

# EXPLANATIONS

TO ACCOMPANY

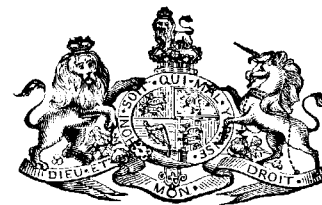
SHEET 144 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PARTS OF THE

COUNTIES OF LIMERICK, TIPPERARY, AND CLARE.



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The observations made in the course of the Geological Survey are entered, in the first instance, on the Maps of the Ordnance Townland Survey, which are on the scale of six inches to the mile. By means of marks, writing, and colours, the nature, extent, direction, and geological formation of all portions of rock visible at the surface are laid down on these maps, which are preserved as data maps and geological records in the office in Dublin.

The results of the Survey are published by means of coloured copies of the one-inch map of the Ordnance Survey, accompanied by printed explanations.

Longitudinal sections, on the scale of six inches to the mile, and vertical sections of coal-pits, &c., on the scale of forty feet to the inch, are also published, and in preparation.

Condensed memoirs on particular districts will also eventually appear.

The heights mentioned in these explanations are all taken from the Ordnance Maps.

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## EXPLANATIONS

OF SHEET 144, OF THE MAPS

OF THE

## GEOLOGICAL SURVEY OF IRELAND.

### GENERAL DESCRIPTION.

THE district included in this Sheet consists of a portion of the county of Limerick on the W., a part of Tipperary on the E., and a small tract at the N.W. corner of the map, separated from the rest of the district by the River Shannon, belonging to the county of Clare.

The principal places are the villages of Cappamore, Castleconnell, Caherconlish, Ballybrood, and Nicker, in the county of Limerick, and Newport, Doon, and Cappawhite, in the county of Tipperary.

#### 1. *Form of the Ground.*

The principal features of the district are, a broad group of mountainous hills on the N.E., and some lower and more broken hills towards the south, with a flat valley running between these two groups from the S.E. towards the N.W.

The high ground on the N.E. is part of a cluster of rounded elevations which has no general name, though a portion of them near the middle of the Sheet is called the Slieve Phelim Mountains, and other parts towards the S.E. are spoken of as the Bilboa Hills.

The whole might be named from their highest summit, which is, however, beyond the limits of this map towards the N., "the Slieve-kimaltha or Keeper Hill group."\*

They rise with long and gentle inclinations from the plain to heights of from 1,000 to 1,500 feet above the level of the sea, and as they recede from the lower ground gradually assume the form of swelling, and sometimes branching ridges, whose slopes are frequently more abrupt than those presented to the plain, and whose crests separate the waters of the five principal rivers which, with their tributaries, convey the drainage of the district to the Rivers Shannon and Suir. The line of watershed between the basins of these two last-named rivers enters the map near its S.E. corner, half a mile S.E. of Green-

\* Many years ago, perhaps during the latter part of the sixteenth, and up to near the end of the seventeenth centuries, these mountains were apparently known by the name of the "Twelve hills of Phelim ghe Madona;" but this name has fallen into disuse as a designation for the group, and the only vestige of it left seems to be the local name of the Slieve Phelim portion of the cluster.

Some outlines of these mountains, taken from the top of Pallas Hill, will be found in the *Transactions of the Geological Society of London*, appended to Mr. Weaver's Paper on "The Geology of the South of Ireland," in First Series, vol. 5, plate 7.—A. B. W.

field House, and runs northward along the high ground between the Multeen and Cahernahallia rivers, and then along the crests of the hills to the N.E., leaving the map about the middle of its eastern side.

The highest elevation in the ground included in this Sheet, is the summit of Mauher-slieve\* or Mother Mountain, which is 1,783 feet above the sea; but many of the lesser elevations, by which it is surrounded, have heights varying from 1,000 to 1,500 feet.

Some hills near Pallasgrean rise to a height of 742 feet, and near Caherconlish some others have a height of about 600 feet, while the lowest points within the district will be found where the Shannon passes out from the northern half of its western side at a height of not more than thirty-three feet. The water of the Shannon where it enters the map, is at an elevation of eighty-five feet.

The low ground in the valley between the hills near Pallasgrean and Caherconlish, and those which we have called the Keeper group, has a general height of about 100 to 150 feet above the sea, with some hills here and there, rising to between two and three hundred feet. It is drained by a large stream, the upper part of which is called the Dead River, while the lower is known as the Mulkear, falling into the Shannon at Mount Shannon, near Annacotty. A small portion of the district at the S.W. corner of the map sends its drainage westward and southward to other streams which run into the River Maigue, and through it into the Shannon, seven miles below, or to the westward of, the town of Limerick.

## 2. Geological Formations or Groups of Rocks.

### AQUEOUS ROCKS.

	Alluvium, Peat Bog, &c. Drift.	Colour on Map. <i>Sepia.</i> <i>Engraved dots.</i> <i>Indian Ink.</i>
<i>Carboniferous Formation.</i>	d <sup>5</sup> Coal Measures.	
	d <sup>4</sup> Upper Limestone.	
	d <sup>3</sup> "Calp," or Middle Limestone.	<i>Prussian blue (dark.)</i>
	d <sup>2</sup> Lower Limestone.	<i>Prussian blue (light.)</i>
	d <sup>1</sup> Lower Limestone Shale.	<i>Prussian blue &amp; Indian Ink.</i>
<i>Old Red Sandstone.</i>	c <sup>3</sup> Upper Old Red Sandstone.	<i>Indian red (dark.)</i>
<i>Lower Silurian.</i>	b Slates and Grits (Bala or Llan-deilo beds)	<i>Pale purple.</i>

### IGNEOUS ROCKS.

D. Greenstone.	<i>Dark crimson.</i>
P. Porphyry.	
Am. Amygdaloid.	
Ds. Greenstone Ash.	<i>Pale crimson with dots.</i>

\* Called everywhere by the peasantry, and generally known in the country by the name of Mauher-a-tlea, or the Mother of the Mountains.—A. B. W.

b. *The Lower Silurian Rocks* chiefly consist of a variety of gray hard shales and slates, among and associated with which, will be found numerous beds of massive quartzose grayish grit, which generally weather of a brown colour. The prevailing tinge of all these rocks is, however, a dusky olive on the outside, and they may be recognised from a considerable distance by their broken and rusty appearance. All the beds are much contorted, with their lines of strike running in various directions, as is evident from the variety of the directions and inclinations expressed by the symbols upon the map. It is, therefore, impossible to state, even approximately, their thickness, though this, from the large portions exposed, must be very great. Few fossils have been found in these rocks within the district included in this Sheet; but in their extension, eastwards and northwards, several have been procured, indicating a Lower Silurian age for the mass of the rocks.

c. *The Old Red Sandstone* stretches in an irregular band of varying width round the outside of the Silurian hills, on which formation it lies unconformably. It is composed in its lower parts of red coarse ferruginous sandstones, interstratified with many bands of pebbly conglomerate, which may in places be traced for considerable distances; and indeed it may be said that beds of conglomerate of one kind or another are never absent from any large portion of it.

In some places there are among its beds many which are highly calcareous, the lime being equally diffused through the rock; and in others, principally in the red shales, the calcareous element occurs in large nodules, or, as at Bilboa, in irregular blotches and veins in white sandstones, which are often conglomeritic.

All along this southern extension of the band, and for some distance eastward out of this map, the Old Red sandstone rocks are more than usually calcareous, being in some places banded with many very thin layers of calcareous matter, which in the red shales seem to take the form of concretions, and when weathered, often leave honey-comb-like cavities. The calcareous beds would seem not to occupy any definite horizon in the formation, but prevail most, perhaps, in its lower portion. These calcareous sandstone rocks are precisely like those described as cornstones in South Wales, and parts of England.

d<sup>1</sup>. *The Lower Limestone Shale* is only seen in one place in this district, and the transition from the Old Red upwards into the Limestone, takes place by means of earthy limestones rather than by the occurrence of any quantity of dark shales.

d<sup>2</sup>. *Lower Limestone.*—The lower part of this group consists of dark blue argillaceous crinoidal fetid limestones, which generally have shale or clay partings between the beds. These shale partings are sometimes of a red or purple colour, but are usually black or dark blue. With these are associated yellow and red ferruginous clays. These limestones often have thin veins of clay running in every direction through the mass of the rock. The beds above those just described, are, thin bedded, and full of chert. Above the cherty beds the limestone is of a gray or blue colour, usually magnesian; sometimes a dolomite, and generally massive, the bedding being rarely if ever distinguishable. When magnesian, the limestone is generally of a yellowish gray colour and sandy aspect; it is often mottled, the

magnesian parts being of an orange or yellowish gray, in streaks and blotches, through a dark blue ground. When a dolomite, it is orange or yellowish brown, and on rare occasions blackish, and always has a saccharoid texture. A few beds of interstratified contemporaneous traps and ashes are sometimes associated with the Lower Limestone. This division of the Carboniferous formation is believed to be about 800 feet thick, the lower part, up to the cherty beds, being 350 feet in thickness.

d<sup>3</sup> and d<sup>4</sup>. *Middle Limestone or Calp, and the Upper Limestone.*—(These two divisions of the Carboniferous rocks, though separable from each other in many parts of Ireland, are here undistinguishable, and will therefore be described together.) Above the Lower Limestone is a set of cherty beds that are well developed in the counties of Limerick and Clare, and have been taken advantage of, and used as the boundary between the Upper and Lower Limestones. These cherty beds are generally about forty feet thick, though in one place they have the unusual thickness of 150 feet. Large contemporaneous masses of igneous origin frequently come in just above them. Over these cherty beds, or where present, over the igneous rocks, are dark blue, sometimes black, fetid, argillaceous limestones, that generally have thin shale partings between the beds; these are in some places succeeded, as we ascend, by another group of igneous rocks, and these again by blue compact limestone. This limestone is usually in beds, that range from a foot to three feet in thickness. Near the top of it there are sometimes beds of shale. It is also magnesian in places, as will be seen in the *Detailed Descriptions*. The Upper and Middle Limestones, including the associated trappean rocks, are calculated to be about 2,000 feet thick.

d<sup>5</sup>. *Coal Measures.*—Here, as is usually the case in the South of Ireland, the lowest rocks in this group are black and olive argillaceous shales, with a few interstratified grits. These either lie on the blue limestone before-mentioned, or on the trappean rocks that have replaced it. Above the *Shale Series* is what has been called in other adjacent districts,\* the *Flagstone Series*, the predominating rocks being grits and flags. Over these are alternations of grits, shales, fire-clay, and clunch. These measures are calculated to be over 1,300 feet in thickness, which would allow of the lowest coal, called No. 1 in the districts before alluded to (see *Explanation of Sheets 142 and 152*), being represented. It is said to have been proved, but the place that was pointed out seems most unlikely for it to occur in, as it is too low down in the series. If coal is ever found here, it is nearly certain that it will be so thin—not more than six inches—as to be unprofitable, and not worth the expense of working.

D. *Greenstone or Diorite*; B. *Basalt*; † P. *Porphyry*; Am. *Amygdaloid*; Ds. *Trappean Ash*. Various igneous rocks, to which the above appellations have been given, are associated with the limestones.

\* For the detailed sections of the Coal Measure, see the *Explanations of Sheets 142 and 152*. Those sections of the Coal Measures are similar to those described there, that is for as much of the lower part of the Coal Measures as occurs in this district.

† The rock here called Basalt would be called Melaphyr by German geologists, and that spoken of as Trappean Ash has been mentioned as Spilites.—J. B. J.

The rocks called *Greenstone* and *Basalt* are often found so blended together that it is impossible to draw a line of demarcation between them. Other trap rocks occur which are in different places dark green, light green, light blue, dark blue, or reddish in colour, the last-named colour being often due to decomposition. Their texture is generally compact or fine-grained, with crystals of feldspar widely dispersed through the mass; other crystals are rare, and some even of those traps, which from their dark colour have been called *Greenstone*, seem almost entirely feldspathic. Some of these rocks pass imperceptibly into Porphyries and Amygdaloids, which have many varieties in the different localities in which they are met with.\*

The *Trappean Ash* is very various in aspect, ranging from a fine porcelain-looking rock to coarse breccias and conglomerates. They are purple, red, green, blue, brown, and greenish in colour; often calcareous, especially when of a blue colour. Some of them are a good firm stone, while others disintegrate when exposed to atmospheric influence. In the green ashes a spheroidal concretionary structure is of common occurrence, while the red are usually of a shaly nature, and the purple are hard and compact, often being good building stones.

*Drift.*—The drift in the low country consists, in a great measure, of limestone gravel, mixed with clay, although in some places there are deposits of fine "Rabbit Sand,"† which is entirely composed of siliceous particles, calcareous matter being rarely if ever found in it, although on all sides it is surrounded by the limestone drift. On the western slopes of the Keeper Hills, and in the valleys, there is also drift, which sometimes is of considerable depth. This drift, though supposed to have been formed at the same time as that on the low country, rarely contains enough fragments of limestone to entitle it to the name of Limestone Drift, but is remarkable for the quantity of Syenite fragments found in it. In a few localities, some of them far removed from the low ground, there are isolated patches so full of limestone boulders, that they are collected by the inhabitants of the neighbourhood for burning into lime.‡

*Bog, Alluvium, &c.*—The bogs and alluvial flats are very similar to those usually found elsewhere, and do not require a general description.

J. B. J., G. H. K., and A. B. W.

\* See note on the Igneous Rocks, in the *Explanation of Sheet 143*, page 9. A detailed chemical investigation into the composition of these varying trap rocks would be very interesting and instructive. Without it, it is impossible to guess the proportions in which the feldspathic are mingled with augitic or hornblende minerals, or even to decide on the nature of the feldspars themselves.

It is greatly to be regretted that the Geological Survey is often compelled to omit the discussion of subjects like these, and of other kindred topics which might have important scientific or practical results, for want of an officer with the requisite chemical knowledge and skill, whose duty it should be to submit the various rocks collected to chemical examination.—J. B. J.

† So called, as it is loose enough for rabbits to burrow in. It seems to be a common country term in Ireland.

‡ When the limestone is found in the drift it is locally called *Running Limestone*.

### 3. Relations between the form of the Ground and its Internal Structure.

The most elevated and central portion of the mountain country occupying the north-eastern quarter of the map, is composed of rocks belonging to the Lower Silurian formation.

The outer slopes of the mountains, and some of their lesser elevations overlooking the low country, are formed of the Old Red sandstone formation, which rests unconformably upon the Lower Silurian, and where the slope of the ground is gentle, frequently runs upwards over the lower rock, to elevations of twelve, and even fourteen hundred feet above the sea.\*

The rock under all the low country belongs to the Carboniferous limestone, which rests conformably upon the Old Red sandstone. Of this limestone also, many of the smaller hills which rise from the plain, are composed, as for instance that of Knockouragh, south of Doon, and others in the vicinity of Cappamore, but much of the higher ground near Pallasgrean, Caherconlish, and in that neighbourhood, as well as some isolated elevations between them and Castleconnell, is formed of the associated igneous rocks. These igneous rocks occur either as a component part of the hilly ground on which they are found, or form small isolated hills in the limestone country.

The trap rocks being of a harder and tougher nature than the limestones with which they are associated, have yielded less regularly and rapidly to the actions of erosion and denudation which have affected both since they assumed their present position, and consequently now appear in the form of hills, which have generally more broken and abrupt outlines than the hills on the N.E., although so much inferior to the latter in altitude.

Overlying all these, and making steep hilly ground in the neighbourhood of Ballybrood, occur some beds of Coal Measures. Thus we find that here, as elsewhere, in the South of Ireland, the Coal Measures form higher ground than the adjacent Carboniferous limestone.

The relations of the groups of rock will be at once seen on referring to the subjoined section,

\* The country formed of this Old Red sandstone, wherever that rock has a large surface exposure, may be easily recognised by its more lengthened slopes, frequently terminating in abrupt escarpments looking towards the hills, as well as by a general rugged, heathery, and barren look, distinguishing it from the Silurian hills, with their rounded outlines, and smooth grassy surfaces.—A. B. W.

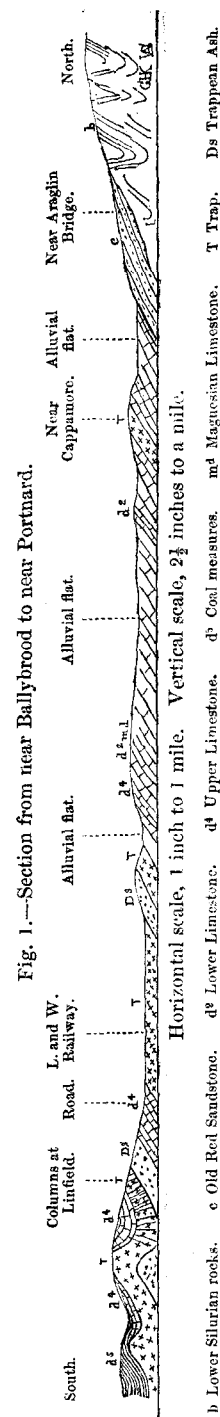


fig. 1, taken from the Coal Measures near Ballybrood, to the Silurian, near Araglin and Portanard bridges, north of Cappamore.

During the Silurian period, the sea deposited chiefly beds composed of mud or other minute particles, and some of these, from the regularity, parallelism, and fineness of their layers, lead to the supposition that the part of this sea in which they were precipitated was deep, comparatively still, and distant from any land. Associated with the mudstones, however, are some thin, ripple-marked grits, and many beds of very thick, hard, and compact siliceous sandstone, both of which point to the existence of occasional currents in this sea.

The organic life of this period is not largely represented in the district; but some tracks, supposed to have been left by molluscs on the surfaces of some of the finer beds, and some small crinoidal fragments embedded in coarse, slightly calcareous sandstone, have been found, and will be alluded to further on.

An interval occurred between the deposition of these rocks and those which now overlie them, one which must have been immense, but which has left us no more definite means of measuring its duration, than the facts that subsequently to their deposition the Silurian muds were consolidated into rocks, raised from the bottom of the sea, brought under the eroding power of its breakers, worn and moulded into an undulating country, which was afterwards submerged again, so as to be covered by the Old Red sandstone.

As the tranquillity of deep water seems to have been the characteristic of the Silurian sea, so the agitation of shallow water appears to have characterized the succeeding one of the Old Red sandstone. That formation abounds in coarse, obliquely laminated sandstones, with many beds of conglomerate, containing pebbles of Silurian rock, and other finer, but still beach-like deposits, suggesting the belief that the water was, during its deposition, not only shallow, and set in motion by currents running in different directions, but that the shores of the Silurian country were not very distant at any time during its deposition. As very many of the sandstone beds are highly calcareous, particularly towards the S.E. corner of the district, it appears that lime was more than usually abundant in the Old Red sandstone sea of this neighbourhood.

During the Carboniferous Limestone period the sea appears to have been again comparatively deep and tranquil, and to have been inhabited by a multitude of mollusca, and other forms of organic existence, which contributed largely to the composition of the rocks belonging to this formation.

At some time during this period, however, outbursts of igneous materials took place at the bottom of this sea, proceeding from more than one focus of ejection.

Some of these materials may have formed cones, partly projecting above the surface of the water, from which were ejected the materials of which the ash beds are composed, and whose sides may have furnished the materials of some of the trappean breccias or conglomerates; but if such cones existed, they were worn down, and their materials strewn over the bottom of the sea before the next beds of limestone were deposited. Some of the trap dykes and intrusive

masses, like that of Maddyboy for instance, are probably some of the sources through which the contemporaneous traps and ashes reached the surface.

One of the submarine lava flows, if not more, certainly occurred while the Lower Limestone was being deposited; but the principal eruptions took place at two periods, one just after the time when the beds grouped as the Lower Limestone had been all formed, and another near the close of the whole deposition of the limestone beds. These outpoured flows of lava and depositions of ash now form two principal bands or belts of igneous materials, separated from each other by the interposition of a number of beds of pure limestone, having a thickness of several hundred feet, the upper trap belt being partially covered by the Coal Measures.

*Denudation.*—One action of denudation which operated prior to the deposition of the Old Red sandstone and Carboniferous rocks, has been already alluded to. Another took place long after the deposition of the very newest rocks which are to be found within our district, removing each succeeding layer of the rocks brought within its reach, as the ground rose from beneath the sea, until at last some of the Silurian country was again brought under its influence, stripped of its thick covering, and together with the rest of the surface of the district, received pretty nearly its present form. The still more recent action of the Drift period has since then modified and altered many of the features of the ground, and rivers have deepened many of their valleys, but it was by the second denudation, spoken of above, that all the leading features of the country were determined, and most of the superficial limits of the different formations fixed.

J. B. J. and A. B. W.

# DETAILED DESCRIPTION.

## 4.—Position and Lie of the Rocks.

[The western side of this district was examined by Mr. G. H. Kinahan; the eastern side by Mr. A. B. Wynne; and a narrow strip along the S. margin by Mr. J. O'Kelly.—J. B. J.]

*Silurian.*—The part of the district occupied by this formation sends three considerable brooks westward and southward to the low ground: they are called the Clare, the Bilboa, and the Cahernahallia rivers, and in the several catchment basins of these, the rocks appear at various places, which will now be described, commencing at that of the Clare river, and taking the others in the order in which they are mentioned above.

Upon ascending the Clare river, between the place where it enters the Old Red sandstone district and Vacluse Cottage, an exposure of the Silurian rocks occurs in its bed; they are hard olive and dark gray shales, apparently much contorted, and here and there seem to have been stained red by infiltration from the overlying Old Red sandstone, which ascends from the river a little to the west of this place, running upward and eastward along both of its banks, the places of its occurrence on each side of the stream becoming more and more remote from each other as they extend to the eastward.

The next place where the Silurian rocks are seen is in two small streams, tributary to the Clare river, which run from the county Limerick side northwards into it at a distance of about three-quarters of a mile eastward of the cottage above-named. They are hard gray slaty and gritty rocks, the bedding of which is not very evident in the most southerly branch, but seems to incline at low angles westward; while, where the two small streams unite, the same kind of rocks dip to the S. at 40° and 50°, and a little further down at 53° to the N.

Similar gray and gritty beds, some of which, however, appear to be more flaggy, are exposed near the Lackamore copper mines, on the opposite side of the main river from the place last alluded to. At the mines they consist of hard gray grits, with some quartz veins, and a little to the E., along the course of a mountain streamlet, they may be found much contorted, but still dipping eastward, at angles varying from 25° to 50°.

Further on some more streams unite and flow from the same side into the Clare river, passing by the place where the final letter of the parish name, KILVILLANE, is engraved upon the map. Just at this spot dips to the N.W. at 20°, and to the S.E. at 70° were observed in dark gray flaggy and shaly grit, that seemed to be strongly affected by a cleavage, the direction of which was not very apparent. Still smaller streams, which flow into this one from the townlands of Killeen and Knockacappul, exhibit various dips and angles in very much the same kinds of rock; and to the N. of this, some streams which fall into the Doonane river\* also expose gray grits, shales, and flagstones, the general dips of which seem to be to the northwards. They will be seen in the stream which passes by Toor Roman Catholic chapel, and in those eastward, as well as in the wood near Knockfune police-barrack.

Another tributary stream from the Slievephelim Mountains falls into the Clare river nearly opposite to that from Killeen above described; and at the upper parts of the streamlets which form it, the Silurian rocks, here consisting of the fine gray gritty shales so common in the formation, may be observed, together with some brecciated grits, where the most southern tributary leaves a steep ravine. The directions of the dips and their angles are concealed and confused by the united effect of concretionary, joint, and cleavage structures.

\* In Sheet 134.



Further up, the river makes a sharp bend, coming more from the northwards, and just here receives the streams from the country to the N., about the place where the Anglesey road crosses the watershed between this valley and that of the Bilboa river. These streams run through open hollows, whose inclinations are at low angles, and do not frequently expose the rocks; but they may be seen forming projecting bosses here and there, and occasionally in the brooks. They are of kinds similar to those already described, and their angles of dip, where seen, will be found marked upon the map.

Returning to the main river, and continuing to ascend its course, many streams will be found to join it both from the N.E. and from the southward; but the Silurian rocks are seldom exhibited by them, as they run chiefly through detrital accumulations. In one, however, near the Knockfune police-barrack,\* these rocks are well seen at intervals. They strike across the stream, and dip to the N.E. at angles varying from  $65^{\circ}$  to nearly vertical. Dips of  $35^{\circ}$ ,  $40^{\circ}$ , and  $50^{\circ}$ , in the same kinds of gray rocks, and towards nearly the same direction, occur at short distances from each other, scattered about this locality; but at the distance of nearly a mile S.E. of the barracks, where two streams join, the dips, in gray gritty shales, are all to the S. at  $65^{\circ}$  and  $70^{\circ}$ . Eastward of this latter locality the gray grits dip to the N.E. by E. at  $35^{\circ}$ ; and at a distance of somewhat more than half a-mile to the S.E., on the opposite side of the hill of Bealaclave, from where the dips of  $70^{\circ}$  to the S. occur, similar hard gray grits, having some cleavage, dip to the north and N. by E. at  $50^{\circ}$ ,  $60^{\circ}$ , and  $70^{\circ}$ . Some of these streams proceed from Mauheraslieve Mountain; they seldom show the underlying rock, except at considerable elevations; and, indeed, rarely even then. One dip of  $50^{\circ}$  to the eastward was, however, taken in that one which runs westward from near the summit close to where the G of ABINGTON is engraved on the map.

Many other streams have their sources near the summit of this mountain, and run to the N.E. and S.; but none of them afford good rock sections. Enough is, however, seen to show that this elevation is, like all those in its neighbourhood, composed of the Silurian rocks.

The Bilboa river rises near the N.E. corner of the map, in the neighbourhood of the villages of Coolacarra and Knockfune;† it then proceeds southwards and westwards between the elevations called Laghile and Knockastanna, receiving many tributaries on its way, to a place exactly three miles S.W. of the last named summit, where the Gortnagerah river—itsself a considerable stream—falls into it. Neither of these rivers afford a good geological section in the Silurians, so far as the main streams only are considered; the former, along its whole course from Knockfune southwards exposing these rocks in but three or four places, and then for short distances only; while in the latter they are not seen except at wide intervals.

In the smaller streams, however, which are tributary to these, the Silurian rocks may frequently be observed. They consist, in the neighbourhood of the Curreeneys, near Knockfune and Knocknascraggan, principally of gray grits and flags, with some beds of dark flaggy shale; and are sometimes concretionary. The dips are chiefly north or southward, sometimes inclining towards the E., and sometimes towards the W., at angles so various that no conclusion could be arrived at which would render it worth while to detail them here. From the positions and inclinations of the beds exposed along a mile of the Anglesey road here, between Knockfune and where it passes northwards out of the map, it is probable that at least four synclinal,

and as many anticlinal, convolutions occur within this short space; but the number may be even greater.

Following the course of the river the rocks may be seen by the streams on both the right and left sides which fall into it above the Roman Catholic chapel and National school east of Laghile. They consist of similar gray grits and slates and slaty-looking hard shales, with some very massive bluish gray grits south of Knockfune.

Further south, the river passes by Kilcommon police-barrack and beneath the Anglesey bridge. Eastward of this, along the N. side of the road, some exposures of the rocks occur; and in one of these, a small quarry close to where an asterisk will be found upon the map, some fine bluish and dark gray grits and indurated shales were found to exhibit peculiar curved and coiled tracks on the bedding surfaces supposed to have, at all events, an organic origin, if not to have been made by some small mollusc.

The tributary to the Bilboa river, which runs south of the road, conveys the water from a wide, open valley, which is chiefly occupied by bogs and detrital accumulations, almost everywhere concealing the rocks; but along the courses of the mountain streams which flow into this tributary, and particularly in their upper portions, the rocks are sometimes visible. They appear to be sharply contorted, and dip at high angles, sometimes towards the north, and sometimes in an opposite direction. They are in all cases similar to the mass of those already described. Two streams which leave the Mother Mountain, running southwards, curve round Laghile, and bending eastward, fall into the Bilboa river, one above and the other below the Anglesey bridge. In the most westward of these, the rocks appear at intervals, usually dipping in a southerly direction, at angles varying from  $10^{\circ}$  to  $40^{\circ}$ , except near the source of the stream, where they seem to incline generally northwards at an angle of about  $45^{\circ}$ . The rocks are of the ordinary kinds. Cleavage was observed to be well developed about a quarter of a-mile above the bridge by which the Anglesey road crosses this stream. Its strike appears to be nearly due E. and W., and it dips to the north at an angle of about  $70^{\circ}$ , crossing the bedding nearly at right angles. It is not often that cleavage is so well marked and clearly seen in this district as at this spot.

Westward of this several small streams are collected into one, which falls into the Bilboa near Cappahroe; and of these, such as are in the vicinity of the high road and near Dermot and Grania's bed expose the Silurian rocks in many places. By the side of that which crosses the Anglesey line, a short way from where the new road to Cappamore and Doon leaves it, some unusually dark gray or blackish slates were found, which weather greenish black; their cleavage has a direction of  $25^{\circ}$  S. of E., and a northerly dip at  $70^{\circ}$ , while the beds dip W.S.W. at  $65^{\circ}$ . A curious ripple-marked surface was observed on one of the bedding faces, along which there appeared to have been a slide of the beds; for the surface alluded to was covered, particularly in the hollows, by a slickinside layer. South of this, and near the road, the rocks are also seen; they dip W. and N. at  $40^{\circ}$ ,  $45^{\circ}$ , and  $50^{\circ}$ , and were observed to be intersected by cleavage, the planes of which dipped  $30^{\circ}$  W. of N.

Southward of this the rocks come to the surface at different places along the new line of road alluded to above; they will be found in the townland of Shanballyedmond, N.W. of Cappahroe, dipping to the W., S.W., and N.W., at various high angles.

The Aughcullish stream, which falls into the Bilboa river, N.E. of Knockastanna, gives a short section in gray and bluish grits, which undulate, dipping in various northerly and southerly directions, at angles varying from  $50^{\circ}$  to the vertical.

The above-named elevation, Knockastanna, sends several streams to the Bilboa; they appear to radiate from the summit, and many of them expose

\* Formerly a shooting-lodge of Lord Bloomfield's.

† This is not the same place as the Knockfune referred to already, which lies to the westward of it.



the Silurian rocks, which are similar in character to those already described; and their chief exposures occur in the townland of Curraghfoil.

Where the boundary between the counties of Limerick and Tipperary makes a sharp angle south of Cappahroe, some coarse gray grits are exposed in the river, and by a small stream which joins it just here after passing through a patch of natural scrubby wood.

Further south the river makes a bend where the R. of Bilboa River is engraved upon the map, and here there are three exposures of the Silurian gritty shales and grits; they dip N.W. at 40°, and S.W. from 15° to 80°; other dips are also seen, but they are not so clearly determinable as these. Some nearly vertical cleavage was also seen here striking 4° S. of E. Westward of this place several long streams run from the south slopes of the Slieve-phelim range, and eventually join the Bilboa river; but not until it has left the mountains entirely and passed into the low country. In none of these will any very instructive sections of the Silurian rocks be found; but they occur with their usual characteristics in the upper part of the streams, near Cullaun summit, and are seen more or less in all those which are engraved upon the map between that elevation and Portanard, lying to the S.W. Above the latter place they also occur projecting from the surfaces of the hills. In one place N.E. of the engraved *b* of the name *Owneybeg*, they consist of the usual kinds of gray grits and slaty beds, dipping to the E. at 35°. The cleavage here strikes 35° N. of E., and dips northerly at 70°.

Just S.E. of the letter above alluded to, a rocky ridge of hard Silurian beds crops out and strikes in a N.E. and S.W. direction. The dips seem to increase from 45° as the ground rises, until at the N. end they are nearly vertical.\*

These rocks seemed much harder than the generality of the Silurian beds; and their colour was also different, being, perhaps from infiltration, changed into a dull red.†

Where the Gortnageeragh river joins the Bilboa, the latter runs through rocky banks, exposing a junction between the Silurian and Old Red sandstone. As usual in such cases, the Silurian rocks are found to have a red tinge, probably derived from the overlying beds; they are otherwise similar kinds of grayish grits and concretionary shales to those which have been described above; and they seem just here to form part of a contortion dipping to the N.W. at 30° and 40°, and to the S.S.W. at 25°. From this place, ascending the course of the Gortnageeragh river, the rocks will be seen at intervals, both in it and at some distance on both sides of it. On the north the gray grits are principally exposed by quarries, &c.; but on the S. they will be found only along a new road, and in some streams which run northwards into the Gortnageeragh river: they are, as usual, fine gray grits and gritty shales. Where the county boundary, from the S., meets this river, some hard bluish gray grits and thin sandy shales dip S. at 70°. Above this, the river runs through bogs, exposing only a number of loose blocks of rock and the usual detrital deposits; but where two small streams fall into it, from opposite sides, S.E. of Nanny's cross-roads, some of the weathered gray slaty shales are exposed.

In the Cahernahallia river the Silurian rocks are seen only where it passes through a wood above Toomaline; but many of the streams which fall into it, from the N.W. and S.E., expose short sections in these rocks, among the best of which are two on opposite sides of the valley, one exhibiting a junction of the Old Red with the underlying beds at the south end of a small wood, and on that side of the valley. The Silurian rocks dip N.W. at 65°, and consist of gray grits and flagstones changed, as usual, to a reddish colour near their junction with the Old Red beds, which here dip, S. by E. at a low angle of perhaps nearly 5°.

\* A number of glacial striae were observed here striking N.W. and S.E.

† The Old Red sandstone occurs close to this place.

On the opposite side of the valley, and bearing nearly N. from the exposure last described, is an abrupt defile or ravine through which a short road runs S. of the *n* in Doon, branching from the main road in the glen, and turning first northwards, and then to the W. In this ravine a section of about a thousand feet of the rocks is exposed; they have an average dip to the N. of from 60° to 70°, and will be found to consist of dark bluish and olive gray grits, sandstones, and slates, nearly all of which appear to be slightly calcareous. Some of them are thin bedded and rusty looking, and oblique lamination on a small scale was observed in some, while others had a curious wrinkled kind of marking upon the surfaces of the beds; but, although the whole group had much the appearance of the beds in which the fossils of these rocks have been found, none were here discovered. The other places in this vicinity where the rocks are seen exhibit only the usual varieties.

West of Glengar house the Silurian beds appear in several places along the streams, by a road and near the boundary of the Old Red sandstone. In one place marked by an asterisk on the map, where a small quarry was opened, some hard pale calcareous gray grits were observed to contain small casts of the joints of crinoids.

This circumstance and the appearance of the rock seem to indicate that these beds are on the same geological horizon as some others of the group, lying far away in the extension of the district towards the N.E., and out of the limits of this map.

S.W. of this a stream, near the capital *L* of *Lisselint*, as engraved upon the map, runs over some sloping Old Red sandstone beds, and seems to have in one small spot cut through them, just exposing the hard, fine splintery, and altered looking, reddish gray shaly or slaty beds of the underlying Silurian rocks; but so little of them is seen that they can hardly be recognised, and their red colour, too, adds to the difficulty of identifying them.

A tributary to the Multeen river runs along the eastern margin of the map, by and underneath *Emonaknock's* *Grave*, and in it, as well as in other streams which fall into that river, the Silurian rocks are frequently seen. They do not, however, present a great variety of kinds, being of the usual gray, and dark olive, gritty, and shaly flags, grits, and concretionary shales, except in the most southern one, which passes by a small plantation. In this some reddish shaly beds, alternate with the others; and among those highest up in the stream, and near a junction with the Old Red sandstone, the red beds appear in the greatest number, and contain a bed of red hematite† three feet thick, lying between fine red grits and variegated shales, which are nearly vertical, dipping sometimes E., and sometimes W. at 80°.

In the lower part of this stream, the olive and gray grits and concretionary shales again prevail.

The Silurian rocks will be found in some few other localities which have not been enumerated above; but in these they are always of the usual and characteristic kinds.

A. B. W.

*Old Red Sandstone.*‡—In the northern part of this district, and about two miles to the N.E. of Newport, a partial section of the beds of this group occurs in the Mulkear River, due west of Oakhampton House, where yellow and reddish grits and clay rocks dip nearly west at 5°. From this down the river, to about 300 yards below Rock Vale Mills, alternations of red and yellow sandstones, grits, shales, and clay rocks occur; some of the grits are

\* Ned of the Hill's grave.

† Attention was called to this by R. Millett, Esq., c.e., of Milbrook House.

‡ The Old Red sandstone grits are locally called, regardless of colour, "brown stone."

This term is also often used for Coal Measure grits and Trappean ash.—G. H. K.

flaggy, some calcareous, and in a few, oblique lamination is well developed. They all dip W. at angles, varying from 2° to 8°. To the N. and S. of Newport, in the same river, similar rocks are found dipping W. at from 3° to 10°. Three miles E. of Newport, the out-crop of a thick conglomerate is well exposed. This conglomerate can be traced for more than five miles to the southward. It is first seen about a mile to the N.E. of Castle Waller, where it appears from under the mountain bog. From that it can be traced through Culley Rock, where it turns to the W. and passes a little to the S. of Castle Waller. It is not seen in the valley in which the Small River flows; but to the south of the valley its out-crop again appears, and was traced round the west end of the hill, that lies between Small and Clare Rivers, into the Clare River valley. It is again met with, in the Clare River to the east of Charlotte Bridge, under the *C* in *Clare*, as engraved on the one inch map. From this it can be followed to the W. towards Ashroe, and at about a mile to the S.E. of that place, it turns and goes nearly south through the Deer Park of Cappercullen; from that it runs to the S. of Glenstal Castle, and then east along the narrow wood, turning north in the wood, over where the *o* in *ABINGTON* is engraved; after this it can be traced round the wood, and is seen a little to the north of the last *x* in *ABINGTON*. From this it runs nearly due south, and ends against the Lower Silurian rocks a little to the N.W. of where the *B* in *OWNEYBEG* is engraved. Hence, it appears that to the N. of the last named place, the Upper Old Red sandstone must be thicker than to the south. That the conglomerate ends against an old Lower Silurian cliff,\* and is not thrown down by a fault, seems probable as the yellow grits that are about 100 feet above the conglomerate, appear a little to the W.S.W. of this place, to stretch across the top of the Lower Silurian cliff in one unbroken sheet.

If we now return to the Clare River, a nearly continuous section of the rocks forming the Upper Old Red sandstone in this district can be examined. The bed that rests on the Lower Silurian rocks, is a red shaly, soft sandstone, which in places is conglomeritic; over this is a soft shaly ferruginous grit conglomerate. Above these are flaggy red sandstones, red grits, and conglomeritic grits, in which are lenticular layers of red shale; and over these, at the place where the *C* in *Clare* is engraved, is the thick massive quartzose conglomerate before mentioned. Here the conglomerate is over twenty feet in thickness, and about twenty-five feet above the base of the Old Red sandstone. All these rocks dip nearly W. at from 2° to 15°. Proceeding down the river from this place, no rocks will be found till the wood at the E. of Charlotte's Bridge is reached. From the top of this wood down to Clare Bridge the beds undulate, but in such a way as to be nearly horizontal, with a slight general dip to the W. They consist of yellow and red conglomerates, sandstones, grits, and shales. W. of Clare Bridge there are flaggy red grits and shales, grit conglomerates, red sandstones and flags, in which are lenticular *cornstones*† and conglomerate. They all dip W. at from 5° to 10°.

Three quarters of a mile to the S. of Clare Bridge red and yellow grits are to be seen north of the new road, while to the south of it are similar rocks and the thick quartzose conglomerate. These dip N.W. at about 20°. A mile to the S.S.W. of these, near Lisgorey, red grits dip N.W. at 15°. In the lane a little to the N.E. of that place, red sandstones dip N.W. at 50°, while farther N.E. on the hill, below the thick quartzose conglomerate, are red flags that are vertical. Such a high dip as the latter is very remarkable in the Old

\* If it does not end against an old Silurian cliff, there must be an overlap of the Old Red beds in this place. This last supposition seems as likely as the former, as the bottom of the Old Red sea may have had hill and valley in it.

† *Cornstones*.—Calcareous patches, sometimes nearly a pure limestone, but more often a calcareous breccia.

Red sandstone of this district, as the angles rarely exceed 30°, and are usually from 1° to 15°. On the hill that lies about a mile and a-half to the S.W. of Lisgorey, are red, yellow, and bluish grits, and sandstones, a few of which are conglomeritic. They dip W.N.W. at 10°. A little to the E. of Farnane House, which is a mile to the S.E. of the hill just mentioned, are red sandstones dipping S. at 10°. About a mile east of this, on the road 500 yards S. of Wilton, yellow grits and flagstones are quarried. They dip S. at 5°, and usually have greenish shale partings between the beds.

G. H. K.

Eastward of the Culley Rock, which is situated three miles E. by N. of Newport, the mountains present an unbroken surface of bog, and the sandstones are concealed thereby, except in the vicinity of an elevation, marked on the map as having a height of 1,204 feet. Near this and on the south slope of the hill over Lackamore, some nearly horizontal red and purplish conglomeritic beds occur, and similar rocks are seen in the stream courses near the Lackamore National School. Red sandstones crop out from the hill over Vauluse Cottage, on the S. bank of the Clare River, two and a-half miles E. of Clare Bridge, in one or two places, and red conglomerates dip down the hill towards the N. at 3°, near the source of a stream S.E. of that cottage. Near the crest of the Slieve Phelim ridge, more red conglomerates, inclining slightly in the same northerly direction, crop out from the hill; and south of this where the Dooglasa river runs by the top of the Glenstal woods, it cuts its way through some red sandstones and conglomerates which are nearly horizontal (or dip W. at from 3° to 10°), and then precipitates itself in a picturesque cascade over some rocky shelves formed of the same material. Two small bosses of sandstone south of this afford a clue whereby to run the boundary, but they cannot be stated to be certainly in *situ*, although it is probable that they are so. A stream which flows under Portnard Bridge, after passing through a long narrow plantation, exposes both the Silurian and Old Red rocks, which in the plantation are nearly in junction. The latter are here found to be red, muddy, yellowish, and pale purple conglomeritic and ferruginous sandstones, their dip is to the S. at about 3°. These rocks do not again appear to the eastward, until a place is reached where the Glashacloonaraveela River receives a considerable tributary from the north, near a new bridge which crosses it close to a point of elevation marked 320 on the map. Here the above named river runs for a considerable distance over red sandstones and sandy shales, which dip to the W. of S. at from 5° to 10°. The beds contain many remarkable calcareous nodules, some of which are as large as a man's head; and two beds of an unusual character in the Old Red rocks of the district occur at this place: one is an olive-coloured hard and close-grained shale, containing small scattered globular concretions; and the other is a layer of fine, heavy, hard calcareous breccia, having a thickness of from eight inches to a foot. Near where the latter occurs a fault crossing the stream seems to have slightly dislocated the beds, which on the north side of the fault appear to have been bent downwards into a nearly vertical position.

From the place last described, a road runs by Holly Park to the Bilboa River, there turning sharply towards the south, and running along the edge of a precipice, formed partly of drift, and partly of red sandstone and shale rocks, which dip at a low angle W. by S. They are here crossed by two east and west nearly vertical trap dykes, which may be seen a few yards to the N.E. of the spot where the road from Doon to Holly Park crosses the Bilboa River. The dyke first met, going up the river, is about eighteen inches wide. It is a rather flaky, soft, yellowish trap that to the touch has a soapy feel, and is affected by a vertical lamination. This dyke does not penetrate through

the red beds that form the top of the bank. The second dyke (see fig. 2), is nearly vertical, and about 2 feet 6 inches wide. It is a blue porphyritic trap with angular fragments, like white crystalline particles, surrounded sometimes by a reddish border. In places it is like a brecciated ash, especially the greenish brown decomposed margin which is often two inches deep. The shales through which the trap passes are altered for about nine inches on each side of the dyke, while the sandstones are seemingly unchanged. The dyke first described may be a branch from the latter.

Fig. 2.



Trap dyke in Old Red Sandstone.

Proceeding up the course of the Bilboa River from this place, a good exposure of what are here the basal beds of the Old Red sandstone occurs,\* they dip towards the S.E. at low angles, and contain many beds of white, yellowish, and pale purple conglomeritic grit, full of calcareous veins and nodules. Tracing them up the course of the stream, they will be found to rest unconformably upon the hard gritty shales of the Silurian formation; and it is remarkable that the very lowest bed of the Old Red sandstone is one of the most highly calcareous of those which occur here. Upon the face of the mountain overlooking Doon village, the same kinds of pale gray, whitish, and yellowish, speckled, ferruginous, and often conglomeritic and calcareous sandstones project from the surface of the ground; they all dip, with the hill, towards the S. or S.W.; and though a very considerable quantity of the rocks are seen, they have perhaps no greater thickness than five or six hundred feet. The pale red and whitish sandstones are again well seen in the Cahernahallin River, near Toomaline; and on the hill above its left bank. They dip S. at various low angles in both places.

Eastward of this, the extent of surface occupied by the sandstone becomes large, and the number of places where it is seen, proportionately small. Whitish sandstones and flagstones with some red and gray shales may be seen in the streams which unite and pass under Glashanailor Bridge; they dip southward at angles, varying from nearly horizontal to 10°, and are only seen

\* Near this place are the celebrated white quarries of Doon, where some of these beds are well exposed.

at and above the bridge. The red flaggy sandstones have been quarried near the village of Cappawhite; and N.E. of this a stream which flows southward and eastward into the Multeen River, in a direction nearly parallel to the Old Red boundary, exposes several of the pale purple and reddish beds, consisting of conglomerates, shales, and sandstones, which all dip southwards at an angle of about 5°.

Following the course of the Multeen, below Iron Mills Bridge, and near the ruins of Aggharrin Church, the last of the Old Red sandstone beds which will have to be noticed occur, in the bed of the river, and beneath its banks; they are dark liver-coloured shales and pale purple speckled sandstones. In some of the shales here a number of small branching fucoid-like markings, were pointed out by Richard Millett, Esq.

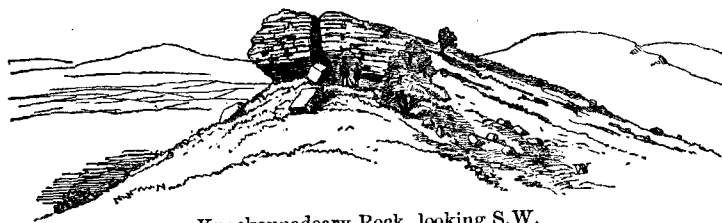
A. B. W.

*Lower Limestone Shale.*—The only place in the whole of this district where this rock is exposed is in the Newport river, a little to the S.W. of Newport; and there it consists of dark blue shaly limestone, arenaceous limestone, and thin shale, with a few thin grits that dip W. at 5°.

G. H. K.

The *Lower Limestone* in the S.E. corner of the map is concealed by the great quantity of drift spread over the country in this neighbourhood, which, indeed, even renders the position of its boundary and that of the Old Red sandstone a matter of extreme uncertainty. Some of it is, however, seen on a hill called Knockouragh, upon which quarries have been worked in dark gray, sometimes cherty, and in places magnesian limestone.\* Some projecting rocks forming cliffs at the top of the hill—the largest of which is called Knockaunadeary Rock (see Fig. 3)—exhibit thin bedded and very

Fig. 3



Knockaunadeary Rock, looking S.W.

cherty, flaggy-looking, gray limestones, which dip generally S.W. at angles of from 10° to 20°; but some angles so high as 30° and 40° have been noted in the vicinity. These rocks have been much acted on by the weather; and although greatly shattered, they still present a fine example of these peculiar beds.

South-west of Togher cross-roads, some thick and thin bedded dark blue limestone, which is magnesian in places, may be seen beneath the ruins of Coonagh Castle; it has an undulating dip of 35° to the southward.†

Where an isolated mound of drift rises from the surrounding bog between Kilmoylan House and Castlegarde; a quarry has been opened in dark gray crinoidal limestone, which dips S. at 10°; and southward of this, along the road from Castlegarde to Togher, some pale gray limestone appears in two places, but its bedding is concealed. Pale gray siliceous-looking and compact limestone occurs in two other places northwards of Castlegarde; and near a bog road

\* These cherty beds are part of those mentioned in the *General description* which divide the dark blue bedded limestone from the gray and blue unbedded limestone.

† A trial was made for lead near Coonagh Castle about the year 1852, and its existence was proved.—Communicated by the late H. M. O'Grady, Esq., of Castlegarde.

more to the N.E., a dip of 20° to the S., in black shale and limestone was observed. Directly S. of this, in the site of Kilcarrigeen burial-ground, is a projecting knob of pale gray crinoidal and variegated limestone, dipping S. at 25°.

Part of the Bilboa River flats surrounds a rising ground W. of Castlegarde, upon which are some quarries in dark and pale gray, sometimes variegated, compact, and thick-bedded, limestone, which appears to have an undulating dip eastwards. East of Cappamore, some more dark gray crinoidal and fossiliferous beds occur near the Glebe House, in two places, dipping to the S. at about 3° and 4°.

Southward of Cappamore, a rising ground, which appears to have caused a deflection in the course of the Bilboa river, is formed of gray and pale gray compact limestone, in places crystalline, and in others magnesian. It may be seen in a great many quarries scattered all over the hill in this direction; and from the variety in the directions of the dips taken, it appears to undulate a great deal. Some of the pale gray beds contain many *Fenestellæ*; and in one place, near where three roads meet N. of Turragh, a peculiar wavy structure was observed on the weathered surface of a rock, the bedding of which was not determinable.

To the E. and S. of Cappamore, the limestone is seen in several quarries, and in two N. of that village. One of these latter is situated in an isolated piece of limestone country, bounded on all sides by an alluvial flat, except the N. where there is a rising ground at the base of the mountain, supposed to be composed of Old Red sandstone. The quarry situated on the S. side of the patch has been opened in dark gray crinoidal limestone with dolomitic and crystalline beds, the dip of all being to the N. at 10°. The other lies just N. of the town, beside a private road leading to Portnard House; but it exposes black crinoidal limestone, which dips S.E. at 35°.

#### A. B. W.

A little to the N. of Cappamore there are dark blue argillaceous exfoliating fetid limestones, which are part of the lower or stratified portion of the Lower Limestone. This kind of limestone can be traced from the N. of Cappamore to the N.W., by Boherglass and Abington to Barrington's Bridge. It dips S. or S. 10° W. at a very low angle, rarely exceeding 10°. To the W. of Barrington's Bridge it extends for about two miles, rolling in slight undulations, but at so low an angle as to be nearly horizontal. To the N.N.E. of Barrington's Bridge similar rocks are also found as far as the northern limit of this district, from which they spread into the area contained in Sheet 134.

The upper part of the Lower Limestone is exposed in various places, as in the county of Clare, at the N.W. corner of the map; on the W. of Castleconnell; and to the S. of that place as far as Annacotty; the rock is usually near the surface of the ground, and appears in numerous crags, quarries, and cuttings. It is always magnesian in a greater or less degree, and its bedding is rarely if ever determinable on account of its thick massive character. In the Mulkear River some of the rocks are actual dolomites. Limestones more or less magnesian are quarried in various places in the rest of the district marked as Lower Limestone, that has not been previously described; but none of it requires special notice excepting the rocks in a quarry a little to the S.E. of Ahabeg House which contain patches of ash.

*Middle and Upper Limestone.\**—A mile to the S.W. of Castleconnell, at the picturesque falls of Doonass, the basal cherty beds of the Upper Limestone are well exposed. They roll in undulations down the river lying in the fold

\* These limestones are undistinguishable, and in these details they will always be called Upper Limestone. Contemporaneous trappean rocks occur in large mass on the horizon that should, according to geological position, belong to the Calp or Middle Limestone.

of a synclinal curve the axis of which has a slight general dip to the S.W. These basal beds and the limestones over them are also to be seen to the E. and W. of Landscape House, which is situated a mile to the W. of the Falls. To the N.W. and S.E. of Prospect House, and in a few places in Mount Shannon Demesne, this limestone has been quarried. In one quarry N.W. of Prospect House trappean ash is associated with the limestone. It is also to be seen at Annacotty, dipping W. at 5°. Three and a-half miles due S. of Annacotty there is a small hill of Lower Limestone surrounded by the basal beds of the Upper Limestone, which dip from it to the N. at 20°, to the N.E. at 10°, to the S. at 2°, and to the S.W. at 15°. To the N. of this hill there are dark blue limestones, while on the E., S., and W. trappean ash is to be seen above the cherty beds.

A little more than a mile E. 10° N. of Caherconlish, at the Knockkeen fox-cover, the cherty beds are extensively developed, being over 150 feet thick. This great thickness seems only to occur in this one place, as they are not more than fifty feet a little to the W.; while S. of Eyon House, which lies two miles on the E., they are only between thirty and forty feet thick.

Over these cherty beds, to the S. and S.W. of this district, there are trappean rocks, which sometimes take the place of the cherty beds to their total exclusion, while in other places they are reduced to only a few feet in thickness.

Above the trappean rock, near the S.W. corner of the district, a little to the south of where the T in Rochestown is engraved on the one-inch map, there is a quarry of dark blue limestone that seems to dip S. 20° E. at 15°; it is traversed by parallel vertical joints, with a bearing of N. 15° W. There are also ashy-looking dikes that have the same bearing as the joints, in which are traces of lead (*galena*). To the east of the R. C. Chapel which lies about a mile to the E.N.E. of the last-named place, are two quarries of limestone; in that which lies nearest to the chapel the limestone is full of small particles of trap, and between the beds are shaly partings composed of trappean debris.

A mile to the east of the chapel, on the northern margin of the alluvial flat, there was a quarry of dark blue limestone, that is now closed, in which the beds are said to dip S. at 10°.\*

A mile to the S.E. of this, at Caherline House,† are blue limestones that dip S.E. at 12°. Half a-mile to the E. of Caherline House, at a farmstead, are blue limestones, in which are a few nodules of chert; they dip S. at 35°, and seem to immediately underlie the basal shales of the *Coal Measures*. Half a-mile N. 5° E. of this there are two quarries of blue limestone which have red ferruginous clay partings between the beds, and one thin bed of yellow ochreous shale two inches thick.‡ They dip S. at 25°. To the east of this, and a little east of Lombardstown House, are four quarries in blue limestone; in one of them the limestone is oolitic and magnesian; and in another by the roadside there are ashy shale partings between the beds. Further east, near Dromkeen House, are some dark blue limestones that dip S. at 35°. Above these are trappean rocks, and over the trappean rocks are gray limestones. In one place, a little to the E. of the R. C. Chapel, a section is exposed in a crag, of which the following is a detailed account:—

\* This quarry would have been passed over, as it has now the appearance of a cattle pond, but for the proprietor, C. M. Wilson, Esq., of Caherconlish House, who kindly accompanied me to the spot and pointed out its locale, and also the dip and strike of the beds, which appear to coincide with the traps and ashes a little to the north.—G. H. K.

† There are two Caherline Houses in the district now under examination, one is about two miles S. of Castleconnell, and the other that which is now mentioned.

‡ Very good building stones might be raised in these quarries.

## Section 1.

	Ft.	In.
10. Gray limestone, very fossiliferous, the principal fossils being <i>Productæ</i> ,	7	0
9. Olive shales, with thin layers of dark blue limestone and gray chert, and thin seams of very siliceous hematite,	3	4
8. Light gray slightly magnesian limestone that has patches of regular dolomite,	30	0
7. Flaggy dolomite of a yellowish gray colour,	3	3
6. Yellowish green ashy-looking shale,	0	4
5. Whitish gray limestone,	10	0
4. Yellowish white dolomite,	5	0
3. Whitish gray limestone,	about,	25 0
2. Yellowish white dolomite, full of large <i>Productæ</i> ,	10	0
1. Decomposed trap (diorite?),	over,	30 0
	123	11

To the S.E. of Dromkeen church one anticlinal and two synclinal curves are visible. The axis of the anticlinal curve runs a little on the S. of the house called Dromkeen, with a bearing of E. 10° N. The northern synclinal dips N. at 50°, and S. at 10°; and the southern, S. at 45°, and N. at 50°. Two miles to the S.E. of Dromkeen, at the village of Nicker, are gray limestones interstratified with trappean rocks, which will be described presently; they are generally oolitic, and dip nearly W. at 15°. To the S. of Pallasgrean Railway Station are dark blue and black limestones, parts of which are dolomitic. They dip nearly W. at 15°.

**Coal Measures.**—These rocks only require a brief notice. In the road that runs N. and S. through Ballybrood, the beds are well exposed. On the N. are olive and black shales; over these, are flags and flaggy grits, which are succeeded by alternations of grits, shales, fire-clay, clunch, and (as reported) coal (?)\* The Measures are calculated to be between eleven and thirteen hundred feet thick.

A mile E. of Ballybrood, there are good flags. A little to the S. of the flags, near Clover Ville, there is a remarkable quarry of gray grits which exhibit spheroidal concretions in places. Some of these spheroids are slightly calcareous, while others are soft sand full of thin veins and oxide of iron; usually they are not removed by the quarrymen, and now stand up in large grotesque rounded masses, giving a most peculiar aspect to the quarry. Nearly all the Coal Measure rocks that are exposed in this district dip S. at angles varying from 5° to 45°.

**Igneous Rocks, D, P, Am, and Ds, Diorite, Porphyry, Amygdaloid, and Trappean Ash.**—Associated with the *Carboniferous Formation* are various traps and ashes, most of which are contemporaneous, while some of the traps are intrusive; but all were formed during the Carboniferous period.

The contemporaneous trappean rocks form two great deposits, occupying well defined geological horizons, the lowest coming in a little above the base of the Lower Limestone, immediately over the cherty beds that are taken as the division between the Lower and Upper Limestones, and the other a little below the basal shales of the Coal Measures.† G. H. K.

**Cappamore trap.**—A mile to the N. of Cappamore some trap is to be seen apparently near the base of the *Lower Limestone*.

This trap is of a blue or a light bluish gray colour. The blue trap is very

\* Coal is said to have been proved here; but when the district was examined, it could not be found; and in subsequent inquiries, no positive proofs that it ever was found could be obtained.

† One of the trap districts in this area has a geological position, which is undeterminable on account of the few rocks seen *in situ* in its vicinity. It is that of Knockbrack, about two miles to the south of Castleconnell, and will be more fully spoken of further on.

hard and compact, and the gray trap occurs in it, in patches and veins. The gray trap is very peculiar, as in places it is ashy-looking and highly calcareous, effervescing freely with dilute acid. These calcareous patches are found all through the mass of the trap, and usually seem to be bounded on each side by a joint plane. They may, perhaps, be due to carbonic acid in solution having percolated into the body of the rock along the joints, and converted some of the silicate of lime into carbonate.\*

The relation between this trap and the adjoining limestone is undeterminable, as very little of the former is exposed, the boundary being marked solely by the physical features and form of the ground. The trap may be the continuation of the dykes just now mentioned in the Old Red sandstone at Bilboa, as those dykes seem to strike towards this place, and the difference in the constituents of the traps here and there may be due to the nature of the associated rocks in each place; it might, however, be part of the trap that will next be described; or, perhaps, it is a small independent outburst of igneous matter; but, on account of the nature of the country hereabouts, which is covered either with deep *Bog*, *Alluvium*, or *Drift*, it is impossible to determine the point satisfactorily. G. H. K. and A. B. W.

**Dromsallagh trap.**—This trap was observed on the W. of Dromsallagh hill, which lies about a mile and a-half to the N.W. of Cappamore, and nearly due W. of the Cappamore trap, from which it is distant a little more than a mile. Its geological position is near the base of the *Lower Limestone*.

The trap is well seen in a quarry on the west face of the hill just mentioned, and appears to be a bed about twenty-four feet thick. The floor of the quarry is limestone which has a rather altered appearance for more than two feet in depth. The igneous rock is a light blue trap with white and olive green crystals widely disseminated through the mass; it has a rather rude columnar structure. The bed can be traced for a short distance towards the east along the top of the hill.

**Maddyboy trap.**—Four miles to the N.W. of Dromsallagh hill, and about a mile to the W. of Abington, at Maddyboy, there is a larger mass of igneous rock. This is a reddish finely crystalline or compact trap, showing small scattered feldspar crystals and crystals of a sea-green granular mineral; also, white crystals, the latter slightly effervescing with dilute acid on the edges of fracture. The trap has a wide and rather imperfect prismatic jointing, producing a rudely columnar structure, and the blocks show a tendency to weather into spheroidal forms. It resembles some of the traps in Sheet 154 and seems to be not unlike a Syenite in which the quartz has not crystallized out. The rocks about it must apparently lie near the base of the Lower Limestone, but its exact relation to them are doubtful, as none of the Limestone is seen nearer to it than at Abington. It is supposed, from its appearance, to be intrusive, and if so, it may reasonably be supposed to lie in one of the volcanic vents or orifices from which some of the flows of trap proceeded that lie on a higher geological horizon.

**Knockbrack Igneous District.**—Two miles to the east of Annacotty, and about the same distance to the south of Castleconnell, there are also igneous rocks, the geological position of which is uncertain, as no limestone *in situ* is seen

\* A similar calcareous trap was remarked near Nicker, at the south of this district.—G. H. K.

† These rocks would seem to be on a different geological horizon to any of those on which the other igneous rocks in this district are found, as the upper part of the lower beds of the Lower Limestone that are exposed in a quarry at the farmstead that lies half-a-mile to the N.W. of Annagh bridge are the nearest rocks *in situ*. From this, it would appear that these trappean rocks are situated about midway in the Lower Limestone. I am inclined to think that this is the case, as all the dips in the ash that were recorded dip N. or N.W., which would seemingly make the ash underlie the upper part of the Lower Limestone between it and Castleconnell.—G. H. K.



near them.† They are principally ash. Near the centre of the district, there is a mass of intrusive black basaltic-looking trap that is in places vesicular. The junction of the ash and trap is well seen in a quarry by the "boreen" on the west side of the hill, where the trap assumes the form of a dyke about four feet wide. The ash is of a green colour, and is generally brecciated, containing numerous pebbles and fragments of limestone and trap.\* It is often affected by N. and S. parallel vertical joints; these are well seen in the quarry at the old ball-court on the west side of the hill. To the N.W. of Knockbrack there are two patches of ash exposed in the bog, one at the E. of Caherline House, and the other to the N.E. of Rich Hill, by the side of the road from Limerick to Newport.

The *Boughilbreaga, Caherconlish, and Coonagh Igneous District*.—The rocks now to be described form the northern half of the large belt of igneous rocks that surrounds the basin in which the *Ballybrood Coal Measures* lie. It consists of alternations of traps and ashes, and lies at the base of the Upper Limestone, sometimes either entirely or partially replacing the cherty beds that are taken as the basal beds of that division. It enters this district at its S.W. corner, and can be traced thence to Boughilbreaga, and then through the Knockroe hills to Caherconlish, and from that by Kilmurry National School to the hill at the S.E. of Eyon House. To the S.E. of the last-mentioned hill, it disappears in the alluvial flat along the Dead river, but is again found to the south of the flat, in the neighbourhood of Sun Ville, and can be followed thence to the margin of the district at Cross Cottage, occupying a semicircular band about thirteen miles long, and averaging a mile in width. Where it enters the map on the S.W., it is supposed to consist of a single bed of trap, which seems to be a Greenstone or Basalt, in places having, however, an ashy appearance. Here it rests on the uppermost beds of the Lower Limestone. As it is traced E. towards Shehan's cross-roads, an ash bed comes in over the trap. This latter bed is well seen in the road to the E.N.E. of the cross-roads, and at Rockview, where it is a coarse greenish purple ash, with a few encrinite stems imbedded in it. On going eastward at Boughilbreaga, the trappean belt consists of—

## Section 2.

4. A glistening crystalline trap, of a reddish green or greenish colour, with bands of amygdaloid, as if there were two or three flows of trap in the bed. It is traversed by lines that are parallel to the bedding of the underlying ash. It becomes sometimes a porphyry, when it contains white and sea-green crystals of felspar and specks of a green and reddish mineral.
3. Ash, which is generally of a purple colour, and of a coarse texture, sometimes becoming brecciated and conglomeritic.
2. A dark finely-crystalline trap, with widely-disseminated crystals of felspar. In places this is columnar; and at the top of the flow, amygdaloidal.
1. Green ash.

The ash bed, No. 1, is first seen coming from the E. in a quarry in the townland of Stonepark (three-quarters of a mile to the N. of Shehan's cross-roads), where it is found to be interstratified with the limestone and to have

\* Some of the slightly rounded pebbles of trap in this ash are full of very minute vesicles, and almost resembled pumice. I have observed this not unfrequently in trappan ash, and believe that we often have preserved in the ash the pieces of the upper vesicular surface of the old lava flows which were swept away or floated off by the sea currents before the time when the mass of the trap became buried under the aqueous rocks in which it is now found. The pebbles in the ash are the heavier portions of this lighter matter, or those which sank after being water-logged.—J. B. J.

† Thomas Weaver, Esq., in a paper *On the Geological Relations of the East of Ireland*, read before the Geological Society of London, May 15th, 1818 (see their *Transactions*, 1st Series, vol. 5, p. 271), mentions the trappan rocks of the county of Limerick. There were, also, papers on them read before the Geological Society of Dublin by James Apjohn, Esq., M.D. (see their *Journal*, vol. 1, p. 24), by John Scouler, Esq., M.D. (see *Ibid.* vol. 1, p. 185), by W. Ainsworth, Esq. (see *Ibid.* vol. 1, p. 112), and by C. W. Hamilton, Esq., (see *Ibid.* vol. III, pp. 52 and 145).

a thick mass of that rock between it and the trap (*bed No. 2*). Through this mass of Limestone runs a dyke of trap, near the angle in the parish boundary. A good section of the ash (*bed No. 1*) is seen along the old road that runs north from Bohereenacorig, in which place also a small trap dyke, one foot wide, was observed running nearly E. and W. through the ash. In a quarry a little to the east of this road, the ash lies on gray limestone, dipping S. at  $15^{\circ}$ . A little to the N. of Boughilbreaga, there is a small mass of trap interposed between the ash and the underlying limestone. Immediately E. of the summit of Boughilbreaga, this ash dies out, the trap bed, No. 2, lying on the limestone; but the ash sets in again immediately, and is found occupying the space between this and the road that runs south from Mount Saint Lawrence, dipping S. and S.E., at angles varying from  $10^{\circ}$  to  $15^{\circ}$ . To the east of the last-mentioned road, none of this ash was found *in situ*, but it is supposed to extend for about a mile to the E., and to die out at the wood there situated.

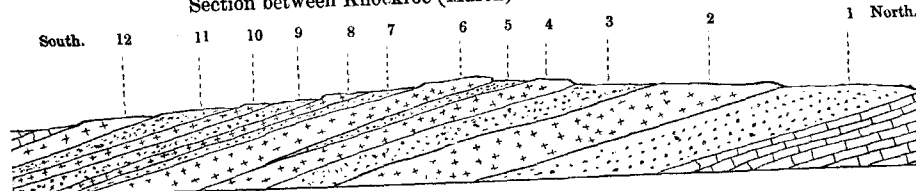
The trap (*bed No. 2*) is well exposed a little to the north of Rockview, and in the road that runs north from Bohereenacorig. On the west face of Boughilbreaga it is columnar; to the east of Boughilbreaga, as before remarked, it rests, to the exclusion of the ash (*bed No. 1*), on the limestone. The limestone is altered to about the depth of four feet. In this place the base of the trap is cut up by joints into angular fragments that are now cemented together by calc spar.\* As this trap is followed eastward, it thins, or, perhaps, dies out, as it could nowhere be found on the road that runs south from Mount Saint Lawrence; but there is a coarse breccia made up, seemingly, entirely of angular fragments of trap, which is supposed to form a connexion between the part of the trap just described, and that which lies to the north of Knockroe (Mason). After this road is passed, the trap can be traced eastward to and through the wood that lies to the S.W. of Caherconlish House, immediately to the E. of which it is supposed to die out or amalgamate with the trap (*bed No. 4*).

The ash bed, No. 3, can be traced from the west of Shehan's cross-roads, along the south face of Boughilbrega and the north of Knockroe (Mason), and ends at the S.E. corner of the wood previously mentioned. A patch of it extends up the south face of Boughilbrega nearly to its summit.

The trap bed, No. 4, is supposed to commence at Sandville, which lies to the south of Shehan's cross-roads, and is well developed and seen at the R. O. Chapel that is situated about a mile to the S. of Boughilbreaga. A little to the W. of the summit of Knockroe (Mason) it is columnar, and on the east face of the same hill it is split up by beds of ash coming in between the different flows of trap. A good section of all these beds is seen in the small valley that lies between Knockroe (Mason), and Knockroe (Wilson), (see fig. 4),

Fig. 4.

Section between Knockroe (Mason) and Knockroe (Wilson).



Scale. 6 inches to a mile.

Scale, 6 inches to a mile.

of which the following is an account, the thicknesses being estimated:—

\* A similar trap was remarked at Carrigogunnell.—See *Explanation of Sheet 143.*

## Section 3.

	Feet.
12. Green glistening trap, with widely disseminated crystals of white felspar, . . . . .	about 50
11. Green and red ash, . . . . .	75
10. Greenish and purplish glistening trap, with crystals of white felspar widely disseminated through the mass, . . . . .	50
9. Ash, coarse trapean sandstone, sometimes flaggy, . . . . .	50
8. Like bed No. 10, . . . . .	27
7. Coarse brecciated ash. Some of the contained blocks are very large; one of trap measured ten feet long by three feet high, . . . . .	252
6. Porphyry, with a greenish base, full of crystals of white and greenish felspar. About half of this bed is columnar, . . . . .	100
5. Coarse brecciated ash, of a red colour, . . . . .	48
4. Porphyry, with a greenish base, containing crystals of white and sea-green felspar; also, specks of green and reddish minerals, . . . . .	80
3. Purple ash, very compact, with minute particles, amygdaloidal in places, . . . . .	100
2. Greenish blue trap, with widely disseminated crystals. Some of these are felspar, of a sea-green colour; there are also white crystals that slightly effervesce with acid. The trap also effervesces slightly along the joints and where weathered, . . . . .	180
1. No rock seen <i>in situ</i> , but the bed of green ash (bed No. 1, Section 2), is believed to underlie the trap in this place, and to have a possible thickness of * . . . . .	220 ?
	1,000

Beds Nos. 1, 2, and 3 are the continuations of beds 1, 2, and 3 in Section 2, and their supposed termination at the E. was mentioned in speaking of that section. The ash bed, No. 5, ends half a mile to the east of the valley in which this section is taken; the trap beds, Nos. 4 and 6, will then of course join, and are then supposed to turn to the N., and run east of Caherconlish, ending at the old castle that lies a little to the north of that place. The trap beds Nos. 8, 10, and 12, all terminate a little to the east of the line of section. These traps (beds 4, 6, 8, 10, and 12), are all part of the continuation of bed No. 4, Section No. 2. The ashes (beds 7, 9, and 11), all begin a little to the W. of the line of section, and they become one large bed when the traps (beds 8, 10, and 12) die out towards the east. They can be traced eastward by Caherconlish to the hill S.E. of Eyon House. The trap beds, Nos. 4 and 6, near their termination to the north of Caherconlish are columnar at the old castle, and at this place they are quarried for building and other purposes, exposing to view a colonnade from 15 to 20 feet in height, and about 100 feet in breadth.† The columns are generally five-sided, rarely four or six-sided. The ash above this trap is well exposed to the E. and N.E. of Caherconlish.‡

Where the trap beds, Nos. 4 and 6, die out north of Caherconlish, the overlying ash takes their place on the limestone, and another flow of trap sets in over the ash. If a N. and S. section was taken a mile and a-half due E. of Caherconlish, the beds would be found in the following order:—

## Section 4.

5. Dark blue limestone. *Upper Limestone.*
4. Grayish green glistening trap.
3. Ash.
2. Cherty limestone. *Basal beds of the Upper Limestone.*
1. Gray limestone. *Lower Limestone.*

\* In this section the igneous rocks of this belt seem to reach their maximum thickness.  
† These are the most regular columns of any that were observed in the county Limerick.

‡ At Caherconlish a thin strip of the basal cherty beds of the Upper Limestone, about thirty feet thick, is found underlying the trapean rocks. They continue round from this to where these igneous rocks leave the district at Cross Cottage. They are sometimes much thicker, in one place, a little to the W. of the coach road, being as much as 150 feet.

Bed No. 3 is the continuation of the ash beds Nos. 7, 9, and 11, Section 3. This ash near Boskill House, which is situated half a mile to the E. of Caherconlish, is coarsely cleaved, the cleavage planes cutting through the embedded pebbles. The strike of the cleavage runs E. 10° S. and it dips southward at 70°. Half a mile to the N.E. of Boskill House the ash is of a green colour, and very calcareous. It dips nearly S. at 10°. Two miles to the east of Boskill House, near the coach road, the ash dips S. at 10°, and is a coarse red bedded sandstone, very hard and compact, like some of the ashes to the N. of Lough Gurr\* (*Sheet 154*). Due east of this, at the N.E. of the railway, the ash is also quarried.

The trap over this ash is well exposed in various places, especially near the coach road, where it is a glistening trap, with white, red, and dark green crystals disseminated through it, and sometimes becomes porphyritic or amygdaloidal.

East of Eyon House there are two parallel faults, that form a trough fault. In this trough fault a mass of ash has been let down, which throws the boundary of the ash northward. This mass of ash is the only ash in the townland of Eyon. Further eastward, on the W. of Tower Hill, a trap appears between this ash and the underlying limestone. The rocks lie in the following order, if a section was taken from Tower Hill towards Dromkeen:—

## Section 5.

6. Dark blue limestone. *Upper Limestone.*
5. Trap.
4. Ash.
3. Trap.
2. Cherty limestone. *Basal beds of the Upper Limestone.*
1. Gray limestone. *Lower Limestone.*

Beds Nos. 4 and 5 are the continuation of beds Nos. 3 and 4, in Section 4. The trap bed, No. 3, is an amygdaloid or porphyry, with a pale green glistening base, the contained crystals being principally calcspar and felspar. Between Sunville and Mount Catherine a second ash is found. The following is a section of the beds, their thickness being estimated:—

## Section 6.

	Feet.
4. Ash, . . . . .	calculated at about 85
3. Trap, . . . . .	180
2. Ash, . . . . .	81
1. Trap, . . . . .	414
	760

beds Nos. 1, 2, and 3 being severally the continuations of beds 3, 4, and 5, in Section 5. Towards the south of the district, the ash bed, No. 2, dies out, but another ash is found to come in under the lower trap, the position of the beds being—

## Section 7.

	Feet.
3. Ash, . . . . .	calculated about 126
2. Trap, . . . . .	270
1. Ash, . . . . .	14
	410

Bed No. 2 in this section is the continuation of beds Nos. 1 and 3, in Section 6, and bed No. 3, of bed No. 4 in Section 6.

\* This would make a good building stone, and could be easily quarried.



**Carrigparson Igneous Rocks.**—This district lies three miles to the N.W. of Cahircionlish. It consists altogether of ash, and is on the same geological horizon as the igneous rocks at Cahircionlish, of which it seems to have been a part, having been disconnected by the denudation that acted on the country hereabouts. At the R. C. Chapel the ash is in a small basin, while a little to the north of the chapel it surrounds a quaquaversal dome. The quaquaversal dome forms a hill, on the summit of which is the Lower Limestone; lying on this, and forming the sides of the hill, are the basal cherty beds of the Upper Limestone, which are here about 100 feet thick; while over the latter, at the base of the hill, lies the ash. On the N.W. side of the hill the ash nearly dies out, its place being taken by dark blue limestones, having over them again an ash, which is the termination of that of the Cahernarry Igneous District (see *Explanation of Sheet 143*). The following section shows the position of these beds, and their calculated thickness:—

## Section 8.

		Ft.	In.
Ash.	Termination of the Cahernarry Igneous Rocks, thickness not known.		
Dark blue Limestone.	Upper Limestone,	about	350 0
Ash.	Carrigparson Igneous Rocks,	"	5 0
Cherty Limestone.	Basal beds of the Upper Limestone,	"	100 0
Gray Limestone.	Lower Limestone,	over	30 0
			490 0

The exposed rocks in this part of the *Cahernarry Igneous District* are all ash, their usual colour being green or blue, though a few of them are red and purple. These ashes vary from a fine compact porcelain-looking rock through shaly ash and ashy grit, to conglomerates. Some of them are very calcareous, in one place passing into a nearly pure limestone.

To the W. of Carrigparson R. C. Chapel there are alternations of ashes and limestones marked on the map. That they are there is not proved in this district, but the supposition is founded on what is known of these rocks a little to the west, where they are known to exist (see *Map and Explanation of Sheet 143*).

To the north of Carrigparson, and S.W. of Annacotty, the termination of the *Limerick Igneous District* is supposed to occupy the space marked on the map. No rocks *in situ* are seen, the boundary being continued from Sheet 143 solely by the features and form of the ground.

Two miles and a-half to the N. of Annacotty, at the edge of the alluvial flat, there is said to be a bed of trappean ash.\* This ash is fine-grained, compact, of a blue colour, and so very calcareous, as that it might be called either an ashy limestone or a calcareous ash. It may be the extreme termination of the ash of the *Limerick Igneous District*, and be connected with the ashes at Gilloge Lock (see *Explanation and Map of Sheet 143*), as it is very like the ash in that place, and also the ash by the Shannon shore to the E. of Plassy Mills (see *ibid*).

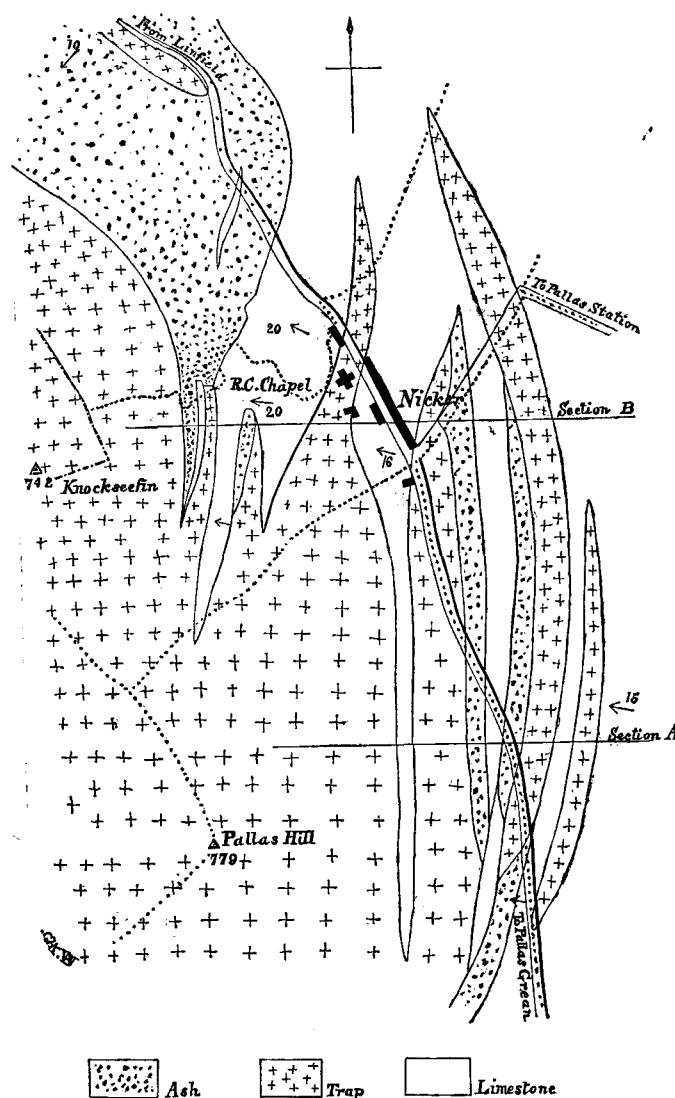
**Dromkeen and Nicker Igneous District.**—This igneous district lies a mile to the West of Pallasgrean (New), and the rocks in it are the continuation of those which farther south immediately underlie the Ballybrood Coal Measures (see *Explanation and Map of Sheet 154*). Where these igneous rocks enter this district at the southern margin of the map, the Coal Measures are also found to be deposited on them; but on going N. within the distance of half a mile, limestones intervene between the trappean rocks and

\* When this place was visited, the quarry was nearly filled up, the only rock visible being dark blue, nearly black limestone; but all the inhabitants of the neighbourhood from whom inquiries were made, pointed out this quarry as the place from which the ash was taken that was used to cope the wing walls of the new entrance-gate into Hermitage, the seat of the Barons Massy.

the Coal Measures, while a little further north, near Dromkeen R. C. Chapel, the igneous rocks die out, and limestone takes their place from that round the north of the Coal Measure basin to the margin of the map, near Ballybrood House.\*

In the neighbourhood of Nicker, and on the east flank of Pallas Hill, there is a very remarkable set of alternations between trap, ash, and limestone. The top of the hill is formed of a great mass of solid trap, and the low land

Fig. 5.



\* The trappean rocks again set in immediately under the Coal Measures a little to the S. of Ballybrood House (see *Explanation and Map of Sheet 154*).

around it of a thick series of beds of limestone; in the intermediate ground, however, a number of beds of the three kinds of rock occur, neither kind being very extensive horizontally, but dying out, so as to let the beds above and below it come together, and fresh beds setting in to separate those which were contiguous in other places. For this reason it is impossible to see the whole number of alternations upon any one line. By taking the beds, however, as they occur on the two lines marked *Section A* and *Section B* on the Map, Fig. 5, we get most of the following series, the other beds being added from observations made in the neighbourhood. (See the Map, Fig. 5, and the Sections, Fig. 6 and 7.)

Fig. 6.

Section A on fig. 5.

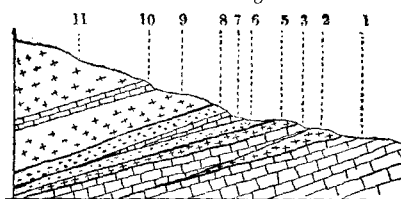
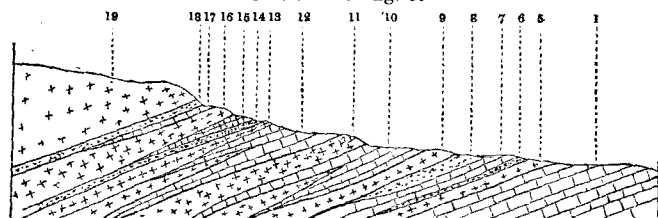


Fig. 7.

Section B on fig. 5.



- |                    |                |               |
|--------------------|----------------|---------------|
| 23. Coal Measures. | 15. Limestone. | 7. Limestone. |
| 22. Limestone.     | 14. Ash.       | 6. Ash.       |
| 21. Trap.          | 13. Trap.      | 5. Trap.      |
| 20. Ash.           | 12. Limestone. | 4. Ash.       |
| 19. Trap.          | 11. Trap.      | 3. Limestone. |
| 18. Ash.           | 10. Limestone. | 2. Trap.      |
| 17. Limestone.     | 9. Trap.       | 1. Limestone. |
| 16. Trap.          | 8. Ash.        |               |

The limestone No. 1 is part of the main mass which lies between the two great belts of trap.

The trap bed, No. 2, was remarked in a quarry a little to the N. of the line of Section A, which runs in an E. and W. line about 600 yards S. of Nicker. It seems to consist of two parts, the lowest eighteen inches of the bed being a porphyry full of small dark green crystals (hornblende?) in a gray glistening base. The rest of this rock that is exposed is a blue compact-looking trap. The limestone under the trap in the quarry is altered to a slight extent.

Beds Nos. 3, 5, and 6 were seen in juxtaposition a little to the W. of this, on the line of Section A. Bed 5 was seen 250 yards to the E.N.E. of Nicker, on the line of Section B (which runs in an E. and W. line through Nicker). Bed No. 3 is a gray limestone slightly altered immediately under the trap. Bed No. 5 is a trap like the upper part of bed No. 2, and bed No. 6 is a green laminated ash.\*

\* It will be seen by reference to the map (fig. 5), that a little to the S. of this district, in Sheet 154, the ash, No. 4, comes in between beds Nos. 3 and 5.

The limestone bed, No. 7, is not seen in this district, but it is well exposed a little to the south.

The ash bed, No. 8, is well seen on the line of Section A, where it is a coarse breccia. It is also said to have been quarried a little to the east of Nicker cross-roads, where it was a highly calcareous ash, almost a pure limestone.

The trap bed, No. 9, is well seen in the road to the S. of Nicker, and on the line of Section A (fig. No. 6). It is a similar rock to the upper part of bed No. 2, although in some places it is of a reddish colour.

The limestone bed, No. 10, is of a gray colour, and is slightly oolitic. It was observed in the village of Nicker, and was formerly quarried to the S. of the R. C. Chapel; but this quarry is now filled up. On the line of Section B (fig. No. 7), and in the district to the south (Sheet 154), blocks of this limestone were observed along the eastern face of Pallas Hill. These blocks run along a definite line, and seem to be nearly *in situ*, and are therefore considered sufficient proof of the limestone existing in that place.

The trap bed, No. 11, is exposed in numerous places to the south of the chapel, and is generally like those previously mentioned, although in one place at the townland boundary, nearly due S. of the chapel, it is of a light green colour, and full of minute crystals of a dark green colour (hornblende?) and small veins of nearly pure gray limestone.\*

Beds Nos. 12, 13, 14, 15, 16, 17 and 18 are seen in juxtaposition nearly due west of the Nicker School-house, along the line of Section A. The trap beds, Nos. 13 and 16), end a little to the N. of the line of Section A (fig. No. 5), while the ashes and limestones end a little to the S. of the same line. The limestones are gray. They are usually fossiliferous and oolitic, and sometimes have partings and small beds of ash interstratified with them.†

Bed No. 13, in the part that lies between beds Nos. 12 and 14, is coarsely cleaved with vertical cleavage. In this place it is of a grayish green colour. The ash bed, No. 14, is of greenish yellow colour, fine texture, and shaly. It does not extend far, being only found a little on each side of the line of section. The limestone bed, No. 15, seems to end to the southward, as marked on the map. The trap bed, No. 16, ends abruptly to the N., its place being occupied by ash. The limestone, No. 17, is very thin, and seems to be an isolated bed; it may, however, be connected with another apparently detached piece of limestone, which was observed a little to the N.N.E., as marked on the map. The ash bed, No. 18, begins a little to the S. of the line of section, where it is very thin; but if it is followed northward it immediately becomes of a considerable thickness. It consists of green and purple beds, one of the latter colour being usually found at the top of the ash. Half a mile to the N.N.W. of Nicker it contains a bed of blue trap. This trap is inclined to assume a columnar structure. It contains widely disseminated red, black, and greenish crystals. S.W. of Linfield House there is an anticlinal curve that deflects the boundary of this ash to the S.W.‡ To the N.W. of Linfield House, near the mail-coach road from Limerick to Tipperary, are purple ashes that are slightly amygdaloidal. A little south of the Halfway-house, at the barony boundary, are alternations of green and purple ash beds, which can be traced for some way to the west towards Dromkeen.

The trap, No. 19, is part of the large bed that forms the principal mass of Pallas Hill (Sheet 154). Shortly after entering this district it rises into

\* This part of this trap has a great similarity to one of the traps at Cappamore (see page 24).

† In one of these ash beds there was a large coral.

‡ In this ash, and near this place, some trials for coal were formerly made, and a little wood coal is stated to have been found (see Mr. Weaver's Paper, before referred to).

the peak called Knockseefin (742 feet). From that it stretches north toward Linfield House; immediately south of which it is columnar, exposing on the side of the hill a fine façade about 70 feet high and 100 yards wide. From these columns this bed extends for more than a mile to the W., forming the ridge of the before-mentioned anticlinal curve. To the north of this anticlinal is a synclinal curve which deflects the boundary of the trap, bringing it back again towards the east, in which direction the trap can be traced nearly to Dromkeen R. C. Chapel, where it is supposed to terminate. It appears to be a partly hornblendic rock, being usually compact, but sometimes vesicular or scoriaceous, and in places porphyritic and amygdaloidal. It is either of a reddish or blue colour, and, even when compact, contains widely disseminated crystals of a greenish felspar. When porphyritic it exhibits more crystals of felspar, and some dark crystals that are probably hornblende, and some reddish-coloured crystals, the red colour being due probably to the weathering as they are only seen near the surface of the stone. When amygdaloidal, calcspar occurs in the vesicles, and perhaps other minerals, sometimes even quartz, which may, however, be due to subsequent infiltration. That this bed consists of a number of flows, is shown by the interstratified beds of ashes and limestones; but the apparent number may be less than the real, as the mass contains layers of amygdaloid that probably point out the top and bottom of different flows of lava. This bed joins into bed No. 21 at the south-west.

The ash bed, No. 20, is not well exposed, the place that it occupies being covered with drift. It was only observed in two localities: at the parish boundary, about three-quarters of a mile due west of Nicker, where it is a conglomerate, and nearly N. of that, at the barony boundary, where it is a compact purple ash. It dies out a little to the W. of the barony boundary, and limestone takes its place.

The trap bed, No. 21, as before-mentioned, joins into bed No. 19. It is a similar trap, and seems to have been formed by one flow, as amygdaloid is only found in its upper portion.\* Where the ash bed, No. 20, dies out to the north, the trap, No. 21, also disappears, and limestone, No. 22, sets in, occupying the entire space between the trap bed, No. 19, and the Coal Measures, No. 23.

G. H. K.

##### 5. Drift and other superficial coverings.

The *Drift*, which in many places, and particularly at the S.E. corner of the map, is thickly spread over the country, is chiefly composed of fragments of the local rocks embedded in a kind of yellow clay. Upon some of the elevations in the low country it is not to be found, while upon others presenting a rocky aspect, it occurs like snow-drifts, filling up small hollows in the rocks, and either in the form of "clean" or of "corn" gravel is seldom far distant from any particular locality. It stretches up into many of the mountain valleys, in the streams of which limestone boulders and blocks of Syenite† are frequently found.

In the valley of the Bilboa River the drift has a vertical thickness of over

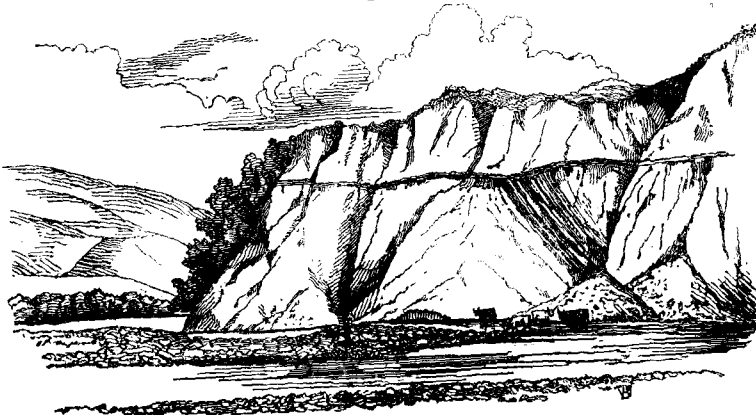
\* Although the presence of a vesicular or amygdaloidal band in a mass of trap may be taken as good presumptive evidence in favour of its having at one time formed either the top or bottom of a flow of igneous rock, it is clear that it would be hazardous to argue from the absence of such a band, that the mass was formed by only one outpouring of molten rock.—J. B. J.

† The Syenite is nearly always similar to that rock in Galway containing large pink crystals of felspar.—G. H. K.

60 feet. A sketch of one of the river cliffs in this valley, which is subjoined (fig. 8), will show some of the curious lines of oblique and horizontal stratification which it often exhibits.

A. B. W.

Fig. 8.



In the low country, especially along the valley of the Mulkear River, between Annacotty and Eyon House, the drift takes the form of a fine quartzose "rabbit sand." Esker ridges and gravel hills also form marked features in this part of this district. To the N.E. of Castleconnell there is a large Esker ridge, called Gooig, entirely surrounded by bog. Between Castleconnell and the road from Limerick to Newport, is a broad Esker composed partly of what is called "rabbit sand," and partly of gravel, which is moulded into curved hills and hollows that have a very peculiar appearance. Along the Waterford and Limerick Railway there is a long ridge of drift that begins a little to the S. of the Killonan station, as a small Esker; it then crosses the railway, and after extending about five miles in length, and in places being nearly 200 feet high, terminates near Eyon House. This Esker is generally formed of a coarse gravel, but sometimes contains fine sand.

*Peat Bog.*—In the high ground in the north-eastern part of this district, the tops of the mountains are generally covered with a coating of peat sometimes concealing the geology of the country. In the flat country bogs are numerous, especially in the neighbourhood of Castleconnell, to the N.E. and S. of which they are very extensive. The bog to the N.N.E. of Castleconnell is remarkable for having in it two sets of trees, one at the bottom and the other about nine or twelve feet from the surface. The upper trees are always fir or birch, while the lower ones are usually oak or yew.\* In the bog

\* In the bog between the Old Castle of Castleconnell and the Esker, called Gooig, an ancient road was discovered in undisturbed bog, at about four feet from the surface. The roadway was twenty-four feet wide, formed of oak saplings, the roots of which were placed on the centre of the road. (Communicated by—*Riordan, Esq., M.D.*, of Castleconnell.) Dr. Riordan also found a round oak vessel, two feet high, six inches wide at the top, and eight inches wide at the bottom, with four ears, two at the top and two at the bottom, made out of a solid piece of wood; covering its top was a lid, and fastened down by a stick that ran through two holes in the handles of the vessel, and lying in a groove cut into the lid for its reception; but the most curious part was the bottom, which was also fitted into a groove; though it is difficult to understand how it could be introduced through the solid-sided vessel into the groove thus prepared for it. This vessel was found under ten feet of solid turf, standing at the root of an old tree, and in cutting the turf the workman drove his slane through its side, and a white liquor, like whey, flowed out of it. The part of the bog in which it was found is just N. of Castleconnell, under where the first L. in Laurel Lodge is engraved on the one-inch map.

between Castleconnell and Newport, horns, &c., of the *Megaceros Hibernicus* were found. (*Communicated by* — *Carroll, Esq.*) There are also bogs near Ahabeg House, to the S. of Caherconlish, near Eyon House, at Portnard, &c., &c. In most of these bogs there is a great waste of the raw material, as they are not properly drained nor systematically cut.

*Alluvium.*—Large alluvial flats extend along the Mulkear river and its tributaries, which are very extensive to the S.E. of Castleconnell and in the neighbourhood of Cappamore. They are composed of silt and fine sand carried down by the waters of those rivers from the high land. Small beds of peat are sometimes found in the alluvial deposits, and the peat often covers part of the alluvium.

G. H. K.

#### 6. Minerals.

The metallic ores occurring in this district are those of *copper*, *lead*, and *iron*.

*Iron* occurs in the form of *hematite*, as a bed in the Silurian rocks close to the boundary of the Old Red sandstone, at a place called the Scotchman's Cooms, about two and a-half miles north of Ironmills Bridge, at the S.E. corner of the map. The bed is about three feet thick, and has been referred to before at page 17.

The *Lackamore copper mines* are in the valley of the Clare river, on the N. side of that stream, and about four miles E.S.E. of the village of Newport. They occur in the Lower Silurian rocks, not far, however, from the Old Red sandstone which caps the hill to the northward of them. The late Mr. Weaver stated, in *A Paper read to the Geological Society of London, May 15th, 1818*, that there "were here three veins composed of *brown spar*, *calcareous spar*, *clay*, and *iron ochre*, more or less indurated. Two of these were only a few inches in width, but the other had a greater thickness, and bore rich copper ore in bunches." \* \* \* "An engine-shaft had been sunk on this vein to the depth of 36 fathoms." When visited by me in July, 1859, the works were discontinued and the mines just closed, but a large opening, where the ground had fallen in, exposed part of the north wall of the main lode, from which its direction appeared to bear W. 15° N., and E. 15° S. Captain William Plummer, who then had charge of the mines, kindly afforded much of the following information:—

The main lode *hades* or underlies S. two feet for every fathom in depth, or at an angle of nearly 70° from the horizon. Its average thickness is from six to eight feet, and it sends off branches containing bunches of ore much richer than the lode itself. The gangue of this lode is composed of *slate*, *clay*, *gossan*, *quartz*, and a small quantity of *sulphate of baryta*. The ore consists of the varieties called *gray copper*, *green carbonate*, *peacock ore*, and *yellow ore*, or *copper pyrites*. *Arsenical* and *iron pyrites* also occur.

At 120 fathoms E. of the engine-shaft, and at a depth of 45 fathoms from the surface, a dyke of clay twelve feet wide, running in the direction of the lode, fills up the space between its walls, and extends from that depth to the surface of the ground. Near this place three or four small veins of shaly stuff parallel to the lode were exposed by short cross-cuts, and found to contain some copper.

The main lode divides at twenty-five fathoms from the surface, and it appears probable that it occupies a line of fault from the occurrence of slickensides along its walls.

This mine has been in existence for perhaps over fifty years, and "old men's workings" have been met with in it to a great extent. Levels in an E. and W. direction have been carried along the main lode for 210 fathoms, and shafts have been sunk to the depth of sixty-three fathoms, but nothing

of much value has been found below the depth of fifty-five fathoms from the surface.\*

*Galena.*—Lead ore was found near Coonagh Castle,† which is situated two and a-half miles to the S.S.W. of Doon, about the year 1852. A lode of the same kind of ore is said to have been found in the wood to the W.N.W. of Tower Hill, but when visited its exact position could not be ascertained. Tower Hill is about two miles north of Pallasgrean (New). Small pieces or bunches of Galena were found in a quarry in Stonepark, which lies on the Limerick and Bruff road, two miles from the S.W. corner of the map, and also in a quarry by the side of the same road, about a mile and a-half to the S. of the Stonepark quarry.‡

A. B. W.

\* The ore was generally shipped to Swansea to the extent of 150 tons per annum, at an average value of £10 per ton. The mine was last worked by John Taylor and Son, of London, and is the property of Miss Hamilton, of Castle Waller. The post town nearest to it is Newport, co. Tipperary.—A. B. W.

† This lode is recorded by Sir R. Griffith, Bart. (*see Catalogue of Mines and Metaliferous Localities, by R. Griffith, Esq., LL.D.*)

‡ In *Lewis's Topographical Dictionary, Vol. II., page 264*, copper ore is mentioned as being in the vicinity of Abington; but when the district was examined, no information about it could be obtained.

## GLOSSARY OF LOCAL AND MINERS' TERMS.

- Black Rock*—Trap.  
*Brown stone*—Old Red grit (regardless of colour), trap, and trappean ash.  
*Brass*—Iron pyrites.  
*Clay*—Fire-clay.  
*Corn or Clean Gravel*—Applied sometimes to gravel mixed with sand, and sometimes to gravel mixed with clay.  
*Crag*—When the rock comes to the surface and forms a broken country.  
*Flint*—Chert.  
*Flucan*—A miner's term for clay or rotten shale.  
*Freestone*—The white grits of the Old Red sandstone formation.  
*Gausen or Gossen*—A miner's term for the oxides of iron.  
*Grandt or Granite*—Old Red grits of a coarse texture.  
*Greet*—Trappean ash.  
*Horse*—A miner's term for a mass of rock protruding into a lode.  
*Ironstone*—Trap.  
*Killas*—A miner's term for shale.  
*Melt*—Applied to a rock that easily disintegrates into clay.  
*Old Men's Workings*—A miner's term in speaking of unrecorded works.  
*Pencil* } Shales of the Coal Measures.  
*Pencil* }  
*Rabbit Sand*—Fine running sand.  
*Red Pencil or Pencil*—Red Silurian shales.  
*Running Limestone*—Limestone blocks in the drift.  
*Sandy Limestone*—Magnesian limestone or dolomite.  
*Seat*—Clunch or hard sandy clay generally under a coal.  
*Seat Clay*—Fire clay under a coal.  
*Seat Rock*—The nearest grit under a coal.  
*Slig or Sliggeen*—Shales.  
*Shingle*—Shales that cannot be blasted, but must be worked with the pick and shovel.  
*Tumblers*—A miner's term for fragments of ore in the drift.

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