EXPLANATIONS

TO ACCOMPANY

SHEETS 197 & 198, AND THE SOUTH-EAST
PART OF 191, OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PART OF THE

COUNTIES OF CORK AND KERRY.

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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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General Description.

The district described in the following pages is the termination of the promontory between Bantry and Kenmare Bays, from Kilmakilloge Harbour and the eastern part of Bear Island to Dursey Head. The only place in it that could be called a town is Castletown-Bearhaven, the remaining villages along the coast being Cahermore, Ballydonegan, the Allihies Mining Village, Coulagh, and the Eyeries.

1. *Form of the Ground.*

The mountainous ridge that separates Bantry Bay from Kenmare Bay (or river, as it is often called), has its loftiest eminences to the east of this district; its crest, however, still retains an altitude of over 1,900 feet, south of Kilmakilloge Harbour, in sheet 191, forming a rather regular flat-topped ridge, from which proceed broken lateral spurs and deep valleys, with sides that show many cliffs and precipices of bare rock. About a mile and a-half north of Castletown-Bearhaven the crest of the ridge sinks rather suddenly down to a level of only 300 feet above the sea, forming an open pass between the hills already spoken of and the Miskish and Knockoura Mountains, which rise to 1,272 feet, and 1,610 feet, respectively.* The ridge is then continued to the west, gradually sinking down to Dursey Sound, which is another pass (the floor of which is now below the level of the sea) between the mainland and Dursey Island, the summit of which is 825 feet above the sea.

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* This gap seems to me a not unimportant feature in connexion with the magnificent harbour of Bearhaven. Should it ever be thought desirable to make that admirable natural port a permanent naval station, it would not be difficult to connect it with the interior of Ireland, by means of a railroad through this gap, along the south side of Kenmare Bay, passing thence by the north side of the Roughty valley to Glenflesk, along the level floor of which it might be taken through the heart of the Killarney Mountains, to the Mallow and Killarney railway, about three or four miles S.E. of the latter town.—J. B. J.

From Knockoura, however, the ridge begins to separate into two, one branch running off to the N.W., with an altitude of over 1,200 feet, till it sinks down and terminates in the promontory called Cod's Head.

It would be difficult to describe and almost impossible to exaggerate the picturesque beauty of much of this high rocky ground, commanding views over Bantry Bay, on the south, and the still more lovely Kenmare River towards the north, backed by the Kerry Mountains, each bay spreading out into the broad expanse of the Atlantic towards the west. The valley in which the Allihies (or Bearhaven) Copper Mines are situated, is singularly secluded, being encircled on the land side by a continuous mountain ridge from Cod's Head to Garinish Point, and open only towards the ocean; it is in fact, merely the head of a new valley, the lower part of which now stretches underneath the sea.

Although the cliffs round Dursey Island, and Ballydonegan and Coulagh Bays are often lofty, and the land above them mountainous, they are not generally so precipitous as those which stretch eastward from Blackball Head along the north shore of Bantry Bay, or from Kilcatherine Point, along the south shore of Kenmare Bay. These are black jagged cliffs, often quite perpendicular for 300 or 400 feet. They are, however, more broken into than the former, by narrow passages, giving admission into sheltered harbours instead of open bays. The beautiful harbours of Ardgroom and Kilmakilloge, in Kenmare Bay, are instances of this, and a still more striking one is Bearhaven, lying between Bear Island and the main.

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2. *Formations and Rocks entering into the Structure of this District.*

Aqueous Rocks.

	Name.	Colour on Map.
	Bog and Alluvium,	*Sepia.*
Carboniferous.	d¹ Carboniferous Slate, and Coomhola Grits,	*Dark gray, with yellow dots for the grits.*
Old Red Sandstone.	c³ Upper Old Red Sandstone,	*Indian red (dark).*
	c² Old Red Sandstone,	*Indian red (pale).*

Igneous Rocks.

D.	Greenstone,	*Crimson.*
Ds.	Greenstone Ash,	*Pale do. with dots.*
F.	Felstone,	*Scarlet.*
Fs.	Felstone Ash,	*Pale do. with dots.*

c². *The Old Red Sandstone.*—This formation consists in this district of purplish gray, greenish gray, and green and purple grits and slates. There is often almost every gradation from an argillaceous to a purely arenaceous rock. Some of the beds occasionally become

calcareous, and some of these contain little flakes of slate in a calcareous sandy base. These latter often assume the appearance of an actual breccia, and may sometimes be so; but usually this appearance is due to the fact of little flakes of clay having been deposited together with the sand, and hardened together with it, the carbonate of lime subsequently filtering into the sand and leaving the clay untouched. These calcareous bands or cornstones are usually rotten at the surface, and have a rusty brown appearance, owing to the decomposition and removal of the lime and the oxidation of the iron.

c³. *The Upper Old Red Sandstone.*—The upper part of the Old Red is marked by a more abundant appearance of purple and liver-coloured slate, together with some green and pale gray grits. Cornstones likewise occur in it, sometimes forming an actual limestone, although very siliceous, and of a pale greenish gray colour. There is no very decided boundary to be drawn between the Old Red and these beds called Upper Old Red. About the arbitrary line which has been assumed as their boundary, green stains of carbonate of copper may often be seen on the surfaces of the rocks.* As we approach the upper part of the group, where it passes into the Carboniferous slate, fragments of plants are often to be seen in it, and occasionally long stems of Knorria occur just at the junction of the two groups.

The thickness of the upper part of the Old Red is assumed at about 800 or 1,000 feet.

The thickness of the beds below is very great, as at least 3,000 or 4,000 feet of rock must be exposed without any appearance of the base of the formation.

d¹. *Carboniferous Slate.*—It is not very easy to give any precise description of the boundary between these rocks and those immediately below. There is a thick mass of strong hard pale gray grits. These are interstratified with green, gray, or liver-coloured shales. As we descend in the series the shales or slates between the grits become red, while as we ascend they become of a darker gray, and eventually almost black. Ascending still higher, the shales and slates retaining their dark gray tinge, become thicker and more frequent, though beds of thick smooth siliceous grit still predominate for a thickness of about 2,000 feet. Above that the grits are fewer, and the mass of the formation is then black slate for a thickness of another 2,000 feet. Some of the grits in the lower part of the series are calcareous, and assume the cornstone character, while calcareous nodules and patches occasionally appear in the slates. In the uppermost part of the group, indeed, there come in little courses of actual limestone, often to be recognised by the rusty or ochrey appearance of the powder of the rock at the surface.

This group of rocks has been called by Sir R. Griffith, Carboniferous slate, while for the massive set of grits in the lower portion of it the

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* The copper in these beds is usually the gray ore, which is widely disseminated through the mass. Where the rocks are weathered the carbonates are formed on the surface and along the joints and cleavage, the blue or green variety appearing according as the place is wet or dry.—G. H. K.

distinctive appellation of Coomhola grits is proposed, as designating a sub-group occurring in the Carboniferous slate.

The total thickness observable, without any appearance of the top of the formation, cannot be less than 4,000 feet.*

The plants which occur in the uppermost part of the Upper Old Red sandstone, are likewise found in the lower grits (Coomhola grits) of the Carboniferous slate. Bivalve shells also occur in these grits; casts of shells, apparently like Cucullæa and Mytilus.

In the upper part of the Carboniferous slate, fossils are in some places very numerous consisting of Orthidæ, Spiriferæ, Encrinites, &c.

Greenstone and Felstone.—The igneous rocks that have been arranged under these heads are very various in appearance, and equally various, doubtless, in composition.

Some of the Greenstones are the ordinary trap rocks so called, a dark green crystalline rock, apparently an aggregate of feldspar (? orthoclase), and hornblende.

Some of those called Felstone, are also, most probably, justly deserving of that appellation. They are smooth, compact, white or light gray in colour, and show here and there little facets of feldspar in the mass.

Others of them, however, are flecked and spotted with brown and yellow dots and specks, so as to become quite spotted, while others are entirely brown and ferruginous looking.

Some even appear to be calcareous, decomposing at the surface into a rusty brown ochre, in the same way that the cornstones do, and might be mistaken for aqueous rocks did they not occasionally cut across the beds of the true aqueous rocks, and assume the appearance of dykes or veins.

The method adopted to decide in each case, whether the rock was to be coloured as a Felstone or a Greenstone, was to test a fragment with the blowpipe. If the rock was very refractory it was set down as a Felstone. If, however, it melted more or less easily its composition was assumed to be more basic, and therefore, to be either that of a Greenstone or analogous to it.

Some of each kind of these trap rocks are evidently of contemporaneous origin with the beds between which they lie, while others of each are as clearly intrusive. This, however, is always to be expected wherever contemporaneous traps occur, as the sources of such beds must clearly be intrusive somewhere with respect to all the beds below them.

The ashes and breccias associated with some of these rocks are most curious, especially those of Black Ball and White Ball Heads. In the former may be seen great crystals of hornblende, as large as the fist, with their angles and surfaces so worn as to show that they were embedded as slightly worn pebbles in the ashy base, and are not native to it. Strings and veins of Asbestos also occur.

* The width of the area occupied by these beds in Bear Island, is rather over a mile and a-half, let us say 8,000 feet. They dip steadily to the south at angles varying from 30° to 80°. If we were to assume the lowest angle for the mean (to make allowance for possible reversals, &c.,) yet, as rocks dipping at 30°, have a thickness half as great as their surface width, we shall still have a thickness of half 8,000 = 4,000 feet.—J. B. J.

These and other appearances, however, will be more fully described in the detailed descriptions.

The varied composition of the trap dykes and veins, is due probably to the different materials they here and there acquired in their passage through the enclosing rocks, as well as in some cases possibly to the subsequent infiltration of water containing mineral matters in solution.

J. B. J.

3.—*Note on the Fossils.*

The highest beds are those which run along the S. shore of Bear Island, and strike thence by Fair Head to Black Ball Head.

Fossils were found in abundance in some of these beds, at the following localities:—

1st.—Near the S.W. end of Bear Island, by the side of the road to the New Lighthouse near the summit of the hill.

2nd.—On Fair Head.

3rd.—On the shore at Mathews' Rock, and at two or three places to the north-east of it.

4th.—Black Ball Head, and places near it.

In all these places specimens of the following fossils were found, the species being determined by Mr. W. H. Baily.

ZOOPHYTA.

Petraia pleuriradialis.

POLYZOA.

Fenestella plebeia. × × ×
„ antiqua?

BRACHIOPODA.

Rhynchonella pleurodon. × × ×
Orthis Michelini. × ×
„ crenistria. ×
„ resupinata.
Athyris Roissyi?
Strophomena crenistria.
Producta scabricula.
Spirifera striata. × × ×
„ lineata.
„ imbricata.
„ disjuncta?
„ cuspidata.

LAMELLIBRANCHIATA.

Avicula, casts of.

ECHINODERMATA.

Actinocrinus polydactylus, stems and heads. × ×
Archæocidaris? plate of.

CRUSTACEA.

Phillipsia pustulata. × ×

In some beds that are below those mentioned above, but still be-

long to the same series, fossils were found at two or three places. One of these was rather more than 150 yards S. of Piper's Point, in the western entrance to Bearhaven, at which the following species were collected, as determined by Mr. Baily:—

Rhynchonella pleurodon.
Spirifera striata.
,, cuspidata.
Modiola MacAdami.
Avicula Damnoniensis,
and other bivalves belonging probably to Curtonotus and Myalina.

At the S.W. corner of Lawrence's Cove, near the eastern end of Bear Island, there were found

Lingula, n.s.
Sanguinolites?
Orthoceras, large sp.
and fragments of plant stems.

On the shore E.S.E. of Rerrin, abundance of Modiola MacAdami, with plant fragments in beds over them.

In still lower beds, just on the S. side of Lonehort Point, there were collected specimens of

Spirifera lineata. ×
,, striata.
Orthis resupinata or Michelini.
Fenestella plebeia;

while some distance above these, just on the S. side of the Martello Tower No. 1. fragments of plants were seen in the rocks.

All the above localities are in the beds containing blue and gray slates interstratified with them.

At Lonehort Point itself, we seem to be approaching the very base of the beds mentioned above and coming into those where the red and purple rocks are beginning to show themselves, but on the north shore of the point and a little west of it, a large collection of fossils was made, consisting principally of casts of bivalve shells, in a rather rotten, incoherent state, which rendered their determination difficult. Mr. Baily detected among them—

Rhynchonella pleurodon.
Avicula Damnoniensis.
Sanguinolites plicatus.
Dolabra securiformis.
Modiola MacAdami.
Mytilus.
Nucula, large species;

and shells that might belong to Curtonotus of Salter, and Cucullæa amygdalina of Phillips.

There were also univalves like Pleurotomaria and Natica, and an Orthoceras, probably approximatum.

In beds still lower than these no fossils have been found, except plants, in the following localities: On the shore of Bear Island, due S. of Mill Cove; on the shore of the mainland, opposite Minane Island, and also opposite the N. end of Dinish Island; immediately S. of the Glebe House of Castletown, and on the shore just S. of Carne Point; on the shore a little south of the old castle of Dunboy;

and, also, very large crushed stems of Knorria, ? several feet in length, in the rocks on the beach, just at the southern end of Dunboy demesne.

The facts as to the nature and distribution of the fossils in the corresponding beds along the shore of Kenmare bay, are believed to be similar. Upwards of four hundred specimens of fossils were collected by C. Galvan, from these beds, of which the following is an abstract account by Mr. Baily.

J. B. J.

Co. Cork, $\frac{101}{4}$.—Between Reen Point and Kilcatherine Point, in lower Carboniferous Slate, with impure limestone.

Plant stems like Knorria from nodules with Avicula Damnoniensis in slate.
Actinocrinus polydactylus, *Miller*, joints of stem. × ×
Actinocrinus, *sp.* numerous joints in limestone.
Ceriopora gracilis, *Phillips*, *sp.* in limestone.
Strophomena crenistria, *Phil. sp.*
Rhynchonella pleurodon, *Phil. sp.*
Avicula Damnoniensis, *Sowerby.*
Modiola MacAdami, *Portlock.*
Sanguinolites, *sp.*
Orthoceras, *sp.*

Co. Cork. $\frac{109}{2}$.—Townland of Ardgroom inward, E. of Foilatluggig, in lower Carboniferous Slate or Coomhola Grit.

Modiola MacAdami. × ×
Curtonotus rotundatus, *Salter ms.*
and small bivalves undeterminable.
Natica, *sp.*
Bellerophon striatus, Bronn.

Co. Cork, $\frac{109}{2}$.—Townland of Ardgroom inward, N. of Knocknamona, in lower Carboniferous Slate.

Plant stems, some of them longitudinally striated.

Co. Cork, $\frac{101}{1 \text{ and } 2}$.—Townland of Kilcatherine, from beds on shore a little W. of Loughaunagallig, in white quartzose grit.

Numerous plant stems and punctured roots, like Stigmaria.

Co. Cork, $\frac{100}{1 \text{ and } 2}$.—Beds on shore Townland of Kilcatherine, in lower Carboniferous Slate.

Actinocrinus joints. × × ×
Fenestella plebeia, *M'Coy.*
Fenestella, *sp.* with large fenestrules.
Ceriopora gracilis.
Strophomena analoga.

Co. Cork, $\frac{102}{1}$.—Townland of Ardgroom inward, from beds on shore N. of Illaunnacuiree, in whitish quartzose grit.

Numerous plant stems, and fruit like Lepidostrobus.

Co. Cork, $\frac{102}{1}$.—Townland of Ardgroom inward, on shore of Illaunnacuiree, in grit beds.

Modiola MacAdami. × × ×
Sanguinolites and other bivalves.

Co. Cork, $\frac{102}{1}$.—Townland of Ardgroom inward, in lower Carboniferous Slate.

Plant stems.
Actinocrinus joints. ×
Spirifera lineata, *Martin, sp.*
,, striata, ,,
,, cuspidata ,,
Rhynchonella pleurodon.
Strophomena analoga, *Phillips, sp.*
Athyris oblonga, *Sowerby, sp.*

Co. Cork, $\frac{102}{1}$.—Townland of Kilcatherine, on shore opposite Illaundonagha, from a thin band of gray micaceous shale in Coomhola grit.

Numerous linear and branching plant stems.

Co. Cork, $\frac{101}{3}$.—Inishfarnard, from gray grit (Coomhola).

Modiola MacAdami. ×

Co. Cork, $\frac{101}{4}$.—Townland of Kilcatherine, near the boundary of Gortgariff, in gray slate.

Plant stems.

Co. Kerry, $\frac{108}{8}$.—N. side of Collorus Island, in dark gray Carboniferous Slate.

Masses of plant stems in good preservation, some of them longitudinally striated and dichotomous.
Detached branchlets and leaves of Sphenopteris? and punctured roots like Stigmaria.

Co. Kerry, $\frac{108}{2}$.—Rocks on shore near Loughaunacreen, in Coomhola grits.

Modiola MacAdami. ×
Avicula Damnoniensis.
Sanguinolites plicatus? *Portlock.*
Natica.

Co. Kerry, $\frac{108}{1}$.—Townland Collorus, in Coomhola grit.

Small bivalves, like Nucula.
Modiola MacAdami. ×
Avicula Damnoniensis. ×
Loxonema, *sp.*

Co. Kerry, $\frac{108}{3}$.—Townland Collorus, in lower Carboniferous Slate or Coomhola grit.

Plant stems.
Small bivalves like Nucula.
Modiola MacAdami.
Cucullæa Hardingii.
Sanguinolites, *sp.*
Fish scale.

Co. Kerry, $\frac{108}{2}$.—Rocks on shore near Bunaw, from a decomposing band in lower Carboniferous Slate.

Avicula Damnoniensis.
Small bivalves undeterminable.
Natica, *sp.*

Co. Cork, $\frac{114}{1}$.—On shore, a little W. of Caherkeen.

Large plant stems, some three or four inches broad, with the surface carbonized.

Co. Kerry, $\frac{108}{3}$.—Townland Collorus, from micaceous slate.

Branching plant stems.

W. H. B.

September 3, 1860.

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4. *Relations between the form of the Ground and its internal Structure.*

These relations are not very well marked in this district, for there is not much difference in the constitution of the rocks. Usually the highest ground consists of the lowest rocks in consequence of those being generally the hardest and most massive grits which have most strenuously resisted the denuding forces. This, however, is not the case in Bear Island, where the low shores next the harbour consist of the inferior, and the lofty southern side of the island of the superior beds. This is partly due, perhaps, to the fact of the upper rocks being there interlaced by hard trap rocks.

All the rocks of the district have been tilted into very high angles, oftener above 45° than below it, and frequently as much as 80° if not even 90° or vertical. They are bent and contorted in various directions, but generally strike with the mean run of the principal features of the ground, the lines of the shores and the crests of the hills, all ranging along lines which run nearly E.N.E. and W.S.W.

If we disregard the minor convolutions, it is clear that the district is thrown into one great anticlinal curve, the axis of which runs about E.N.E. and W.S.W. through the centre of the promontory. Owing to this, the lower beds of the Old Red sandstone are generally to be seen near to the axis, either on the top of the ridge, or in the depths of the valleys that run farthest into the mountains according to the local inclinations of the beds. On each slope of the ridge, as the ground declines on either hand towards the sea, the beds dip in the same direction but at still higher angles, so that newer and newer (or higher and higher) beds come in as we descend, and the highest beds are found on the southern shores of Bear Island and the coast west of it on the one side, and on the northern shores of Ardgroom and Kilmakilloge on the other. (See section, fig. 1.)

We may now see the reason for the difference in the character of the coast before alluded to at p. 6. The coast made of the massive beds of the lower part of the Old Red sandstone, although bold and lofty, is generally open and exposed. This is more especially the case in Ballydonegan Bay, as the beds seem inclined to dip on all sides towards the centre of the bay, as if to bring in the Upper Old Red sandstone, which generally forms the lower ground. It is probable that if we could follow the beds out to sea, we should find that the single anticlinal curve as it proceeded towards the west separated completely into two at Knockoura, so as to include a synclinal

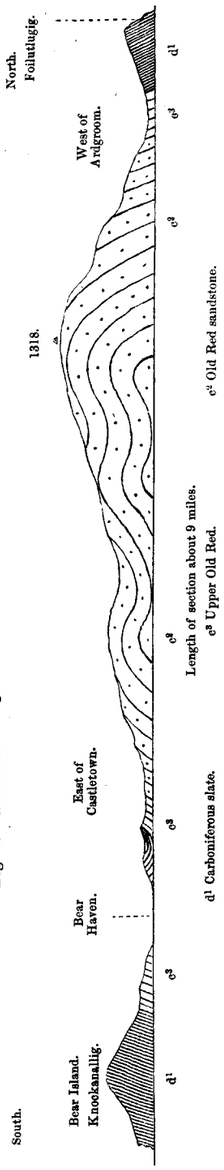


Fig. 1.—Generalized diagrammatic section from Bantry Bay to Kenmare Bay.

trough between them, which would contain perhaps further west, beds belonging to the Carboniferous Slate.

This formation when it forms coast cliffs, breaks away in sharper and more angular forms than the Old Red, and is more easily worn by the waves into abrupt and irregular hollows, with narrow ravines or valleys cutting directly across the strike of the rocks. The harbours worn out of it are therefore closer and more completely land-locked, or protected by jutting headlands and rocky islands, while the Old Red more naturally forms open bays with bold sweeping curves.

One curious minor feature observable on the flanks of the mountains of this district, is that formed by frequent straight cuts or gashes, locally called Coombs. They are deep, well-marked fissures, that run up the sides of the hills and cut across the tops of the mountains, some of them can be proved to be on lines of fault, but usually no proof of displacement can be discovered in them. These are well seen in the mountains in the centre of the district, but the most remarkable of them are found in the hills to the south of Ballydonegan Bay. One of these, which is more than 200 feet deep, is used as a pass from Garinish to Firkeel; another called Barns Gap, runs north from Killough to Ballydonegan.

J. B. J. and G. H. K.

Detailed Descriptions.

[The ground which lies between the Bays of Bantry and Kenmare, was surveyed by Messrs. A. Wyley (late Government Geologist to the Cape Colony), G. H. Kinahan, and J. O'Kelly.]

J. B. J.

5. *Position and Lie of the Rocks.*

In describing the position and lie of the rocks, it will, for this district, be most convenient to take them in stratigraphical order, commencing with the lowest.

Old Red Sandstone.—In the hills round the southern end of Glenbeg Lough, Mr. O'Kelly found massive grits, varying from purplish to greenish-gray, dipping in different directions,

at angles varying from 40° to 60°; the exposed beds forming parts apparently of boldly sweeping curves, and dome-shaped, or basin-shaped, undulations.

North of the Lough they began to dip more steadily to the northward, at first, at 40° or 50°, but farther north, at still higher angles; so that about Ardgroom and Kilmakilloge Harbours, the dip is steadily N. or N.N.E., at from 75° to 85°, or even sometimes to 90°.

S. of the Watershed, about the Glas Loughs, and in the valleys of the Rossmackowen and Owgarrif rivers, Mr. Kinahan found the beds even still more curved, with many sharp anticlinal and synclinal undulations, the axis of which ran E. 20° N. and W. 20° S., and these undulations continue even down to the shores of Bearhaven.

Calcareous bands (cornstones) show themselves here and there on both sides of the Watershed, but those on the south are more numerous, or are more frequently exposed. Mr. Kinahan describes one of these, S. of Curryglass House, as having the look of an amygdaloid, from the occurrence of concretionary lumps of carbonate of lime in the red shale.

Proceeding from Glenbeg and Ardgroom, towards Ballycurane Harbour, the massive purple and gray grits acquire a strong westerly inclination, undulating frequently both to the north and to the south, but often dipping W. at 35° or 40°.

This westerly dip is very remarkable all along the south shore of Coulagh Bay, where, with a few reversals and short anticlinal curves and contortions, the dip is on the whole N.W. or W. at from 45° to 75°. Beds of red slate are here often interstratified with the grits, especially as we ascend in the series.

The cleavage was observed at the following places:—

Reeve Point—beds dip N.N.W. at 80°; cleavage dips S.S.E. at 50°: in the Little Creek, one mile and a-half W. of Coulagh, beds dip N.W. at 60°; cleavage dips N. at 85°: on the shore, half-a-mile west of the above, beds dip W. by N. at 65°; cleavage dips N.W. by N. at 35°.

In the bed of the brook, that rises between Miskish and Knockoura, there is a good section in purple grits and slates, dipping generally between W. and N. at high angles, and at one point where the dip was N.W. at 80°, the cleavage dipped S.S.E. at 80°.

On the summit of Miskish Mountain, the dip is S. at 60°; but between the summit and the Castletown Pass, there are rocks to be seen dipping S.W., and then curving so as to dip N.W., and then, as they strike towards the southern slopes of Miskish, curving round again so as to dip W., all at angles varying from 30° to 60°. These seem parts of anticlinal and synclinal curves, the axes of which are inclined to the west, as to take higher and higher beds over them in that direction.

J. B. J., from Notes by A. W., G. H. K., and J. O'K.

To the S.W. of Miskish Mountain, on the top of the ridge which joins Knockoura and Knocknagallaun, the strata are well seen, but they are all very much of the same character. Beginning at the east of the ridge, the first rocks met with are purple and purplish-gray grits, dipping to the W. at 50°. Due north of this is the Urhin Copper Mine, which will be more fully spoken of hereafter. From this to the road from Coulagh to the Bearhaven Mine, nothing is to be seen but purple and purple-gray grits and slates, dipping nearly W., at angles varying from 60° to 70°. Where the road crosses the ridge there are purplish-gray and green grits (full of quartz strings, and veins), dipping W.N.W. at 50°. The cleavage here runs nearly E. and W., and dips S. at 80°. Having passed the road, green and purple beds are met with, which are slightly undulating, but with a general dip of 75° to the west; these underlie green and purple slates and grits (full of quartz veins, and strings), which dip N.W. at 65°; from this to the top of

Knocknagallaun there are green and purple grits and slates, which dip N.W. at from 60° to 65°.

A little to the north of Knocknagallaun there are two nearly parallel faults, the northern of which is a downthrow to the E.; they run E. 10° N. The rocks between these faults dip N.W. at 50°. At the north of these faults, when the disturbance caused by them is passed, the beds are found to dip W. at 50°.

On the sea-cliffs, to the north of Knocknagallaun, there are green and purplish-gray slates and grits, dipping S.W. at 70°. About a mile to the N.W. of Knocknagallaun there are two faults, one running N. and S., and the other nearly E. and W.; in the N. and S. fault there is a quartz vein, in which a trace of copper pyrites was observed.

To the north of Cod's Head, where the northern margin of the map (sheet 198) joins the sea-coast line, there is a thick bed of Greenstone, which dips to the S. at 50°; over the greenstone is green and purple slate, and above that are purple and gray grits, in which are quartz strings. The next rocks are gray and purple slates, full of quartz strings. Having passed these, the beds then seen are purple and green sandy slates, with an occasional grit, these first dip to the S.W. at 50°, then W.S.W. at 50°. This dip curves round gradually, and to the north of Cod's Head the rocks are found dipping S. at 60°. Above these last-mentioned beds is seen a thick bed of greenstone, over which are green and purple slates, which dip S. at 70°. At Cod's Head there is a thin calcareous bed.

Having passed to the south of Cod's Head, the strike changes, and the beds dip to the W.S.W. at about 60°. The same beds as those just described are again seen; and about three-quarters of a mile from the Head the bed of greenstone is met with. Having passed the greenstone, purple slates are found, in which are five or six calcareous beds, from four to twelve inches thick. The strike here changes again, and the beds dip S.W. at 38°. A little to the south of this the strike curves round, and at the cliffs, the dip is nearly W. at from 60° to 70°. Under these slates are green grits, with a few purple slates; they dip N.W. at 87°. The next beds in a descending order are purple slaty grits, in places calcareous; they lie above green and purple slates. Here there is a well-marked fault, the general line of bearing of which is N. and S.; it is a downthrow to the west. Having passed this fault, purple slates and slaty grit are found, that dip W.N.W. at 70°. Similar beds occur for a quarter of a-mile, at the end of which are green and gray grits, interstratified with a few slates; they dip W.N.W. at from 50° to 70°. Underneath these are some green and purple slates, among which there is a small Greenstone dyke. From this to the head, on the north of Allihies Point, the line of cliff runs nearly along the strike of the beds. The rocks are purple and green slate, with a few gray grits; they dip W.N.W. at from 40° to 50°. To the south of the head just mentioned the rocks dip E. at from 50° to 75°; and at the north of Allihies Point they dip S.W. at 50°. To the east of this, in the lowland, lie the Bearhaven Copper Mines.

At Allihies Point the rocks, which are purple slates, undulate in such a way as to have a general dip to the W. To the south-east of this, at Ballydonegan, the beds dip nearly N. at 65°. The highest beds are purple and yellow slate, under which are purple and green grits, some of them weathered brown, and when so weathered, looking very ashy. These rocks rest upon some purple slates that in their turn overlie green grits, underneath which are purple slates again. A little to the south-west of Ballydonegan, there appears to be a fault, as the end of the next beds met with come right up against the strike of those beds just now spoken of. These latter beds undulate with a general dip of about 15° to the W. From this to Keam Point the principal rocks are purple and green slates; they all dip to the W. and W.N.W. at from 60° to 70°. From Keam Point to Dursey Sound the rocks are green and purple slates and grits. As far as Garinish the strata

undulate more or less, but with a general dip to the W. At White Strand there is a bed of greenstone. After passing Garinish the rocks have a steady dip to the W. of generally about 80°. To the west of the White Strand the rocks are full of quartz veins and strings.

Along the north coast of Dursey Island, for about one mile and a-half, purple slaty grits are generally to be seen, among which are a few green slate beds; they dip W. and W.N.W. at from 70° to 75°. Due north of where "D" in Dursey, is engraved on the one-inch map, on the coast-line, there is a large bed of Greenstone.* Over this Greenstone, and lying conformably upon it, are purple slaty grits, dipping N.W. at 80°. This bed of Greenstone extends out to the point to the north of Dursey Head, and has a steady dip to the N.W. at from 80° to 90°. On the south coast of Dursey the same beds are met with as those on the north, all dipping to the N.W. at angles varying from 60° to 75°. To the south-west of Kilmichael, in an old wall, there was found a piece of slate, like the slates of the neighbourhood, full of annelid tracks of an oval form, about an inch and a-half long, and about the eighth of an inch in the longest diameter, shaped like the long teeth of a hare.

In the Crowhead Promontory there are found green and purple slates, with a few grits, all dipping to the S.W. at 45°. Associated with them are trap dykes, and some of the green slates have a very ashy appearance. All round Firkeel Bay the beds undulate with a general dip to the west. From Horn Point to Serough Island, the coast-line runs along the strike of one set of beds, which are principally purple slates; they all dip south at about 75°.

Igneous Rocks.—The greenstone that is found in the Old Red sandstone, appears in two distinct districts—one to the north, and the other to the south, of the Allihies Copper Mines.

The northern trap district lies to the north-west of the Mines, and north-east and east of Cod's Head. These igneous rocks are divisible into contemporaneous and intrusive.

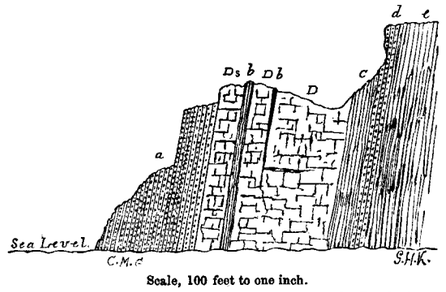
The contemporaneous traps of the northern district, the beds of which average generally about 120 feet in thickness, are for the most part, at least in the undermost portions of the beds, a compact Greenstone, with here and there veins of a light green colour, with small asbestos veins, and in some places minute crystals of white hornblende disseminated through the mass. These traps are also traversed by veins of quartz, compact and crystalline, besides flaky partings of greenish opal in the joints, with crystals of iron and copper pyrites, the copper pyrites being confined apparently to the asbestos. Small distinct crystals of white felspar and black hornblende are also to be found. Three or four feet of the uppermost portion of these beds is different from the rest, being very ashy and full of small round cavities, about a quarter of an inch in diameter, which at present seem to contain decomposed calcareous matter; besides these cavities, it is, in some places, full of crystals of iron pyrites.

To the west of the southern trap district, on the north-west coast of Dursey Island, stretching along to Dursey Head, is a thick bed of Greenstone, which seems to be a continuation of one of these beds, and appears to be confined to the north-west portion of the Island, but as to this it is difficult to decide, as the Island is covered with drift and bog, and the coast is the only place which affords any exposure of rock. This bed of Greenstone, at its eastern end, is divided into two by a bed of slate, about four feet thick, which, however, dies out again, as it is not to be found when the trap is followed westward. The higher bed which lies

* Our attention was first drawn to this trap bed by the late Captain Church, R.N., who discovered it while making the coast survey of this district.—G. H. K. and J. O'K.

over the slate is very ashy, and very much resembles the highest portion of the beds on the mainland at Cod's Head. The lower bed seems to have been poured out at two distinct periods, as, on going a little farther to the west, another small bed of slate is found in the Greenstone. This slate at the edge of the cliff is about one foot thick, it gets thinner as it goes east, and dies out after having extended for forty feet in length; it also thins as it goes down in the mass, and disappears at a depth of thirty feet below the top of the cliffs.* These facts may be seen on the coast, which at that place cuts right through the beds, showing a good transverse section. See Fig. 2.

Fig. 2.
Diagrammatic sketch on N.W. coast of Dursey Island.



Scale, 100 feet to one inch.

a Slaty grits. *b* Altered Slate. *c* and *e* Purple slate.
d Green grits. *D* Greenstone. *Ds* Ashy greenstone.

The bed of trap is traceable along the coast to the north side of Dursey Head, where it disappears in the sea. A little more than a mile on the north-east of Dursey Sound there is a mass, apparently a bed of similar Greenstone, which may be connected with the Dursey trap.†

The intrusive traps of the northern district all spring from a large irregular mass, with dykes running out on all sides. Some of them could be traced more than 500 yards, while some do not exceed 50. They generally end most abruptly. This volcanic focus seems to have been in action at a later period than that which produced the contemporaneous trap, as the latter, along with the associated grit and shale, are displaced and faulted seemingly by these intrusive traps. The intrusive traps are, in aspect and nature, very like the bedded traps, but do not seem to have any ashy portion in them.

There is also a small Greenstone dyke to the north of the Dooneen Mine, which may belong to these traps.

* It seems almost impossible to suppose that a mass of intrusive trap, injected along the beds, could have included a bed of slate forty feet wide, and only one foot thick at the thickest, thinning out gradually in every direction till it ended in a sharp edge. If, however, the Greenstone is the result of several successive submarine flows of lava, it is very natural that on the upper surface of one of these flows a slight hollow may have existed after its consolidation, in which a small bed of mud or silt may have been deposited, and that the next flow of lava covered this mud, and baked it into hard rock. That successive flows of lava coalesce, so that no appearance of their having been separate remains, unless some such matter is interposed, is shown by the facts described in Sir C. Lyell's paper "On Lavas of Mount Etna, &c., Phil. Trans., 1858."—Note by J. B. J.

† This trap escaped my notice when I was examining the district; but from the description given me by C. Galvan (fossil collector), and the specimens he showed me, I am inclined to think it a similar bed to that just described. That it is a bed appears certain from the upper part being ashy.—G. H. K.

The southern trap district is situated on Dursey Island, and on the part of the north coast of Bantry Bay, that lies between Crow Head and Scrough Island. Those on Dursey Island and White Strand have already been described with the northern district, as, though situated in the south, they are supposed to be connected with those of the north. The rest of these traps consist of a pale ashy-looking Greenstone; they have a most marked difference from all the others, and seem to have no connexion with them whatever. They are all very small intrusive dykes, the largest not being more than three feet thick, most of them about one foot and a-half, and the small ones about nine inches. None of them are contemporaneous; all are nearly vertical, with a slight dip to the north, and run in a direction generally E. 15° N., except one that is near the north of the peninsula, and runs nearly along the strike of the beds; they are not easily traced, on account of their small size, and the country being covered with drift and bog. The best place for seeing and examining them is on the north-west coast of the Crow Head Promontory. At Horn Point, which is the headland to the east of Firkeel Bay, there is a small oval mass of igneous matter of an ashy appearance, which at first sight seems to be contemporaneous, and with the same stratification as the surrounding slate; but that character is hard to be accounted for, as there are a number of ashy-looking dykes branching from it to the south-east and north-west. There is also a dyke to be found about half a-mile farther east along the coast, but it is not traceable all the way on account of the deep drift. It is, however, most likely that it had its origin at the above spot, as also all the dykes at or near Crow Head. This has all the appearance of having been the vent of a small submarine volcano, as all the dykes that, probably, are connected with it are of a very flaky nature, and such as one could imagine a volcanic ashy-mud to become on being consolidated. The underlying slate seems to be altered for the space of two or three feet.

There is a Greenstone dyke to the west of Caheraphuca. This runs nearly north and south in a fault. As it goes south, it divides into two branches, the western of which could only be traced a short way, the eastern branch runs through the Upper Old Red sandstone into the Carboniferous slate, and is, therefore, clearly, much more recent than the Old Red sandstone.

c^3. *The Upper Old Red Sandstone.*—At the west of Cahermore, in the stream flowing from Killough, the first rocks seen are purple slates and grits, dipping S. at 60°. Above these are purple and green slates, which dip S. at from 70° to 90°. Similar slates occur up to the boundary of the Carboniferous slate, near which they contain one or two calcareous beds. The same kind of rocks are met with towards the E. below the boundary of the Carboniferous slate for about three miles, when the rocks become very marked in their character, especially at Drumsharra Point, where the slates next to the boundary contain many siliceous limestone beds, and are highly impregnated with copper. Some of the limestone beds are very pure, and are two feet thick; one of them is also highly impregnated with copper. From Pulleen Harbour to the west, for nearly a mile along the cliffs, all the rocks have been affected by a large land slip, which extends from the coast inland for more than a furlong, the beds being thrown into curiously discordant portions, so as to appear very puzzling, until the true nature of the disturbance is perceived. On the road from Castletown to Cahermore there is a good section across the Upper Old Red. The lowest beds are purple gray grit and slate, dipping S.E. at 87°, over which are greenish grits and slates, in which is a siliceous limestone. Next these is found a felstone dyke, which runs along the bedding for more than half a-mile; at its western extremity it is lost in a bog, while to the east it splits into two, and shortly after dies out. The colour of this felstone is bluish or greenish white; in

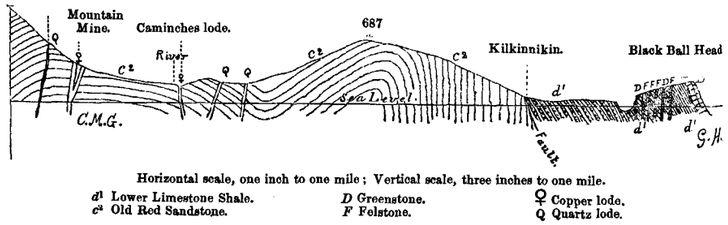
a few places it is like Serpentine; and the weathered portions effervesce slightly with acid. To the south of this dyke are green and purple slates and strong purple gray grits, dipping to the S.E. at 70°. Above these are greenish and purplish sandy cleaved grits, over which are green slates, with specks of copper ore. The rest of the section, up to the boundary of the Carboniferous Slate, exposes nothing but purple and green slates. All these dip to the S.E. at from 60° to 70°.

Along the coast, to the east of Dunboy Castle, the section is very much the same as that just described. To the south of the old castle in Dunboy Demesne many compressed stems of large fossil plants are to be seen in these rocks. Nearly similar sections are seen to the west of Castletown, and to the north of Brandy Hall. The Upper Old Red is also well seen at Minane, Millcove, and Hermitage Cottage. To the north of Hermitage Cottage the slates are full of specks of gray copper ore, and when broken they weather quite green. Along the north coast of Bear Island there is a strip of Upper Old Red, the rocks being so similar to those on the mainland as not to need a special description.

d^1. *The Carboniferous Slate.*—This formation occupies the coast of the mainland from White Ball Head on the west, to Piper's Point on the east, and nearly the whole of Bear Island; there is also a small detached basin of it to the south and east of Castletown. There is a good section to be seen in it to the west of Cahermore. Beginning at the lowest bed, the first rocks met with are greenish and gray slates, in which there is a bed of Felstone and a calcareous bed; over that comes some greenish grit, then blue and ribboned slate, then blue slate, over which are blue grits and black shale, above which are blue and ribboned slates and grits, in which plants are found. The beds dip S.E. at from 65° to 75°. To the south of Tramore are found green and gray grits, blue sandy slate, and ribboned and greenish grits, in which are two thick beds of trappean ash; over these are blue ribboned slate, and then green and gray grits; these all dip to the S.E. at 70°. These latter grits are those that form White Ball Head. On the south of the bay that divides White Ball and Black Ball Heads are found black and blue slates and flagstones, dipping S.E. at 60°. The rocks next met with are grit, flagstone, and shale, in which are numerous dykes of trap. (See fig. 3). To the east of the traps there are black and blue slates, which are capped by a thick greenstone bed. Calcareous bands full of fossils, especially encrinites and fenestellæ, are found in these upper slates.

Fig. 3.

Diagrammatic section from the ridge of hills at the north of the Bearhaven Copper Mines to Black Ball Head.



Horizontal scale, one inch to one mile; Vertical scale, three inches to one mile.

d^1 Lower Limestone Shale. *D* Greenstone. ♀ Copper lode.
c^2 Old Red Sandstone. *F* Felstone. Q Quartz lode.

In this section are found similar beds to those that lie between Black Ball Head and Carrigfadda, which lies three miles to the E.N.E.

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Two other very good sections through these rocks are to be seen in the sides of the western entrance of Bearhaven. Going south, from the point east of Dunboy Castle, the following rocks are met with:—First dull grayish blue and green slates, with occasional grit beds, over which are greenish slate and slaty grits. The next rock met with is a Felstone dyke. To the south of that are bluish gray slates, in which were seen many large stems of plants (?Knorria) greatly compressed; another dyke also traverses them. Over these blue slates are gray and pale gray grits, very solid and massive. All these rocks dip nearly S. at from 75° to 85°. To the south of this, on the coast opposite the small islands, there is a slight anticlinal curve, the northern side of which dips N. at 87°, and the southern S. at 40°. The next rocks met with are gray grits and slates, which dip S. at from 50° to 85°, and from this to Piper's Point there are gray and blue grits and slate, dipping nearly S. at from 50° to 60°; associated with which are a number of beds and dykes of felstone and greenstone. To the south of Piper's Point are gray and greenish slates and grits, over which are blue ribboned slate, and then greenish and gray grits and flags, among which are a few thin shales; all dipping S.S.E. at from 60° to 90°.

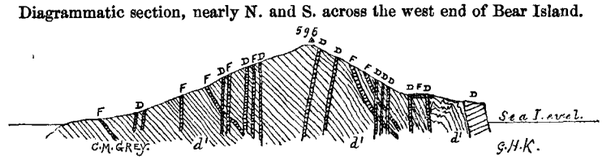
G. H. K., from Notes by A. W.

The rocks to the north of Fair Head are blue and greenish flagstones and grits, with shale partings, and beds of Felstone and Felstone Ash. They undulate; but on an average dip S.W. at an angle of about 65°.

A similar section to that just described is seen on the west coast of Bear Island, but there are here more traps associated with the aqueous rocks. On the new road, about half-way between the Landing Stairs and the New Lighthouse, there is a bed of blue slate, in which there are calcareous patches, full of shells, corals, and encrinites. Beneath these, striking from the coast, through the centre of the island, are many thick compact grits, interstratified with slates and indurated gritty shales. They strike very regularly E.N.E. and W.S.W., and dip to the S. at high angles. These beds form the lower part of the Carboniferous slate group, that sub-group for which the name Coomhola grits is proposed. (See explanation of Sheet 192.) In the S.W. corner of the island the beds are much broken, twisted, and cut up by dykes of igneous rocks running in every direction. (See fig. 4).

Fig. 4.

Diagrammatic section, nearly N. and S. across the west end of Bear Island.



Horizontal scale, two inches to one mile; Vertical scale, four inches to one mile.

d^1 Lower Limestone Shale. *D* Greenstone. *F* Felstone.

In the eastern part of the island the beds are generally regular; and the following section may be seen beginning on the sea coast, due south of where the N in Bearhaven is engraved on the one-inch map. The lowest beds seen are dull gray and green gritty slate, in which are calcareous nodules and beds that contain fossils (bivalve shells), over which are flaggy grits and dull gray shales; these all dip S.S.E. at 75°. The next rocks met with are blue slates, which dip under green, gray, and blue grits, flagstones, slates, and shales, alternations of which are found all along the coast to the village of Kerrin. To the south of the Martello Tower, No. 2, are blue ribboned slates,

resting upon grit beds, that are in one place traversed by an anticlinal curve; over the slate are greenish and bluish flagstones and sandy indurated shales, which are full of fossiliferous calcareous nodules. These are well seen on the coast to the west of Leahern's Point, where they dip south at 87°.

Igneous rocks occurring in the Carboniferous Slate.—The Carboniferous Slate of Bear Island and the neighbourhood has many igneous rocks associated with it.

In Bear Island they are divisible into five kinds, viz.: contemporaneous and intrusive Felstone, contemporaneous and intrusive Greenstone, and Felstone Ash.* The only beds of real ash are felspathic. Most of the greenstone dykes have an ashy appearance, owing, probably, to the decomposition of the rocks. The felstones, for the most part, seem to be contemporaneous, the greenstone generally intrusive.

In the south-eastern part of the island, and to the north of Carriglickeenadarrig, there is a series of beds of felstone which seem to be strictly contemporaneous, since the tops of the beds are all more or less ashy, and they generally become altogether ash before dying out. They are of a bluish white colour, with a few crystals of white felspar widely disseminated through the mass. No greenstone was found in this part of the island.

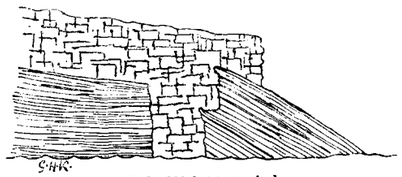
In the north-western part of the island, near the Redoubt, the traps, which are usually felstone, run along the strike of the bedding, some of them being themselves bedded. These are traceable a short way to the east, when they are lost in the drift; a few of them can be traced as far as the Telegraph Tower, but they do not go much further, if any, as they are not to be found in the hill to the east of it, beyond the patch of drift that intervenes. To the south of these traps, the slates, and interstratified contemporaneous traps, are cut up by a system of dykes, of which those that are traceable are composed of an ashy-looking greenstone; but on the coast are found several small felstone dykes, which, on account of their small size, cannot be traced into the interior. The greenstone dykes run in almost every direction, but the principal ones strike N.E., and some of them are traceable as far as the Telegraph Tower, dipping at an angle of 85° to the N. and N.W., and on an average about two and a-half feet thick. Some of these end in bosses of compact greenstone. Under the Western Lighthouse Tower, at Ardnakinna Point, there is a large mass of trappean breccia, with a white felspathic base, in which are pieces of altered grits, slates, &c. There is a section seen in the cliffs towards the west, where it has the appearance of being interstratified with the beds; but on the east there are a number of dykes running out of it. A very good section of two of these is seen on the road leading down to the lighthouse. In a quarry near a small detached house to the east of the lighthouse, there is a good example of a dyke dividing into two. These dykes, after they leave this quarry, seem to run evenly between the beds. Along the coast to the east of the lighthouse there are felstones, which run towards the east with the same bedding as the surrounding grits and slates, but are cut up in two or three places by the greenstone dykes (see fig. 4). At that part of the island that lies farthest to the south at Carrignanean two large beds of felstone are found, with greenstone dykes running obliquely towards them; these latter are seen in the grits and slates, but do not appear through the felstone, which, however, is raised and twisted in the places that are in the line of direction of the dykes. Due west of Knockanallig there is a valley, in which there is a large boss of greenstone, with many small dykes running out of it, mostly in a westerly direction. This valley is bounded on the east by a cliff which is full of small felstone traps, that seem to be contemporaneous. There is also one

* This is only a general division of them, as some of them become porphyritic; while others are intermediate, as felspathic greenstones, and hornblendic felstones.

greenstone, which at the cliff is a hornblendic felstone, but in a short distance it changes into a beautiful porphyry, and afterwards into a compact greenstone. All these traps die out on the east face of Knockanallig, or are lost in the drift at its base. Due south of this valley there are a number of felstone beds, with one or two greenstone dykes. All the felstones observed seemed to be contemporaneous, the bed of slate or grit (as the case may be) on which each of them lay being altered more or less, and the upper part of each trap being generally ashy. There are at least in this place sixteen of these beds.* None of these are very thick, usually varying from two to ten feet, and most of them being not more than four feet thick. Across these run the greenstone dykes, which latter generally strike in a direction nearly N. 25° E. They cut through the felstone, and chop it up in a most inconceivable manner. One of these felstones ends abruptly against a greenstone dyke, and is a most peculiar rock, being cut up by joints into small angular pieces.† Its colour is white, and it seems to be nearly a pure felspar. To the west of this, along the coast, at the north of the Greenane Rock, there are some beds of felstone trap and ash, and some felstone trap dykes, the latter being mostly very small, none of them above two feet in thickness; they are very compact, of a reddish hue, and a hand specimen of some of them might be easily mistaken for a grit. Near the coast, and due south of the Telegraph Tower, are two masses of hornblendic felstone. That to the north has two greenstone dykes running through it. The mass to the south is tabular, as shown by sections in a small bay near its centre (see fig. 5). To the west, in a small island, there is a bed of grit, caught up in the trap in a peculiar

Fig. 5.

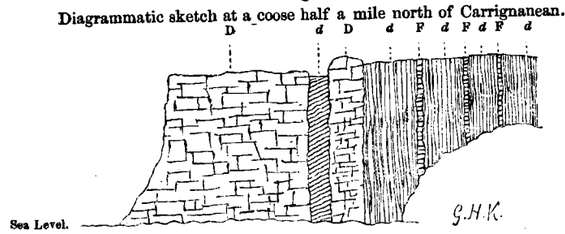
Diagrammatic sketch half a mile W. of Fig. 6.



Scale, 100 feet to one inch.

Fig. 6.

Diagrammatic sketch at a coose half a mile north of Carrignanean.



Scale, 100 feet to one inch.

D Greenstone. F Felstone. *d* Slate.

* Twenty-two beds can be counted, but as the ground is faulty hereabout, many of those that seem to be additional beds, are considered to be more likely parts of some of the others.—G. H. K.

† I have subsequently observed traps with nearly similar characters in two places in the county Limerick, viz., Carrigogunnell and Boughilbreagha; but in these places the fragments are now cemented together by calcspar, the traps being associated with the Carboniferous limestone. (See explanation of Sheets 143 and 144.)

manner. At the east end of this mass, in a small "*coos*," there is a good section, showing this trap and three felstone beds (see fig. 6). Due west of this, and at the head S.E. of Ardnakinna Point, is a large mass of intrusive felstone.

The felstone traps associated with the higher beds become more hornblendic than those in the lower; and at the south side of the island, in the highest rocks seen, the felstone might be called hornblendic felstone, and in some places changes into a pure greenstone, and all of them fuse more or less before the blow-pipe. These are often regularly bedded, in other places intrusive. After the formation of these traps the greenstone dykes appear to have originated. They are very ashy-looking and flaky, but generally have through them here and there compact portions, or end in a compact boss; so, that it is clear, that the flaky appearance is due to decomposition. The contemporaneous or bedded felstones are either bluish or white, with crystals of felspar widely disseminated through them; but none become a regular porphyry. In the ashes there are also a few crystals of felspar. It is difficult to ascertain the relative age of the felstone dykes, as they only were observed on the coast, and in no place were they found in contact with any of those formed of greenstone. All that can be said about them is, that they are older than the hornblendic felstone; but whether they are newer or older than the greenstone dykes, has still to be discovered.*

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On the mainland the traps are very much like those on Bear Island. Near the south end of the wood in Dunboy Demesne, on the coast, there are two bluish white porphyritic felstone dykes to be seen. These, when they go a short distance inland, join into one, and can be traced to the west for about a furlong. Immediately south of the wood there is a large massive bed, about eighty feet thick, of green compact felstone; this can be traced from the strand, where it is not more than two feet thick, to near Pulleen Harbour; it is twice broken by small cross dykes, which are composed of white felstone, and are about ten feet thick. The first of these dykes going from the east, is in a fault, which is a downthrow to the west of about 200 feet. The second north and south dyke cuts off the bed of felstone altogether, as beyond it, it is not to be found for more than two miles, when a thick bed, at about the same position, though different in character, is met with due south of Caheraphuca. South of this bed, and both to the north and south of Piper's Point, there are a number of thin dykes and beds of trap, most of which are felstone. Due south of Piper's Point were three rocks standing up, called the Piper's, which are part of a trap dyke.† At Fair Head, and along the coast, both north, east, and west of it, there are beds of felstone, trap, and ash, and dykes of greenstone. Towards the north-east the felstone makes its appearance in beds, but at Fair Head it becomes tabular. The greenstones are all small.

To the west of this, and north and west of Carrigfadda, there is a well-developed igneous district, full of dykes and beds. This place is very like Bear Island, the traps being felstone at the lower part of the formation, getting more hornblendic as we ascend, and all being cut up by a system of thin ashy-looking greenstone dykes. The hornblendic felstones are partly contemporaneous, and partly intrusive (see figs. 7 and 8). To the east of Quarry Point a remarkably good section is seen (fig. 8), which shows both

* It was impossible to mark on the one-inch map all the dykes that have been discovered and traced, as there was not sufficient room to receive them on any less scale than the six-inch maps, of which copies are preserved in the Geological Survey Office, Stephen's-green, Dublin.

† The heavy weather in the winter of 1857-58 broke one of these off right between high and low water mark, so that now there are only two.—G. H. K.

the contemporaneous and intrusive traps. About two miles to the north-west of Quarry Point, and two furlongs to the south-west of Cahirmore, there is a very peculiar mass of trappean breccia; it forms a mass which cuts across the beds of the surrounding rocks, and is made up of fragments of trap, slate, grits, "primary limestone," and other kind of rocks in a bluish white base, and from it proceed both beds and dykes of felstone and greenstone. South of this, on White Ball Head, there are three beds of trappean ash; the two to the north have a greenish brown earthy base, in which are partially rounded crystals of black hornblende, often two inches in diameter; their angles being rounded, while their facets are brilliantly glistening. The bed of ash towards the southern part of the peninsula is very like the mass of breccia to the S.W. of Cahirmore: it runs to the east for about 200 yards, and then changes gradually into a slaty grit. At the point of White Ball Head there are four dykes, cutting directly across the beds, full of trappean breccia, very like that in the two ash beds that lie to the north, and have been just described.*

Fig. 7.

Diagrammatic sketch of cliff half way between Quarry Point and Mathews' rock.

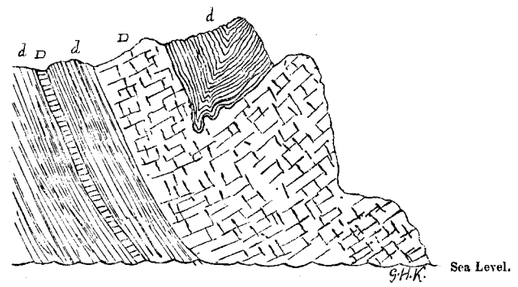
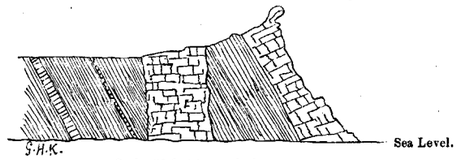


Fig. 8.

Diagrammatic sketch of cliff to the E. of Quarry Point.



Scale, 50 feet to one inch.

South of this, on the north-west side of Black Ball Head, there is a large irregular mass of trappean breccia, the middle of which is the same as that which fills the four dykes on White Ball Head, while on the outside it is like the mass of breccia that lies to the S.W. of Cahirmore. In the inside breccia are veins of asbestos, sometimes of considerable magnitude. The

* These dykes, full of breccia, on White Ball Head, are certainly very curious. They are vertical, from two to five feet wide, and strike nearly due N. and S., directly at right angles to the strike of the beds, which consist of alternations of grits and slates, nearly vertical, and running about E.N.E. and W.S.W. The dykes can be well seen in a neck of land that juts out to form the head, and in the cliffs on each side of it, and are undoubtedly genuine dykes of breccia, as described by Mr. Kinahan, full of angular fragments of trap and other rocks embedded in an ashy base, the pieces being often as large as the fist. —Note by J. B. J.

breccia on Black Ball Head would appear to have been the vent of eruption of a submarine volcano; and the dykes on White Ball Head, and the mass of breccia to the S.W. of Cahirmore, may have been part of the funnel. The Black Ball Head breccia appears to have been contemporaneous with the mass of slate, and aqueous deposition seems to have been taking place, together with that derived from the igneous source, as the mass of breccia blends in gradually with the surrounding slate, and is quite coarse near the centre, getting finer and finer as it recedes from it. Out of it there proceed a number of dykes, most of them felspathic, but a few hornblendic, which are partly intrusive at their origin, but they run nearly even along the strike of the beds. To the north of this mass of breccia there is a system of dykes, one of which is a compact green felstone, very like the one that runs to the south of Dunboy Wood, but this is much higher in the formation.

Under the Black Ball Head Tower there is a large mass of greenstone, quite different from any of the other greenstones found in the Carboniferous slate of this district. In the first place it is, undoubtedly, contemporaneous; and secondly, it is compact, and very like the greenstone found in the Old Red at Cod Head, only that it has not the light green patches, with asbestos in them. It seems to have been poured out at two distinct periods; as on the eastern side of the headland there is a small bed of green and black slate, about nine inches wide, which runs through the mass of the greenstone under the tower.

G. H. K.

We have now to describe the Carboniferous slate rocks that show themselves along part of the south shore of Kenmare Bay.

At Reen Point, on the north side of Ballycrohane Harbour, the red and purple slates and grits after one or two sharp folds and contortions dip N.N.W. at 80°, and seem to strike steadily towards the E.N.E. They contain a few bands of green grit interstratified with them, and these become more numerous as we ascend in the series, and many compact pale gray, or greenish gray beds occur, till we find on the shore, about 600 yards N.N.W. of Reen Point, yellow, brown, and light green grits with small bands of slate, and fragments of fossil plants. We here lose the red colours altogether; and still further north, up to Kilcatherine Point, we find a series of dark blue and black slates, sometimes earthy, sometimes hard and gritty, all striking E.N.E. and W.S.W. and nearly vertical.

The straight piece of shore inside of Kilcatherine Point exhibits a section of about 1,500 feet, measured directly across the strike of the beds, through strong greenish gray compact grits, with a few thin beds of black slate, all in a vertical position, and striking E.N.E. and W.S.W. These are the true Coomhola grits, and they strike westwards through Inishfarnard to Ballycrohane Island, being in fact the hard and firm rocks which have enabled those projecting points to resist the wearing action of the sea longer than the rocks N. and S. of them.

Eastwards, these grits strike steadily through all the high ridge of ground that runs directly from Kilcatherine Point to Ardgroom Harbour.

Outside of Kilcatherine Point dark blue slate strikes along the coast; all the beds being so nearly vertical that it is impossible to feel sure whether they are beds above the Coomhola grits, or a reappearance of those which occur beneath them on the south. This difficulty is increased by the occurrence of one or two folds in the slates as we go along the shore to the E.N.E., and the reappearance in the headland, called Derrycoosa where the height 166 is marked on the map, of a group of grits precisely similar to those inside Kilcatherine Point. Dips at angles, varying from 50° to 80°, were observed at several places, sometimes to the N.N.W., and sometimes to the S.S.E., but it was found impossible to determine with certainty the precise

nature and effect of these undulations so as to be sure whether these were the same group of beds, or another group like them.

We may feel pretty sure that the plant-bearing beds, north of Reen Point, are the representatives of the Upper Old Red, or Yellow sandstone, in which these plants are found all over the South of Ireland, though in this part of the country, as indeed elsewhere, it is impossible to draw any other than the most arbitrary boundary between them and the beds below. The boundary, indeed, between them and the beds above, can only be drawn by means of the colour of the slates associated with them, which is red in the beds below the boundary, while that of the slates above it is black, and the fact that marine fossils are sometimes found in the black slates, but never in the red ones. Plant remains occur more abundantly in the beds associated with the red slates; but they do also occur, and sometimes in great abundance, among the black slates, and even high up in the Coomhola grits.

In tracing the rocks along their strike from Reen Point towards Derryvorn and Lough Fadda, dissimilar rocks, having precisely the same line of strike, were observed at two or three places to be striking so directly at each other as to inevitably suggest the notion that they were cut through by the faults which are drawn upon the map. It is possible, however, that the observed facts may be accounted for either by lateral changes in the lithological character of the rocks, or more probably by sudden twists in the beds, which were concealed from view. The faults, however, give the simpler and more natural explanation, and have therefore been adopted. With these exceptions the beds, shown on the coast section of Kilcatherine and Reen Points, seem to strike steadily to Ardgroom. Portions of the beds appear here and there on the crest or flanks of the ridge (which over Derryvorn is 519 feet high) along the valley in which Lough Fadda lies, and the brook by which it is drained into the head of Ardgroom Harbour, and along the northern slope of the ridge towards the sea.

There is also a continuous coast section the whole way along the shore, and a good transverse section right across the ridge from the lower end of Lough Fadda to the harbour or cove, which is protected by the islets called Illaunbweeheen, Illaundonagha, and Carrigfadda. In the latter, the observed dips are all steady to the northwards, at angles varying from 40° to 70°. The section starts in the purple beds near Lough Fadda, and runs through the variegated series, which is taken as the Yellow sandstone with its plant fragments, and then thorough bluish and greenish clay slate and the Coomhola grit series to the dark clay slates of the coast, which, by this section, would appear to be above the Coomhola grits. Sharp contortions, however, may be observed in the beds in following the coast both westwards and eastwards from this place.

Strong grits make their appearance at Foilatluzzig, where a natural bridge is formed by one of the folds into which they are bent. These then, strike steadily off for Knocknamona Point, which is the western headland of Ardgroom harbour.

Inside that harbour, at Cus Island, and thence along shore to the S.E., we find thick beds of blue and greenish gray gritty slate, becoming interstratified in their lower parts with beds of thick greenish gray grit (Coomhola), and then near Illauncreagh, taking in purple beds and showing fragments of plants occasionally; while all along the S. shore of the harbour the purple colour predominates, showing that we have again got down within the limits of the Old Red sandstone. Calcareous beds (cornstones) are rather frequent hereabouts, both in the mass of the Old Red and in the beds above it; some of the black slates also show calcareous courses. The dip of the beds is apparently steady to the N.N.W., at high angles. The cleavage, where it was observed on the west side of the harbour, dipped S.S.E. at 45°.

On the eastern side of Ardgroom Harbour, purple slates and grits may be

seen at Clashaninnaun Bridge, dipping N.N.W., and passing up into alternations of green and dull purple slate and grit, with plant fragments, which may be seen along the road towards Collorus, and in the rocks of the harbour, as far as the point N. of Bird Island. The purple colour fades away as we ascend; and the beds near the head of the cove, inside of Bird Island, exhibit one or two strong contortions. In the crags of the shore inside Black Island may be seen black and blue slate, with greenish gray grits and flagstones, dipping N.N.W. at 75°, striking thence all the way to Collorus, where they may be seen about the Coastguard station. Similar rocks form the whole headland of Collorus, north of this, dipping sometimes northerly sometimes southerly, and exhibiting occasionally curves and contortions about the ends of the partial and interrupted axes of these anticlinals. Both plants and bivalve shells were collected from these beds. Immediately east of the Coastguard station, however, purple grits and slates are to be seen, and purple beds appear in the rocks of the shore northwards and all the way southwards across the road up to the Keeoragh mountain. These purple grits and slates dip all to the north, at angles varying from 10° to 80°, and strike directly towards the gray and green beds, the two kinds of rock being abruptly separated along a certain gently curved line, running a little E. of N. and W. of S. between the Coastguard station and the Viaduct.

This line of separation may be traced across the bend of the road, running parallel to its general direction for more than half a-mile south of the shore, until red rocks are found on both sides of it. It is apparently the line of a great fault with a downthrow to the westward of very large amount.

East of Collorus, purple and green slates and grits strike along the shore of Kilmakilloge Harbour to Eskadorva Point, and over all the ground to the south of it, dipping steadily to the northwards, at 70° or 80°.

On the north side of the Harbour, about Battle Point, the variegated beds of the Upper Old Red come in again, alternations of a few purple with many green and yellow, and some bluish or grayish grits and slates, with the plant impressions as usual. They are nearly vertical, and strike E.N.E. and W.S.W. North of these, about Bunan, and thence all along the headland to the northwards, the blue and black slates with their associated gray grits are alone to be seen, having at first a similar general strike and being equally vertical, but afterwards dipping in large masses in several directions. Bivalve shells and plants were found in them in one or two places.

A little further to the eastward, these beds are again cut off by another great upthrow to the east, similar to that already described near Collorus; but this will be mentioned more at large in the explanation of sheet 192.

J. B. J., from Notes by G. H. K. and J. O'K.

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6. *Drift and Bog.*

Drift.—The Drift in this district is all local. Its origin seems in a great measure to be due to glacial influence, as all the rocks in the district are scratched and rounded in a greater or less degree by ice. The following are the bearings of some of the scratches. To the north of Cod Head their bearing is N.W. and S.E. On the east flank of Miskish, at a height of 1,100 feet, the striæ run N.N.E. and S.S.W. On the hills to the north of Curryglass House, the scratches range N. and S., while to the east of Curryglass, they are N.N.E. and S.S.W. Due south of this, at Ardagh Point, their bearing is a little different, being N.E. and S.W. Three miles west of this, at Bracklagh, they run N.N.E. and S.S.W. On the east face of Knockanallig, at the

height of 400 feet, the bearing is nearly N.E. and S.W.; and at the Redoubt, to the north-west of Bear Island, they were found to be N.E. and S.W.

Bog.—On most of the hills and mountains in this map there is a slight coating of peat, but the only deep bogs are those at the east of Knockoura, and Knockgour, to the north of Pulleen, and about three miles W. of Castletown. Peat may be seen below high water mark in the harbour of Ardgroom, and at several other places.

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7. *Minerals.*

This district is rich in Minerals. The principal of which are five ores of copper, one of lead, and two of iron; besides these there is a mineral found abundantly in the quartz veins allied to Chlorite, and seemingly that called by Dana, anhydrous Mica. In the traps there are Asbestos, crystals of Feldspar, Hornblende, &c., &c.

The ores of copper are, *Copper Pyrites*, or yellow ore, *Variegated Copper Pyrites*, or purple ore, *Gray Ore*, and the *Green and Blue Carbonates*. These ores are all found in the mines belonging to the Bearhaven Mining Company.

Copper is also found in the following places. To the north-west of Knocknagallaun, in a quartz vein, there are specks of copper pyrites, and in the slates, flakes of the green carbonate. To the north of Waterfall Cottage, there are flying veins of quartz containing copper pyrites,* in shales and slates which are themselves highly impregnated with copper: there is no regular lode of ore; but the veins of quartz have here and there taken up the copper from the surrounding rocks.† To the north of the village of Killough, in a quartz vein, there are specks of the yellow ore, but it seems to be very much in the same state as the locality just spoken of. In a fault to the east of Caheraphuca, the rocks are stained with the green carbonate. To the west of Pulleen Harbour, at Drumsharra Point, the weathered parts of the beds are full of flakes of the green carbonate, and some quartz veins associated with them have specks of copper pyrites. On the road from Castletown to Pulleen, and to the east of Pulleen Lake, there is a shale bed highly impregnated with copper. Copper also occurs in some of the slates of the Upper Old Red, in the northern part of the district, towards Kenmare Bay. It is nearly always gray copper ore that is found in the slates and shales which, decomposing, stains the rocks with the green carbonate.

The ore of lead is the *sulphide* or *Galena;* it was worked for some time to the S.W. of Cahirmore, where the old shaft is still open.

Iron is found in most of the quartz veins as *Specular iron ore;* and *iron pyrites* is found associated with the copper in the different mines. The only places where the Specular ore appears in any abundance are in two veins of quartz on Bear Island; one of these is situated about half a mile east of Ardnakinna Point, the other is found to the north of Carrigbreedia, and west of No. 3 Martello Tower.

There are two small veins of *Asbestos* in the mass of trappean breccia on Black Ball Head, and two or three veins in the greenstone that lies to the north-east of Cod Head. At this latter place, in the joints, are partings of a kind of opal.

G. H. K.

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* "Flying veins" is a term used by the miners to denominate broken, discontinuous, irregular veins.

† Lately a company was formed to work this place: they made a few small trials, and, I think wisely, abandoned it.—G. H. K.

Notes on the Bearhaven or Allihies Mines, by Warington W. Smyth, M.A., F.R.S., formerly Mining Geologist to the Geological Survey of the United Kingdom, and now Surveyor to the Crown and Duchy of Cornwall.

The copper mines of this district, which are confined to very narrow limits, considering the large area occupied by similar rock formations, have been for many years past eminently productive. The mines occupy a tract, in part of very low land, lying at the western foot of the Slievemiskish Mountains, which rise very abruptly from the level of the Atlantic to the height of 1,242 feet.

The range of mountains which thus carries the Bearhaven mines on its extreme western slope, is a continuation of the lofty and broken ridge which divides the Bays of Bantry and Kenmare. It consists, at this western extremity, of slaty rocks (the *killas* of the miners), and of some interstratified more massive beds, all of them highly cleaved. The cleavage planes are almost vertical, inclining a shade north in Cloan, and coursing east 35° north. The dark blue varieties of the clay slate are considered by the miners unfavourable to the production of copper ores, whilst the gray, and particularly the buff kinds, as in Cornwall and elsewhere, are held to be "congenial."

The commencement of the entire series of operations was the working of an east and west lode, consisting of quartz and copper pyrites, which was exhibited to view in the cliffs of the townland of Allihies, on the coast north of Ballydonegan Bay.

The Allihies "Old lode" was worked to the depth of fifty or sixty fathoms, and outward for some little distance under the sea. It has now been abandoned for a quarter of a century.

Next came into operation the "Mountain lode." An extraordinarily thick course of white, hard, wild quartz, runs in a rudely east and west direction, with a northerly underlie, through a rough mass of slaty and grit rocks, at an elevation of between four and five hundred feet above the sea, in the townland of Cloan. For a length of above a hundred fathoms, it is fifty to sixty feet in width, but by no means attractive to the eye of a miner, except in its southern side, where a rib of three or four feet was gossany, and at a small depth yielded copper pyrites. At a greater depth, the whole width of the lode, in despite of the unfavourable opinion which would have been passed on it at the surface by most miners, became impregnated with ore, and was, in some parts, worked to as much as sixty feet wide, enormous cavities standing open without support, in consequence of the strength of the grit rock which forms the wall.

The Mountain mine is entered by an adit level cross-cut from the south side, leading to a whim-engine placed underground, the smoke of which ascends through the *leeries* or excavations between the walls of the vein.

At from thirty to fifty fathoms deep the lode is from twelve to fifteen feet wide, and consists of quartz, with disseminated copper pyrites. Here only a few "arches" of ground have been left, and the inclination is one foot in six to the north.

At the 150 fathom level the ground is worked away for a great width and height, rendered the more imposing by a branch which strikes off northward from the vein at about thirty fathoms east of the whim-shaft. This was worked, in places, to a width of twenty-six feet, and was very rich in ore, particularly on the hanging side. The chief point of note about the lode here was, however, that from its hardness and moderate admixture of ore, it would have been, if small, unprofitable, whilst from its great size, allowing of operations on a large scale, it proved highly remunerative. At the 162,

a cross-cut from the whim-shaft leads to a large lode of similar character, where it appeared that the shoots of ore have a tendency to incline eastward.

On the east the Mountain lode is cut off suddenly, at a natural gully through which it is probable that a slide or dislocating vein runs, in a N.N.W. direction. On the west it splits into two branches, one of which turns up suddenly and in a most unusual manner, to the north; but both in the course of a few fathoms cease to be productive.

The water is not abundant, and is raised by a draft-engine, placed on the top of the rocky brow. The ore is mostly what miners term "dradge" work, coarse and very hard. It is crushed, first, by rough, and then by smooth rolls, and jigged by very effective machinery. The returns were in 1853, about 170 tons per month, with an average yield of ten per cent.

A very similar lode, further north, of four to ten feet wide, consisting mainly of hard quartz, runs east and west, and where tested has yielded a little copper pyrites.

The next important mine was on the Caminches lode, which courses N.N.W., with an inclination to the S.E., and which has now been proved over a length of one and a quarter miles. At its northern end, in Cloan, it formed a very productive mine, for about ninety-five fathoms long, and was worked to the depth of 162 fathoms, when it became so poor and small, that it was reported by some to "cut out" altogether. Ten fathoms more were sunk upon it, but without improvement.

This lode appears to cease, in the north, against a cross-course, striking E.N.E., with a northerly dip, beyond which the underground explorations led to no good result. An east and west lode, included in the acute angle between these two, was also cut off on both sides.

The lode varies from one to twelve feet in width, averaging four to six feet. Its only ore is copper pyrites, interspersed through quartz, often hard, though certain portions of the matrix are argillaceous or "flucany," and are then in general highly coloured.

For nearly four hundred fathoms to the south, only an adit was driven, and the lode was found to be unproductive throughout that extent.

Further south again, in Kealogue, a very rich mine has been worked, although the regularity of the lode has been much disturbed by a succession of cross-courses, which fall in with it very obliquely. No lode at all had been found for 100 fathoms between two of these, notwithstanding numerous drivings carried on to search for it. A very exceptional feature is a sharp turn of the lode, almost at right angles to its former course, close to one of these cross-courses.

This latter mine, worked to 100 fathoms deep, proves the lode tolerably good as far as the river on the south; but the vein there dwindles to a mere slide, and continues to exhibit the same unpromising character to the furthest shaft south on the adit level.

With reference to the relation between the ore-bearing character of the lode and the rocks which it traverses, it is remarkable that the great length of vein which was proved in the adit to be unproductive as far south as close to the north of Kelly's shaft, coincides with the strike of certain blue fissile slates dipping 35° to 42° W.S.W., which are seen further to the west. Near the great course of ore at Caminches is an anticlinal axis in the slaty rocks; but at the Mountain mine, although some small contortions are to be seen, the principal dip is 40° to 60° N.W., the purple slates nearly coming up to the main lode, and being then succeeded by the more massive gray grits, with frequent ribs and veins of quartz.

The old Allihies lode runs also E. and W., very close on the same junction of different beds.

These important mines, under the able management of Captain Reid, and

since his death, of his son, have for many years sufficiently proved their value by the returns reported in the Swansea ticketings.

They employ from twelve to fifteen hundred persons in all, and the steam engines constantly at work are the following :—

Puxley's engine, 52-inch cylinder, pumping.
Engine at new engine-shaft, 36-inch cylinder, do.
Mountain mine, do. do.
Mountain mine, whim-engine, 22-inch cylinder.
Kealogue, whim-engine, 18-inch cylinder.
Kealogue, stamps-engine, 36-inch, working 36 heads of stamps.
Mountain mine, do. 30-inch, 72 heads of 7½ cwt.

Considerable expectations were formed, a few years since, of the results to be derived from new explorations at the Irbin mine, on the north side of the rocky ridge which towers over the Mountain mine. The beds of rock are here mostly slaty, dipping to the N.W., blue on the south wall of the lode, and gray on the north; but the vein itself crosses the strike of the beds, by coursing in a direction more nearly east and west.

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