used in building ; but the many handsome varieties among the older rocks of Galway and Donegal still await full development. The granite of the ridge near Newry is worked for setts, and also as a good grey ornamental stone.

Coal occurs in the north at Ballycastle, round Lough Allen, and at Coalisland, north of Dungannon, and there is still much to be raised from these fields. An immense amount of coal-bearing strata was worn away from the uplifted country even before the red sandstones of Tyrone and Antrim were laid down. A high and considerable coalfield remains, however, in Leinster between the Barrow and the Nore ; the material here is anthracite, containing less gas than that of the northern areas. An extension of this field runs westward into Munster ; but the few seams in the wide Carboniferous plateau in Clare and Limerick are not sufficient to encourage exploration.

Peat is justly valued as a clean and handy fuel by the peasantry throughout the country. It is possible that some of the large bogs in the plain may be used for the production of gas, and in this way for the driving of machinery to transmit electric power. Work in this direction is already being done near Portadown. A large part of the bogland in the west is connected with small holdings, and the possession of fuel on the farm tends to become of greater and greater value as the price of coal is raised.

Conclusion.

THIS little book is not going to end with a reference to the price of coal or of any other article. There are things in Ireland far more lasting than a hundred pounds in the bank or a good position in the market square. When we look at the hills and valleys, we cannot help thinking of the men and women who knew them also in the old times, who gathered wood in the forests to light their fires in ringed encampments, and who heard the wind blow round them from the sea, while they said to one another, " Here we have made a home." The tales of the old folk, long before history was written down, are full of the names of mountains and pleasant plain-lands, and of green raths placed above the streams. There was then much burning of homesteads, harrying of cattle, and clamour of heroes meeting at the ford. But the clearing of the savage woodland, the first tilling of the soil, the hands-grasp of friends, and the gracious arts of intercourse these things, scarcely noticed by historians, were moulding the fellowship of a people. Family by family, age by age, an Irish race has grown in Ireland. Through her eastern gate and her Atlantic harbours her people have gone out across the world ; but they look back to the green hillsides, to the white rivers widening into lakes, and the sweet air of the moorland, soft with rain. This book is written for those who learn and work in Ireland, and what they love best in her they will read into it for themselves.

[1] " Carboniferous" means " coal-bearing." Beds of coal occur in places above the limestone, and the name has become applied to a whole series of rocks, most of which contain no coal.

[2] This was first pointed out by J. B. Jukes when he was marking out the rocks on maps for the Geological Survey.

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