

---

# The geology of Anglesey

By Edward Greenly

Memoirs Of The Geological Survey. England & Wales.

In Two Volumes, Volume 1

London Printed Under The Authority Of His Majesty's Stationery Office By Jas. Truscott and Son, Ltd., Cannon Street, E.C. 4. and to be purchased from E. Stanford, Ltd., 12, 13 And 14, Long Acre, London, W.C. 2; W. & A. K. Johnston, Ltd., 2, St. Andrew Square, Edinburgh; Hodges, Figgis & Co., Ltd., Grafton Street, Dublin. From Any Agent For the sale of Ordnance Survey maps; or through any bookseller.

from The Director General, Ordnance Survey Office, Southampton. 1919. In Two Volumes. Price £3 3s. 0d. Net.

Frontispiece (Plate 1): The folding of the Mona Complex. As viewed from the South Stack, Holyhead. Height seen = 445 feet.

## Preface by the Director

The Island of Anglesey was geologically surveyed on the old series one-inch map in 1849 and the following years, mainly by Ramsay but in part by Selwyn and Warrington Smyth. The map was published in 1852 and was followed by a Memoir on the Geology of North Wales in 1866. The Memoir, except for a palaeontological Appendix by Salter, appeared under the authorship of Ramsay, and the preparation of a second edition, which was published in 1881, occupied much of his time towards the close of his tenure of office as Director General.

The author of the present Memoir, after spending six years in the geological surveying of a part of the Highlands of Scotland as a member of the staff of the Geological Survey, resigned his post in 1895. But the fascination of the crystalline schists with their infinitely complicated structures and metamorphism was strong upon him, and within a few weeks, actuated solely by a spirit of research, he commenced, single-handed, the detailed six-inch survey of Anglesey, of which the results are embodied in the following pages and upon the forthcoming one-inch geological map.

There were many reasons for his choice of this island for an investigation that proved to be the work of no small part of his life. It is a naturally defined tract that could be dealt with apart from adjacent ground. There was no doubt that much reconsideration was required of some of the earlier conclusions with regard to the crystalline schists. Little was known of some occurrences of Lower Palaeozoic rocks, which were likely on further investigation to furnish connecting links between the Welsh and Scottish types of development. That Old Red Sandstone existed in the Island had long ago been recorded, but its relations to the subdivisions of that formation as recognised elsewhere, remained to be ascertained. The Carboniferous rocks presented several almost unique characters, some of surpassing interest, all of which called for detailed examination; while lastly a study of the glacial deposits, which were not shown on the original map, promised to throw much light on the movements of the ice along the North Wales border and in St. George's Channel. That the examination of an area, presenting problems so numerous and so varied, should have occupied Mr. Greenly's energies for 24 years is no matter for surprise. The wonder is rather that one man should have been able to concentrate on so many subjects, and mete out to each the exhaustive attention which is evidenced in the following pages.

In May, 1908, Mr. Greenly wrote to Sir J. J. H. Teall, at that time Director of the Geological Survey, in the following words. 'The end of my work is now within moderate distance, and I therefore wish, and the act gives me great pleasure, to offer its results to the Geological Survey to which I am so much indebted for training and experience. The only condition I would ask is that the Geological Survey should publish a one-inch map of the Island, together with a descriptive Memoir which I would write to accompany that, as soon as might reasonably be done after the completion of the work'. This generous offer was accepted by Mr. J. A. Pease (Lord Gainford), at that time President of the Board of Education, subject to the map being certified to be satisfactory. Inspection was made at once with the result of showing that the six-inch

survey had been made with the utmost care and accuracy, and that the map offered by Mr. Greenly was up to the highest standard of Geological Survey work.

The MS. of the Memoir was completed in 1916, and a suggestion made by Mr. Pease in 1908 that the author should receive the thanks of the President of the Board of Education when the map and memoir were handed over, was adopted by Mr. Pease's successor. The following letter was addressed to Mr. Greenly by Mr. A. Henderson:

'I understand that during the 20 years that have elapsed since you were a member of the staff of the Geological Survey, you have devoted yourself to geological investigations in Anglesey, and that you have now completed a geological memoir to elucidate the map which you have already presented to the Survey.'

I am informed that the map is a work of great skill and precision, and that it will rank among the best productions of the Geological Survey. The memoir which you now offer is, I have no doubt, a lucid interpretation of the geology of the area, and worthy of the map. I wish to convey my personal thanks to you for giving the results of your long labours to the public through your old branch of the Service, and I congratulate you upon the successful completion of so admirable an example of well-directed effort'.

In the meantime however difficulties in preparing the map and printing a memoir had arisen in consequence of the war. Colour-printing of maps was temporarily in abeyance; there seemed also to be probability of delay in printing, at such a time and as an official publication, a long and detailed memoir that had little direct bearing on war requirements. Influenced by a desire to have perfect freedom as to the time and manner of producing his results, Mr. Greenly offered to bear the whole expense of producing the Memoir, and though the great increase over the estimated cost which resulted from the War rendered this impossible, he has nevertheless contributed a considerable part. Of the results of this generosity the volumes themselves bear evidence. The author has availed himself of his freedom from the official restrictions which were inevitable in a time of stress, not only fully to present his scientific conclusions, but to record the wealth of detailed observations on which those conclusions are based, and at the same time to do justice to the remarkable structures he describes by numerous drawings and photographic reproductions.

This briefly is the history of the Memoir on Anglesey. Ample proof will be found in its pages of the labour and thought which have been bestowed upon it, both as regards its editing and the exhaustive treatment of the geology. Nor has the author hesitated to call upon others who have been engaged in kindred subjects elsewhere, to give him their aid in dealing with the problems presented by this difficult area. The volumes are included among the Geological Survey Memoirs in the confidence that they will rank not only as the standard work on Anglesey, but as a work of reference in several branches of geological research, for many years to come.

A. Strahan. Director. Geological Survey Office, 28, Jermyn Street, London, S. W. 1. 2nd May, 1919.

## **Author's preface**

In England and Wales there are about a dozen places at which we seem to catch a glimpse of the old floor that underlies all the Paleozoic and later formations. Of these glimpses, the most extensive and varied is that which is afforded us in Anglesey. Yet mists have long hung about this fascinating view. For many years indeed it was held, and that by those who, rightly, commanded most authority, to be but a mirage, a simulation of the sought-for by that which in reality was hiding it from our eyes. The enthusiasm kindled by such a problem did not fail to lead to keen and persistent investigation. Eventually, however, a stage was reached when it became evident that what was needed, not merely as a mode of research but as a reliable basis for future research, was a detailed re-survey upon the lines that had been found so successful in other regions. Hence the present map and memoir. But whatever the interest of the ancient crystalline schists and their associates, hereinafter called (see p. 39) 'The Mona Complex', they have been accorded no special treatment on the maps, every formation, 'Drift' as well as 'Solid', having been similarly mapped, in accordance with the practice of the Geological Survey.<ref>Information concerning the various maps that have been used will be found in Appendix 1.</ref>

In dealing with the Succession in, the Tectonics of, the General View of, and the Age of the Mona Complex (Chapters 6, 7, 8, 9), unrestricted expression has been given to the interpretations that are advocated; but in full realization of the hazardous nature of the subject, and with the expectation that they will be modified, perhaps extensively, by criticism and future research. Special attention is asked to the fact that the interpretations in question do not in any way affect the lines upon the maps, which were drawn without any reference to them, and in fact, before they had been adopted.<ref><The succession in Holy Isle was made out on the completion of the mapping of that isle in 1906, and its tectonic interpretation followed upon a suggestion thrown out by the late C. T. Clough in 1907; but the interpretations of the rest of the Complex were not arrived at until after the whole of Anglesey had been surveyed./ref>

A chapter entitled 'Metamorphism in the Mona Complex', treating that subject as a connected whole<ref>Its various aspects are described and discussed in Chapters 4, 7, 8, and 10.</ref>, ought properly to have followed upon Chapter 7. At the time it would have had to go to press, however, I had not succeeded in bringing the metamorphic into satisfactory correlation with the tectonic phenomena. The Supplement, and the. genetic studies added in Chapter 41 (pp. 900–4 and especially 907–10) partly supply the lack; but I hope, ere long, to deal with the aetiology of this fascinating aspect of the Complex in a systematic manner.

The local detail of the more extensive formations has been relegated to special chapters, in which have also been placed the local fossil lists, with the registered numbers of fossils and microscopic slides. Their prime object has been to provide a guide to the more important exposures; but they also provide means of verifying generalised statements, thus relieving the general descriptions from a distracting multiplicity of place-names and reference-numbers.

The fossils have been determined by specialists: the graptolites by Miss Elles<ref>Miss Elles has also kindly contributed a valuable essay on the Graptolite Sub-Faunas.</ref>, the Ordovician trilobites by Mr. Lake, the Ordovician brachiopods by Dr. Matley, and the Ordovician phyllocarida by Dr. Peach. The Carboniferous Limestone fossils were named by the late Dr. Ivor Thomas (some having been previously examined by the late Dr. Vaughan), the Millstone Grit and Coal Measure fish by Mr. E. T. Newton, their mollusca by Dr. Wheelton Hind, and their plants by Dr. Kidston. Some miscellaneous forms, chiefly from glacial and later deposits, were named by Dr. Kitchin, Mr. Allen, and Dr. Ivor Thomas. The late Dr. G. J. Hinde examined all the sponge-spicules and other microscopic organisms. The fossils from the South Stack Series of the Mona Complex were determined by Dr. Peach and Dr. G. J. Hinde.<ref>Particulars of the Survey collection are given in Appendix.</ref> For more than half of these indispensable fossils we are indebted to the skilled and patient collecting of Messrs. Macconochie and Muir, who, sent to Anglesey for that purpose by the Geological Survey, pursued their aim through a succession of visits amounting in the aggregate to a year's work, and with enthusiasm never damped by long searches, often in cleaved and barren rocks.

For the Petrology I am responsible, except for assistance upon the following important subjects, as well as on some others mentioned in the text. Most of the slides and specimens of the spilitic volcanic rocks and of the serpentine-suite of the Mona Complex, as well as of the silicified rocks of Parys Mountain, were examined by Dr. Flett; the igneous boulders of the Skerries conglomerates by Sir J. J. H. Teall; and the, Palaeozoic Intrusions, the Later Dykes, and the Red Measure sandstones by Dr. H. H. Thomas. More than half of the chemical analyses are the work of Mr. John Owen Hughes, but several other chemists have contributed, and others kindly permit us to quote unpublished analyses.<ref>Statistics of the Anglesey rocks and slides in the collection of the Geological Survey, and of these analyses, will be found in Appendix 2.</ref>

To all these specialists, and particularly to Miss Elles and Mr. John Owen Hughes, we desire to return the most cordial thanks.

The work of Miss Elles upon the zonal graptolites has made it possible to determine the effects of the Post-Silurian disturbances, not only upon the Lower Paleozoic rocks themselves, but also upon the Mona Complex, knowledge essential to the interpretation of the Complex. Mr. J. O. Hughes, during seven years, devoted all the time at his disposal to chemical analyses of the rocks of the Island, without which the petrological work would have been seriously defective. The results he has obtained represent an important contribution to petrological science in general, quite apart from their bearing on the geology of Anglesey.

I have also had the great advantage of going over much of the ground with Sir J. J. H. Teall, Sir Aubrey Strahan, Dr. Horne, and Dr. Flett. Dr. Horne, who was detailed in 1908 to inspect the maps, visited the Island again in 1911. And all these officers have been ready at all times with valued aid and advice, especial thanks being due to Sir Aubrey Strahan for his tact and patience throughout the period of difficulty caused by the recent war.

The public-spirited interest which has been taken in this work by the County Council of Anglesey, by the Senate of the University College of North Wales, and by the Agricultural Committee of that college, ought also to be remembered.

The grants generously made, in aid of the chemical analyses, by the British Association and the Senate of the University College are referred to on p. 28.

To the Elder Brethren of the Trinity House we are indebted for a unique opportunity to survey the remote islets of The Skerries at leisure. They not only gave me permission to live for several days in the Skerries Lighthouse, but, with great courtesy, despatched me there and brought me back in their own vessel, the Triton'.

To Mr. Thomas Prichard of Llwydiarth Esgob in Anglesey we are indebted for a series of kind actions, continued over a period of some 18 years, too varied and too numerous to specify, but among which may be mentioned his loan of the valuable plants from the Coal Measures.

To him, and, equally, to the generosity of Mr. E. Neil Baynes, we owe nearly all the information of an archaeological or historical nature that is given in Chapters 1, 32, 35, and 37. Mr. Baynes has now been working for several years on the archaeology of Anglesey.<ref>By the energy and public spirit of Lord Boston and Mr. Baynes, an Anglesey Archaeological and Natural History Society has been formed, which has already done excellent work. Its aim is not only research, but preservation of destructible objects of interest, and several of the great erratic boulders of the Island are now included in its watchers' list.</ref>

The late Dr. Callaway's interest in Anglesey problems never flagged, and I had often the privilege of discussing them with him, especially the origin of the Peninynydd mica-schists, on which his views have proved most enlightening. Mr. Barrow also contributed valuable suggestions, chiefly concerning the jaspers and the hornfels; while Prof. Bonney never begrudged the trouble of correspondence upon any question submitted to him. Certain chapters were kindly read by various friends, as follows by Dr. Horne and Dr. Callaway; 13, 14, 15, by Miss Elles; 13 by Prof. O. T. Jones; parts of 16, 28, by Dr. H. H. Thomas; 20, 23, 24, 25, 35, by Sir A. Strahan; 30, by Sir J. J. H. Teall, Sir A. Strahan, and Dr. Horne; and all those which contain fossil names by Dr. Kitchin. Mr. Edmund Dickson made five analyses of rocks, and the late J. Hort Player made many reproductions of the field-maps by his photographic contact-process.<ref>The rest of the photographic map-reproductions are by Mr. J. Wickens of Bangor.</ref> Microscopic slides were presented to the Survey by Dr. Matley and Mr. Barrow, and lent by Miss Blake, Dr. Callaway (who also lent fossils), Prof. Bonney and Miss Raisin, and the Sedgwick Museum at Cambridge. The plates are from photographs by Mr. J. Rhodes, Junr. (who was sent for that purpose by the Geological Survey), with the exception of Nos. (Plate26)B, by Mr. Griffith J. Williams; (Plate 38), (Plate 43), by Mr. J. Trevor Owen; 56, by Mr. E. Neil Baynes; and 59, by Mr. H. E. Spencer; who have also presented photographs to the Survey Collection.<ref>Information concerning this collection, and the means of obtaining photographs therefrom, will be found in Appendix 2.</ref> We are indebted to the Council of the Geological Society for leave to reproduce (Figure 135), (Figure 135), (Figure 189), (Figure 190), (Figure 191), (Figure 194), (Figure 195), (Figure 260); to the Editor of the Geological Magazine for (Figure 169), (Figure 258), and (Figure 289); and to the Council of the Cambridge Philosophical Society for (Figure 305). The half-tone and line blocks are by the Thames Engraving Co., the folding-plates and collotypes by Malby and Huth respectively.

The Coal-mine plans and boring-sections were kindly lent by Lord Boston, the late Hon. Lady Neave, the late Lady Reade, Mr. T. Prichard (on behalf of Sir G. Meyrick), and (through Mr. Bernard Smith) by the Menai Colliery Co., Ltd. Access to the Parys Mountain plans, together with frequently repeated other aid, was cordially given by Mr. T. Fanning-Evans, the Manager of those mines.

For aid on a number of different points we are indebted to the following persons: the late James Bennie, the late J. F. Blake, Prof. K. Busz, Mr. T. C. Cantrill, the late C. T. Clough, Prof. Grenville A. J. Cole, the late J. R. Dakyns, Prof. J. R.

Ainsworth Davis, Mr. H. Dewey, Mr. Allan B. Dick, Sir J. J. Dobbie, Mr. W. C. Evans, Sir Archibald Geikie, Mr. C. T. Gimingham, Dr. Harker, Prof. Harold Hilton, Prof. W. H. Hobbs, the late Prof. T. Rupert Jones, Mr. Lamplugh, Prof. Lapworth and Dr. Stacey Wilson, Prof. J. E. Lloyd, the late Joseph Lomas, Mrs. Longstaff, the Comte de Montessus de Ballore, the Director-General of the Ordnance Survey, Prof. K. J. P. Orton, Mr. E. R. Radley, the late Sir W. Ramsay, the late Clement Reid, Miss Reyner, Mr. J. Rhodes, Sen., Mr. W. Roberts, Dr. R. L. Sherlock, Mr. E. Watson, Mr. Gilbert Williams, Mr. Griffith J. Williams, Prof. Hudson Williams, and Dr. H. Woodward.

For local aid and information we are indebted to the following residents: Miss J. H. Adeane, the Town Clerk of Beaumaris, Mr. Barbagli of Bryn-fuches, Lord and Lady Boston, Sir R. W. Bulkeley, the late Admiral Burr, Mr. F. E. Cotton, Mr. T. Clegg, Mr. J. R. Davies, Mr. R. L. Edwards of Bodafon-isaf, Mr. R. Ellis of Llanfairynghornwy, Mr. S. J. Evans (Headmaster of Llangefni County School), Mr. W. Fanning, Mr. J. J. Ffoulkes of Bodrwyn, Col. W. A. Fox-Pitt, the Managers of the Holyhead and of the Porth-wen Silica Works, Mr. H. O. Hughes of Llangaffo, the late James Hughes of Llanerchymedd, Mr. J. Hughes of Parys Mountain Mines, Mr. W. Jones of Llanrhwydrys, Mr. L. D. Jones (Llew Tegid), Mr. W. E. Jones (Agent to the Marquis of Anglesey), Col. Lloyd of Tregaian, Mr. O. J. Lloyd of Llangefni, Capt. McKinstry, Sir G. Meyrick, Messrs. E. Morris and W. E. Williams, Mr. and Mrs. Humphrey Owen of Treddolphin, the late C. F. Priestley, Miss M. F. Rathbone, Mr. J. Rice Roberts, Lord Sheffield, Mr. Toiler, Major Lawrence Williams, the late Rev. Chancellor Williams of Llanrhyddlad, Dr. R. M. Williams, the District Superintendent of the London and North-Western Railway, the Secretary of the Holyhead Waterworks; also to the local naval and military officers, and to the county police, for their courtesy and co-operation during the recent war; and, for many years past, to land-owners, farmers, and many others all over the Island.

It is pleasing to reflect upon the magnitude of this body of aid, and upon the cordiality with which it has been given.

There is no one to whom so great a debt is due as to my wife. To mention that she has read both the proofs and the manuscripts of this book, as well as prepared the Index, is to mention but the last of a long series of services, too numerous and varied to be specified, or even to be recalled to memory. But this material aid has been as nothing when compared to the moral aid and support, that has never failed, no matter what the vicissitudes (neither few nor light) of the 24 years through which this work has been in progress. Had dedication been admissible, it should certainly have been to her.

I cannot close this long list of obligations without a tribute of gratitude to those officers of the Scottish Geological Survey (Drs. Horne and Peach) with whom I had the privilege to be thrown when first joining that staff. Also in particular, to the memory of our noble-minded colleague the lamented C. T. Clough, on account of the inspiring standard ever held up in his truly marvellous mapping, an embodiment at once of the highest scientific precision and of lofty devotion to an ideal.

Edward Greenly.

April, 1919.

## **Table of contents**

### **Part 1 — Preliminary**

#### **Chapter 1 — Introduction**

General aspects of the Island. Its dimensions. Its climate. Its population. Its names. Its Geological Formations. Tabular Statement of the Formations.

#### **Chapter 2 — History of previous research**

Introductory. The Mona Complex. Baron Hill and Careg-onen Rocks. The Ordovician Rocks and the Palaeozoic Movements. The Silurian Rocks. The Palaeozoic Intrusions. Metasomatism. The Old Red Sandstone. The Carboniferous Limestone. Millstone Grit and Coal Measures. The Red Measures. The Later Dykes. Glacial and Later Geology.

The Land Surface. Chemical Analysis. The Present Survey.

## **Bibliography**

### **Methods of reference to publications**

## **Part 2 — The Mona Complex**

### **Chapter 3 — Introduction to the Mona Complex**

Regions and Inliers. Composition, Characters, and Sub-divisions. The Designation 'Mona Complex'.

### **Chapter 4 — The petrology of the Mona Complex**

Introductory.

The Holyhead Quartzite.

The South Stack Series: The South Stack Series Proper. The Coeden Beds.

The New Harbour Group: The Green-mica-schists. Green Biotite. The Amlwch Beds. The Jaspersy Phyllites. The Bedded Jaspers. The Spilitic Lavas.

The Skerries Group: The Church Bay Tuffs. The Skerries Grits. Their Conglomerates. The Tyfry Beds.

The Gwna Group: The Alternating Grit and Phyllite. Autoclastic Phyllite-and-Grit Mélange. The Gwna Green-schist. The Spilitic Lavas. The Tuffs. The Albite-Diabases. Kerato-phyre. Basic Schists. The Quartzites. The Limestones. Graphitic Phyllite. The Jaspers. The Jaspersy Phyllites.

The Fydlyn Group.

The Coedana Granite.

Hornfels: Cryptocrystalline Hornfels. Crystalline Hornfels. Unity of the Hornfels. Composition. Origin of the Hornfels. Foliated Hornfels.

Diorites.

The serpentine suite: Serpentine. Pyroxenites. Gabbros. Dolerites. Mutual Relations. Associated Metamorphic Rocks (Talc-schist, Tremolite-schist, Ophicalcite, &c.). Deformation and Metamorphism. Marginal Rocks.

The Penmynydd Zone of Metamorphism: The Mica-schists. Quartz-schists. The Limestones. Graphite-schist. Rutiliferous-schists. The Hornblende-schists. The Glaucophane-schist. Its Origin. Banded Marginal Rocks. Origin of the Penmynydd Mica-schists. Conclusions.

The Gneisses: Hornblende-gneiss. Biotite-gneiss or Gneiss-proper. Its Granitoid Component. Its Foliated Component. Nature, Origin, and Relations of the Components of the Gneiss. Comparisons and Conclusions.

Foliation.

General mineral characters of the Mona Complex.

### **Chapter 5 — The palaeontology of the Mona Complex**

### **Chapter 6 — The succession in the Mona Complex**

Introductory.

Correlations within the complex.

Order of succession: Group Sequences and Junctions. The Bedded Succession. The Penmynydd Zone. The Gneisses. Local Successions.

Table of the general succession.

Chronological order of the succession: Ancient fragments. The Plutonic intrusions and the Penmynydd Zone.

Relation of the gneisses to the bedded succession.

The ancient floor.

## **Chapter 7 — The tectonics of the Mona Complex**

Introductory.

The maximum primary recumbent structures: Evidence for Inversion. The Maximum Primary Folding as revealed in Holy Isle. The Maximum Primary Structures on the Main Island (with evidence for directions of close and gape). amplitudes, facies, and recapitulation.

The major, minor and minimum structures: The Major Secondary Folds and Thrusts. The Minor or Ternary Folding. Types of Minor Folding. Pitch. Minor Thrusting. Principles of Auto-clastic Mélange. The Minimum or Tessary Folding.

Structures of the second and third generations: The Valley Thrust-planes. The Foliation of the Western Region. Relations of the Penmynydd Metamorphism.

Later structures: Transverse Folds. Final Catamorphic Movements.

Folial relations: Relations to Bedding, Folding and Thrusting. Chronology of the Foliation.

## **Chapter 8 — General view of the Mona Complex**

Introductory.

Developments in the several regions: Holy Isle. The Western Region. The Northern Inliers. The Northern Region. The Middle Region. The Gneissic Inliers. The Deri Inlier. The Pentraeth Ethers, The Aethwy Region.

Developments over the island considered as a whole: Probable thickness. Facies and physiography. Geographical distribution of the stratigraphical and tectonic members of the Complex. Arrangement of the Post-Recumbent Foldings. pitch, dip, and strike throughout the island. Distribution of the metamorphism. Laws of the Metamorphism.

Recapitulation.

## **Chapter 9 — The age of the Mona Complex**

Relations of the Complex to Ordovician Rocks.

Relations of the Complex to Cambrian Rocks: The indirect evidence. Pebbles in conglomerates (with table). Horizons and localities of the conglomerates (with table). Pebbles from Llanberis and Bethesda. Pebbles from the Harlech Anticline. Review of the evidence. Conditions of the Cambrian erosion.

Conclusion.

[NOTE — See also pp.425–6, 559, 906]

## **Chapter 10 — The detail of the Mona Complex**

Holy Isle.

Tracts West of the North Stack Fault. The North Stack and the Fault. The Stack Moor. The South Stack. The Stack Moor Syncline. Henborth and Llwyn-y-berth. Rhoscolyn.

The Country between the Two Main Faults: The Rhoscolyn Anticline. Rhoscolyn to the Tre-Arddur Gap. The Country about Holyhead. Holyhead Mountain.

District North-east of the Namarch Fault: Stanley Gate to Soldier's Point. The Breakwater Coast.

The Serpentine-Suite about the Strait of Holy Isle: Mainland and islets: Four-Mile-Bridge to Cymyran. The Lakes, Porth-delisc. The Strait Islets,

Holy Isle: Between the Strait and the Alluvium. West of the Alluvium. The Southern Margin.

The Western Region.

The New Harbour Group: The Sea-Board. The Interior.

The Gwna Group: Llanfaethlu to Brwynog. Llanrhyddlad. Foel High Land.

The Church Bay Tuffs.

Boundaries.

The Northern Inliers.

The Garn Inlier.

The Mynachdy Inlier.

The Fydlyn Inlier: Trwyn-y-crewyn to Fydlyn Beach. Fydlyn Beach to Porth-yr-hwch. Porth-yr-hwch.

The Gader Inlier.

The Corwas Inlier.

The Northern Region.

The Llanfairynghornwy Belt: Carmel Head to Gwaen-ydog. The Mynachdy Gneiss.

The Coeden Beds.

The Amlwch Beds: The Coast. The Interior.

The Gwna Beds of Gynfor, Pant-y-gaseg, and Wylfa: General Characters. Wylfa. Gynfor. Pant-y-gaseg.

The Skerries Group in the Trwyn Bychan Tract: Hell's Mouth to Porth Wen. Trwyn Bychan to Bull Bay.

The Skerries Grits between Llanfechell and Llan-rhwydrys.

The Three Mouse Islets.



The Skerries.

Basic intrusions of the North.

The Middle Region and its inliers.

Gneiss of the Middle Region: The Southern end. Allor. Llandry-garn and Gwyndy to Llechcynfarwydd. Henblâs to Mynydd-mwyn-mawr. Gneissic Inliers of the Middle Region. Basic Gneisses near Llangwyllog.

Gneiss of the Nebo Inlier: The Interior. The Coast.

The Coedana Granite.

Hornfels: The Coast, Llanfaelog, and the Marginal Aureole. The Xenoliths.

The Deri Inlier.

The Foel Inlier.

Mynydd Bodafon: The Quartzite, Hornfels; and Moor Flags. Tectonics.

The Penmynydd Zone of the Middle Region: The Coast. The Western Margin. The Rest of the Inland Tract. The Inliers.

The Gwna Beds and Tyfry Beds of the Eastern Middle Region: The Coast. South-eastern Margin. Between the Margin and the line through Cerrigceinwen. The Ceinwen Volcanic Zone. The Engan Spilites. The Western Tracts.

The Pentraeth Inliers.

The Western Inlier.

The Eastern Inlier: Dyffryn to Tyfry. Tyfry to the seaward end.

The Aethwy Region.

The Gwna Beds of the East: The Menai Coast. Cadnant to Red Hill. The Interior. The Eastern Margin. The Llanddona Highlands.

The Penmynydd Zone of the Aethwy Region: The Eastern and South-eastern Margins. The North-western Margin. The Centre. Mynydd Llwydiarth.

Gneiss of Holland Arms and Gaerwen (with Rhos-cefn-hir).

The Llanddwyn Wedge: Llangaffo to Newborough. The Dunes of Newborough. Llanddwyn Island. Carnarvon.

The Order of the minor sub-divisions of The Bedded Succession.

Order of the Sub-divisions of the Groups. Horizons of Development of the Penmynydd Metamorphism.

## **Chapter 11 — Recapitulation of the Mona Complex**

### **Part 3.-Subsequent formations and phenomena**

## **Chapter 12 — The Baron Hill and Careg-Onen rocks and the Cambrian Period**

Introductory.

The Baron Hill Rocks: Introduction and petrology. Tectonic relations. Age of the rocks.

The Careg-Onen Beds: Introduction and petrology. Palaeontology. Structure and relations. Geological age.

Bwlch-Gwyn Felsite and Trefdraeth Conglomerate.

Chronology of the Outliers.

The Cambrian Period in Anglesey: Relations of the Cambrian and Ordovician Systems in Carnarvonshire. The Cambrian rocks of Anglesey.

### **Chapter 13 — The Ordovician rocks**

Introduction.

Petrology: Conglomerates and Grits. Shales, Limestone, Cherts. Oolitic Ironstone.

The Zonal Succession.

Palaeontology: Faunas of the Zones. Upper Hartfell Beds. Zonal Types of Shale.

The graptolitic sub-faunas of Anglesey, By Miss Elles.

General view of the Ordovician rocks — The Northern Overlap.

Thickness of the series.

The Composition of the Sub-Ordovician floor (With its bearing on the age of the Mona Complex)

Physiography.

Conclusion.

### **Chapter 14 — Detail of the Ordovician rocks**

The Menai fragments.

The Llangoed area (With the Llanddona Outlier)

The strips along the Berw Faults.

The Llangwyllog area.

The Principal Area: The South-Western Wing and South-Eastern Margin. The Western Margin. The Country about Llanerchymedd. The Country To the north-east of Llanerchymedd. Llanbabo and the Cors-y-Bol country. The Northern Margin and Parys Mountain.

Mynydd-Y-Garn to Carmel Head.

Mynydd Eilian.

The Northern Wedges: The succession. Fossils of Gynfor. Relation to the Mona Complex. The Gynfor Sections. Mynachdy.

### **Chapter 15 — The Silurian rocks**

The Parys Mountain Infold.

The Rhos-Mynach Infold.

## **Chapter 16 — The Palaeozoic intrusions**

Introductory.

Petrology: The Basic Dykes (varieties, selvages, veins, contact-metamorphism). The Basic Sills (diabases, hornblende-picrites, selvages, contact-metamorphism). Dykes and sills of intermediate composition. The Acid Dykes and their contact-metamorphism. The Acid Sills. The Lamprophyres. Scheme of the intrusions. Their unity. General characters and comparisons.

Behaviour on the large scale: The Basic Dykes (dimensions, form, grouping, &c.). The Lamprophyres and Porphyrites. The Acid Dykes (dimensions, grouping, &c.). Composite or multiple dykes. The Basic Sills (relations, &c.). The Acid Sills.

The age of the intrusions: Relations to the Mona Complex. Horizons traversed. Pebbles in conglomerates. Effects of earth-movements. The intrusive succession.

Recapitulation.

## **Chapter 17 — Detail of the Palaeozoic intrusions**

The Basic Dykes. The Lamprophyre Dykes. The Intermediate Dykes. The Acid Dykes. The Basic Sills (diabases and picrites). The Sills of Intermediate Composition. The Acid Sills.

## **Chapter 18 — The tectonics of the Ordovician and Silurian rocks**

Introductory.

Comparative tectonics of the several in-folds: The Menai Strait to the Llangwyllog area. The principal area and its wings. Ruptured Major Isoclines of the North-West and North-East. The Northern Wedges, Summary.

The Carmel Head Thrust-Plane: Evidence of Rupture. Its Inclination. Its Dynamical Effects. Its Magnitude.

Petrological effects of the movements: Cleavage. Disruption. Effects upon the Dykes and Sills (catamorphism and anamorphism).

Chronology of the movements: Folding, cleavage, thrusting, faulting, &c.. date of the movements.

Comparison with the tectonics of the Mona Complex.

General view of the movements.

## **Chapter 19 — Palaeozoic metasomatism**

Introduction.

Parys Mountain: The Processes and Products. The Lodes. Ferrification. Chronology. Minerals.

Sporadic metasomatism: Local Silicification, &c.. Kaolinite. Dolomites. Chronology.

Genetics of the metasomatism: Conditions Precedent. Operation and Sources.

Recapitulation.

## **Chapter 20 — The Old Red Sandstone**

Introductory.

Petrology: Conglomerate and Sandstones. Mudstone, Marl, or Dust-rock. Cornstones. Limestones. Staining.

Contemporaneous erosion and disturbance.

Succession and general view.

Tectonics: Molar movements. Internal modifications. Cleavage and movement.

Thickness.

Age, and relations to the Carboniferous.

Physiography and Recapitulation.

## **Chapter 21 — Detail of the Old Red Sandstone**

The Coast. The Coed-y-gell Escarpment. The Penrhoslligwy Plateau. The Base around Mynydd Bodafon. Bodafon to Llangefni. Trwyn-cwmrwd and the Staining.

## **Chapter 22 — The Carboniferous System and the Carboniferous Limestone**

1. The Carboniferous Series as a whole.

2. The Carboniferous Limestone Series.

Introductory.

Petrology: Sandstones. Conglomerates. Shale and Chert. The Limestones. Dolomitisation.

Palaeontology: The Zones and Sub-Zones. Faunas of the Sub-Zones. Characters of the Fauna, by Dr. Ivor Thomas.

Contemporaneous erosion and disturbance: Limestone Conglomerates. Erosive Junctions. Behaviour of Sandstones. Sandstone Pipes. Local Discordances, Local Disturbances. Discussion.

General view of the Carboniferous Limestone.

Thicknesses, overlap, and unconformity.

Composition of the Sub-Carboniferous floor.

Physiography.

Conclusion.

## **Chapter 23 — Detail of the Carboniferous Limestone**

The Principal area: Lligwy, The Coast, and Pentraeth, 629- The Escarpment or Western Margin. The Interior. The Cefni to Bodorgan. The Esgeifiog Strip.

The Straitside area: The Shore Section. The Escarpment. The Dip-Slope.

The Small Outliers.

The Penmon area: The Escarpment and Eastern Coast. The Northern Coast. Puffin Island.

## **Chapter 24 — The Millstone Grit and Coal Measures**

Introductory.

The Millstone Grit: Petrology. Kaolinite. Nature of the Base. Palaeontology.

The Coal Measures: Petrology. Palaeontology.

Summary and correlation.

## **Chapter 25 — The Red Measures**

Introduction.

Petrology: General. Heavy Minerals, &c.. Pebbles, their nature and condition.

Unity Of The Red Measures.

Succession and thickness.

Relations, age, and conclusion.

## **Chapter 26 — Detail of the Red Measures**

Mainland and Foel Ferry. Holland Arms and Llangaffo. Berw and Morfa-mawr Shafts Material. The Shaft and Boring Records.

## **Chapter 27 — The tectonics of the Carboniferous rocks**

Types of Structure. The Internal and External Systems. The Berw Fault. Relations and Age of the Movements. Comparison with the Tectonics of the Older Systems. Recapitulation.

## **Chapter 28 — The Later Dykes**

Introductory.

Petrology (general characters, veins and selvages, contact-metamorphism)

Comparison With The Palaeozoic Dykes.

Behaviour on the large scale.

Relations to the Palaeozoic dykes.

Relations to sedimentary groups.

Geological age.

The Late Faults.

## **Chapter 29 — Detail of the Later Dykes**

Table. Those that outcrop in Carboniferous Rocks. Those that outcrop in the Mona Complex.

## **Chapter 30 — Drifts and glaciation**

Introductory.

Modifications of the surface.

Striation (deflections, &c.). Modelling, Shattering, &c.. Condition of the Pre-Glacial Surface.

The Drifts: Introductory. Boulder-clays. Sands and Gravels. Moraines. Special Physical Features of the Drifts (eskers, bluffs, drumlins). Composition of the Drifts. Erratics (insular trains, extra-insular, shells, &c.). Insular and Extra-Insular Drifts. Uplifts. Carboniferous Limestone of Bryn-gwallen. Chronology of the Drifts.

Theoretical summary: The Ice-sheet. Overflow-notches on the Bethesda Mountains (Depths of Ice upon the Mountain-land and Anglesey). Movements of the Ice. The Episode of Recession. The Decay of the Ice.

### **Chapter 31 — The detail of the Drifts And Glaciation**

Arrangement Of The Subject.

Holy Isle: Surface and Striation. The Drifts: The Coast. The Interior (drumlins, boulders).

The North Central Country: Surface and Striation. The Drifts: The Coast. The Interior (drumlins, boulders).

The South Central Country: Surface and Striation. The Drifts: The Coast. Railway Sections. The Rest of the Interior. Boulders.

The Northern Country: Surface and Striation. The Drifts: The Coast. The Interior (drumlins, &c.).

The Eastern Margin: Surface and Striation. The Drifts:-The Coast (red and blue clays). The Interior. Gravels and Eskers.

The Penmon country: Surface and Striation. The Drifts:-Llanddona to Penmon. Penmon to Beaumaris (gravels and red clay).

The Menai country: Surface and Striation. The Drifts:-Ty'n-y-caeau Gravels, Menai shore, and Llanddwyn. The Inland Margins. The Railway Sections. The Rest of the Interior (boulders, &c.). Summary of the District.

### **Chapter 32 — The later Superficial Deposits**

Introductory. Raised Beach. Submerged Forest. Marine Alluvia. Fresh-water Alluvia. Blown Sand (Desert Scenery, Sand-blast, &c.). Miscellaneous Phenomena.

### **Chapter 33 — The sea-floor**

Sources of Evidence. The Menai Strait. The Sea-Basin. The Tertiary Anticline.

### **Chapter 34 — The development of the land-surface**

The platforms: The Menaian Platform. The Monadnocks. The Tregarth Shelf. Age and Origin of the Platforms. Tertiary Decay.

The erosion of the platforms: Watershed and Valley Systems (Longitudinal and Transverse Valleys, the Northern Barrier, &c.).

Studies of special features: The Rivers Cefni and Braint. The Menai Strait and its Development. The Strait of Holy Isle. Fydyln. The Lakes. The Forms of the Coast-line. Types of Scenery. Nature, Origin, and Age of the Boss-Lands.

Post-Glacial erosion: Inland (diversion of rivers, limestone-escarpments). The Coast (Llangwyfan Islet, &c.). Holyhead Breakwater.

Chronological sketch of the development of the land-surface.

## **Part 4 — Economics**

Introductory.

## **Chapter 35 — Coal mining**

Its History. Output and Quality. Details of the Mines and Seams. Tabulation of the Seams. Structure of the Coal-field. The Relations of the Red Measures. Concluding Considerations.

## **Chapter 36 — The metalliferous mines of Parys Mountain**

Introductory. History of the Mines. Extent of the Mine. The Ores. The Lodes. Primary Ore-Zones. Gossan and its date. Anglesite. Treatment, in early and modern times. Output. Conclusion.

## **Chapter 37 — Other metalliferous deposits**

Sulphides and their Associates. Miscellaneous. Ironstones. Note on Gold and Silver.

## **Chapter 38 — Various mineral industries and resources**

Silica-Rocks. Limestone for Burning. Brickworks. Building-Stone. Sites for Houses. Road-stones. Railway.

Ballast. Asphalt. Paving-Flags, Curbs, and Setts. Minor Industries and Resources. Sand. Peat. Marl. Millstones and Rollers. Ochre and Umber. Asbestos. Rocks suitable for Decoration. Churchyard and Cemetery Monuments.

## **Chapter 39 — Water-supply**

Introductory, Difficulties of the Subject. The Mona Complex (its deceptive structures, &c.). The Ordovician and Associated Rocks. The Old Red Series. The Carboniferous Rocks. The Glacial and Later Superficial Deposits. Borings near Boundaries. Pollution. General Remarks.

## **Chapter 40 — Agriculture**

Introductory. Soils of the principal formations. The distribution of the Drifts. Zones of Glacial Overlap. Reclamations of Land. The Woodlands. Grass-weaving. Summary.

## **Part 5 — Conclusion**

### **Chapter 41 — Additional studies**

Miscellaneous studies: The Hereford Earthquake of 1896. The Ice-worn Slab in the Dolmen of Henblâs. Land-surface and Earth-movement. The Depth of Red Measure Erosion. The Age of the Palaeozoic Intrusions. Palaeozoic and Tertiary Vulcanism. A Persistent Petrological Tendency. The Age of the Careg-onen Beds. The Determination and Development of the Coast-line. The Comparative Heights of Anglesey and of the Mountain-land.

Additional studies on the Mona Complex: The Mona Complex outside Anglesey. Vulcanism in the Mona Complex. Another Analysis of the Holyhead Quartzite, Some Improvements in Nomenclature, The Plâs Newydd Boring. The Age of the North Stack and Namarch Faults. The Penmynydd Zone. Folded. Mono-planic Schists. The Age. of the Gneisses. The 'Mutual Relations of the Basic and Acid Gneisses. The Occurrence of Soldier's Point Beds to the West of the Namarch Fault. The Fydlyn-Gwna Junction. The Gwna-Skerries Junction. The Age of the Mona Complex. Folding and Metamorphism. Reconciliation of the Metamorphic with the Tectonic Succession, Ulterior Bearings of the Study of the Complex.

### **Chapter 42 — General chronological recapitulation**

## **Appendices**

### **Appendix 1 Particulars of the geological maps**

**Appendix 2-Statistics of fossils, rock-specimens and slides, chemical analyses, and photographs.**

**Appendix 3.-Particulars of the microphotographs.**

**Appendix 4 Particulars of the folding-plates.**

**Cancellation of certain appendices.**

## **Supplement**

Metamorphism in the Mona Complex.

Introductory.

Comparative view of the metamorphic products.

Ætiology of the metamorphism: Metasomatic, Thermal, and Catamorphic Agencies.. Dynamical Origin of the Regional Anamorphism. Foliation and Folding. Ætiology of the Textures. The Two Paths of Intensification. Tectonics and Anamorphism: a Correlation.

The metamorphism in space and time.

Recapitulation.

General and regional ætiology.

## **Figures in text**

Note — Where the scale of a section is given, it is the same vertically as horizontally. In the sections marked 's./'. in this list, the base line indicates sea-level. In those not so marked it is merely a local level. In this list many titles have been condensed for economy of space, and many have been modified in order to give a better indication of the subject.

### **In Chapter IV. The petrology of the Mona Complex.**

Figure 1 Ellipsoids in spilite, Llanfwrog.

Figure 2 Ancient foliated pebbles in Skerries Grits

Figure 3 Deformed boulder in Skerries conglomerates

Figure 4 Phacoids of grit in Gwna mélange

Figure 5 Phacoids of grit in Gwna mélange

Figure 6 Venous-quartz phacoids in Gwna Green-schist

Figure 7 Broken zircon in the Bodaf on quartzite

Figure 8 Compound oolite-grain in Gwna limestone

Figure 9 Old foliation in the Coedana granite

Figure 10 The felsite survival at Graig-fawr, *map*

Figure 11 Position of passage in Mynydd Llwydiarth, *map*



Figure 12 Drawing-out of oldest hornblende-gneiss, Allor tract

Figure 13 Albite-pegmatite knot in hornblende-gneiss, Allor tract

Figure 14 Albite-pegmatite sill in hornblende-gneiss, Allor tract

Figure 15 Albite-pegmatite sill in hornblende-gneiss, Allor tract

Figure 16 Albite-pegmatite isolating hornblende-gneiss, Allor tract

Figure 17 Albite-pegmatite isolating hornblende-gneiss, Allor tract

Figure 18 Albite-pegmatite isolating hornblende-gneiss, Allor tract

Figure 19 Inclusions of gneiss in albite-granite, Llandrygarn

Figure 20 Inclusions of gneiss in albite-granite, Llandrygarn

Figure 21 Banding with transgression, Henblås

Figure 22 Gneiss with lenticular granites, Gader Inlier

Figure 23 Gneiss with lenticular granites, Gader Inlier

Figure 24 Gneiss with granitoid interfelting, Gwyndy

Figure 25 Passage along strike from gneiss to granite, Gwyndy

Figure 26 Films of gneiss in albite-granite, Gader Inlier

Figure 27 Rejuvenated clastic albites

## **In Chapter 6. The Succession In The Mona Complex**

Figure 28 Infolded outlier of Holyhead Quartzite, South Stack Moor

Figure 29 Spilitic tuff and passage beds, Holyhead

Figure 30 Spilitic tuff and passage beds, Bodwradd

Figure 31 Spilitic tuff and passage beds, Rhoscolyn

Figure 32 Passage from Fydlyn to Gwna Group, Fydlyn

## **In Chapter 7. The tectonics of the Mona Complex**

Figure 33 The North Stack Fault, from the Signal Station

Figure 34 The Namarch Fault, Porth Namarch

Figure 35 Diagram of the Recumbent Folding

Figure 36 Major isoclinal folds in the dyke's chasm, Henborth, *s.l.*

Figure 37 Minor isoclinal folds near Perth Dafarch, *s.l.*

Figure 38 Foliation in massive and fissile beds, South Stack

Figure 39 Opposition of minor to major isoclines, Rhoscolyn, *s.l.*

Figure 40 Symmetrical minor folding, Amlwch Port

Figure 41 Symmetrical minor folding, Bodorgan Tunnels

Figure 42 Symmetrical minor folding, Bryn-yr-odyn

Figure 43 Symmetrical minor folding, Bryn-yr-odyn

Figure 44 Minor isoclines, Holyhead

Figure 45 Minor isoclines, Holyhead

Figure 46 Minor isoclines, Holyhead

Figure 47 Minor isoclines, Holyhead

Figure 48 Minor isoclines, Gors-goch, Holy Isle

Figure 49 Minor isoclines, Bryn-eilian, Amlwch

Figure 50 Minor isoclines, Bryn-eryr

Figure 51 Minor isoclines, Myrnydd Llwydiarth

Figure 52 Straight-limbed minor isoclines, Point Lynas

Figure 53 Straight-limbed minor isoclines, Holyhead

Figure 54 Anticlinal minor folding, Mynydd Llwydiarth

Figure 55 Anticlinal minor folding, Mynydd Llwydiarth

Figure 56 Anticlinal minor folding, Penmynydd

Figure 57 Polyclinal minor folding, Mynydd Llwydiarth

Figure 58 Polyclinal minor folding, Mynydd Llwydiarth

Figure 59 Polyclinal minor folding, Mynydd Llwydiarth

Figure 60 Polyclinal minor folding, detail of (Figure 59)

Figure 61 Vertical pitch, Mynydd Llwydiarth

Figure 62 Minor thrusts in the Tre-Arddur Zone

Figure 63 Minor thrusts in in the Tre-Arddur Zone

Figure 64 Minor thrusts in Trwyn-bychan

Figure 65 Minor thrusts in along bedding, Amlwch Beds

Figure 66 Stretching along bedding, Amlwch Beds

Figure 67 Incipient lenticular cutting, Amlwch

Figure 68 Breaking-down of beds, Tyfry

Figure 69 Diagram of Autoclastic Mélange

Figure 70 Strain-slip on minimum folding

Figure 71 Change of structure along the Alaw Estuary

Figure 72 The Valley thrust-planes

Figure 73 The Valley thrust-planes

Figure 74 Undulation of the Valley thrust-planes

Figure 75 Folding and thrusting of the Valley thrust-planes

Figure 76 Diagram of the structural change from Holy Isle to Western Region

Figure 77 Folded phacoids of grit, Pedair-groeslon

Figure 78 Lenticular limestones, Baron Hill drive

Figure 79 Folded phacoid of limestone, enlarged from (Figure 78)

Figure 80 Cross-wrenches

Figure 81 Foliation in Llwyn grits, Porth Ruffydd, Holyhead, *s.l.*

Figure 82 Kingsland, Holyhead

Figure 83 East of Porth Ruffydd, Holyhead, *s.l.*

Figure 84 Diverging foliation in a grit, Gors-goch

Figure 85 Bending of the cleavage-foliation, Porth Ruffydd

Figure 86 Folding of cleavage-foliation, Rhoscolyn

Figure 87 Cross-foliation in fissile bed, Rhoscolyn

Figure 88 Foliation-thrusting, South Stack

Figure 89 Folding of the minor thrusts, Clybyddiad

Figure 90 Second foliation in glaucophane-schist., Llangaffo

### **In Chapter 8. General view of the Mona Complex.**

Figure 91 Folding of the quartzite, Holyhead Mountain, *s.l.*

Figure 92, Diagram of the Recumbent Breakwater Fold

Figure 93 Section across the Breakwater tract, *s.l.*

Figure 94 Section at Mynachdy, *s.l.*

Figure 95 The major thrusts of Trwyn-bychan, *s.l.*

Figure 96 The Wylfa thrust-plane at Porth Wnol, *s.l.*

Figure 97 Diagram of the relations of the Glenkiln conglomerates to the Mona Complex in Gynfor 98 Charts of the structures in the Aethwy Region

Figure 99 Abstract of the major secondary folds on the Main Island, *s. 1.*

Figure 100 Chart of the tectonic horizons of the Complex

Figure 101 Chart of the strikes within the Complex

Figure 101B Chart of the metamorphism in the Complex

### **In Chapter 9 The Age. Of The Mona Complex**

Figure 102 Pebbles from Arenig Conglomerate, containing old folding of the Mona Complex, 102B Pebble from Lower Cambrian Grit, containing an old fold of the Mona Complex

### **In Chapter 10 The detail of The Mona Complex**

Figure 103 Deflection of Scolithus

Figure 104 Nipping of galls in the Stack Moor Grits

Figure 105 Isocline on Henborth Cliff, *s.l.*

Figure 106 Structures on minor fold, Gors-goch

Figure 107 Major and minor isoclines, Llwyn-y-berth Promontory, *s.l.*

Figure 108 Minimum folds on limb of minor isocline

Figure 109 Folding of minor thrust-planes, Tre-Arddur

Figure 110 Outlier from thrust-plane, west of Holyhead

Figure 111 Anticline of passage beds, Holyhead

Figure 112 Passage beds, Holyhead

Figure 113 Section at crags near Capel Gorllas, *s.l.*

Figure 114 Bedding in the Holyhead Quartzite, North Stack, *s.l.*

Figure 115 Folding counter to dip, Penrhos

Figure 116 Second foliation, Soldier's Point

Figure 117 Overfolding contrary to dip, near -Breakwater, *s. 1*

Figure 118 Section along the cliffs, Porth Namarch, *s.l.*

Figure 119 Section at right angles to (Figure 118), *s.l.*

Figure 120 Detail of Fig 119, sheaving Breakwater Thrust-plane

Figure 121 Basic intrusions, Rhydbont Creek, *map*

Figure 122 Basic intrusions, Cerig-moelion, *map*

Figure 123 Minor thrusting, Porth-y-defaid, *s.l.*

Figure 124 Minor folding, Llywenan

Figure 125 The Valley thrust-planes, Pen-llyn, Llywenan

Figure 126 Undulating dip, Llywenan.

Figure 127 Thrusting in a quartz-vein, River Alaw

Figure 128 Minor folding at low angles, Meiriogen

Figure 129 Small thrusts in fold of tuffs near Porth-trwyn

Figure 130 Section at Porth-yr-hwch, *s.l.*

Figure 131 Northern part of Gader gneiss, *map*

Figure 132 Minor folding, Coeden beds

Figure 133 Epidosite bands, Henborth, Mynachdy

Figure 134 Jaspers and spilites, Amlwch, *map*

Figure 135 Minor isoclines, Llanfairynghornwy [after Matley]

Figure 136 Bedded jaspers on Amlwch Port Moor, *map*

Figure 137 Shears in Gwna quartzite, Graig-wen

Figure 138 Autoclast in Gwna mélange, Llanbadrig

Figure 139 North-west cliffs of Mynydd-y-Wylfa, *map*

Figure 1.40 Thrust near Ogo Gynfor, *s.l.*

Figure 141 Minor thrusting at the rwyn-bychan thrust-plane

Figure 142 Bisected and shifted pebble, Trwyn-bychan

Figure 143 Thrust-planes cutting foliation, The Skerries

Figure 144 Gneiss with lenticular granites, Porth Helygen

Figure 145 Granite sills in mica-hornfels, Caer-glaw

Figure 146 Granite sills in mica-hornfels, Caer-glaw

Figure 147 Granite sills in mica-hornfels, Caer-glaw

Figure 148 Granite vein in mica-hornfels, Caer-glaw

Figure 149 Granite sills in mica-hornfels, River Caradog

Figure 150 Granite sill in hornfels, Gwalchmai

Figure 151 Granite and mica-hornfels, Y-foel

Figure 152 Granite sills in hornblende-hornfels, Coedana

Figure 153 Granite and hornblende-hornfels, Coedana

Figure 154 Northern parts of Bodafon Moor, *map*

Figure 155 Central parts of 1Vlynydd Bodafon, *map*

Figure 156 Section across northern parts of Mynydd Bodafon, *s.l.*

Figure 157 Section across central parts of Mynydd Bodafon, *s.l.*

Figure 158 Section across southern parts of Mynydd Bodafon, *s.l.*

Figure 159 Cataclastic thrusts, Ynys Meibion

Figure 160 Outcrops of the Bodwrog marble, *map*

Figure 161 Quartzite masses in Gwna mélange, near Porth Cadwaladr, *s.l.*

Figure 162 Fold and cleavage, from Bodorgan Tunnel

Figure 163 Jasper with foliation, Prys-lorwerth

Figure 164 Folding in the Engan spilites, Craig-las

Figure 165 Base of limestone near Garth Ferry, *s.l.*

Figure 166 Lenticular limestones, roadside, near (Figure 165)

Figure 167 Basic schist in Gwna Green-schist, near Garth Ferry

Figure 168 Folding of quartzite, Pen-y-parc

Figure 169 Lenticular grit in Gwna mélange, Llansadwrn

Figure 170 Basic knot in Gwna Green-schist, Llanddona Highlands

Figure 171 Basic schist, crossing the strike

Figure 172 Plan and section of basic schist

Figure 173 Foliation-dip counter to true dip

Figure 174 Biotite-augen, Menai Strait

Figure 175 Cross-folding in glaucophane-schist, Castellior

Figure 176 Hornblende-schist and mica-schist, Gwydryn

Figure 177 Foliated quartz-vein in old fault

Figure 178 Llangaffo Cutting, *plan*

Figure 179 Folding at Treferwydd

Figure 180 Small hitch in Penmynydd schist

Figure 181 Quartz-phacoids in mica-schist, Berw

Figure 182 Quartz-phacoid cutting older quartz, Berw

Figure 183 Internal corrugation in siliceous seam, Bridin

Figure 184 Siliceous inclusion in glaucophane-schist, Careg-landeg

Figure 185 Southern parts of Mynydd Llwydiarth, *map*

Figure 186 Isoclinal in glaucophane-schist, Mynydd Llwydiarth

Figure 187 Foliated pegmatitic vein, Newborough

Figure 188 Boss near Cerig-duon, *map*

### **In Chapter 12. The Baron Hill And Careg-Onen Rocks**

Figure 189 Third boss on Baron Hill Drive

Figure 190 Fourth boss on Baron Hill Drive

Figure 191 Thrusts in (Figure 190)

Figure 192 Bedding and cleavage, Careg-onen

Figure 193 Sponge-spicules from the Careg-onen Rocks

Figure 194 Section along the cliffs at Careg-onen,

Figure 195 The anticline in (Figure 194)

Figure 196 Detail of (Figure 195)

Figure 197 The Same

Figure 198 Section at Coch-y-mieri

Figure 199 Section near Ty-mawr

### **In Chapter 13. The Ordovician rocks**

Figure 200 Sponge-spicules from the Glenkiln cherts

### **In Chapter 14. The detail of the Ordovician rocks**

Figure 201 Section across the Llangwyllog area, *s.l.*

Figure 202 The Llyn Traffwl Complex, *map*

Figure 203 The rupture at Yr-ogo-goch, *s.l.*

Figure 204 Section across Foel Hill, Llanerchymedd, *s.l.*

Figure 205 Isoclinal near Llwydiarth Esgob

Figure 206 The Same

Figure 207 Positions in the Fferam Infold, Llanbabo, *map*

Figure 208 Section across the Fferam Infold, Llanbabo, *s.l.*

Figure 209 Ironstone, Lane Infold, Llanbabo

Figure 210 Positions in the Church Infold, Llanbabo, *map*

Figure 211 Section across the Church Infold, Llanbabo, *s.l.*

Figure 212 The thrust-plane at Rhwnc, Parys Mountain

Figure 213 Section through the western end of Parys Mountain, *s.l.*

Figure 214 Section across the central parts of Parys Mountain, *s.l.*

Figure 215 Anticlines at Craig-y-gwynt, Mynydd-y-garn

Figure 216 Section through Mynydd Eilian, *s.l.*

Figure 217 Section through Torllwyn and Graig-wen, *s.l.*

Figure 218 Section along cliffs, Llanlleiana Head, *s.l.*

Figure 219 Section at Glochog, *s.l.*

Figure 220 The cliff-section, Ogo Gynfor, *s.l.*

Figure 221 Unconformity at Ogo Gynfor, *s.l.*

Figure 222 Section through the Infold of Mynachdy, *s.l.*

Figure 223 Limestone lump in shales, Porth Padrig

Figure 224 The Padrig slide, Mynachdy, *s.l.*

## **In Chapter 16. The Paleozoic Intrusions**

Figure 225 Second injection in basic dyke, Menai shore

Figure 226 Dolerite dykes, Mynydd Mechell, *map*

Figure 227 Basic dykes at Cemaes, *map*

Figure 228 Margin of dolerite dyke, Menai shore

Figure 229 Vein from basic dyke at Cemaes

Figure 230 Branching of basic dyke near Garth Ferry

Figure 231 Margin of basic dyke near Garth Ferry

Figure 232 Splitting of the Rhoscolyn dyke, *map*

Figure 233 Thirteen-foot basic dyke, Menai shore, *s.l.*



Figure 234 Group of small basic dykes, Menai shore, *s.l.*

Figure 235 Flank of large basic dyke, Mechell Hills

Figure 236 Bending-over of basic dyke, Mechell Hills

Figure 237 Outlier from basic dyke, near Bwlch

Figure 238 Felsite dyke, Ynys-fawr

Figure 239 Felsite dyke, near Gwalchmai

Figure 240 Felsite dyke

Figure 241 Felsite dykes S.W. of Gwalchmai, *map*

Figure 242 Felsite sheet, Bryn-twrog, *map*

Figure 243 Composite dykes, Coeden, *map*

Figure 244 77, Drum, *map*

Figure 245 The intrusions on Mynydd Eilian, *map*

Figure 246 Basic sills at Llandyfrydog

Figure 247 Basic sill at Llanerchymedd Station

Figure 248 Basic sill, Dulas Bay *s.l.*

Figure 249 Tongues from basic sill, Ogo-fawr

Figure 250 Basic sill of the Skerries Lighthouse, *s.l.*

Figure 251 Felsite sill near Mynydd Eilian, *s.l.*

Figure 252 Shifted margin of basic sill near Mynydd Eilian

Figure 253 Thrust in basic dyke, Pant Ho wel

Figure 254 Detail of (Figure 253)

Figure 255 Faulted basic dykes, Traeth Lydan

Figure 256 Schistose basic dyke, Gwalchmai

Figure 257 Faulted basic dyke, Porth Tre Castell

## **In Chapter 17. The detail of the Palaeozoic intrusions**

Figure 258 Dolerite west of Careg-onen, *s.l.*

Figure 259 Schistose dyke, Point Lynas, *s.l.*

Figure 260 Section in composite dyke near Llanfechell [after Malley]

## **In Chapter 18. The tectonics of the Ordovician and Silurian rocks**

Figure 261 Folding and cleavage, Rhosneigr, *s.l.*

Figure 262 Folding and cleavage, Rhosneigr, *s.l.*

Figure 263 Thrusting and cleavage, Rhosneigr

Figure 264 The Nebo thrust-plane at the coast, *s.l.*

Figure 265 Detail of (Figure 264 The Nebo thrust-plane at the coast,), *s.l.*

Figure 266 The Gwichiaid slide and thrust-planes at the Cliff, *s.l.*

Figure 267 Minor thrusts, Gwichiaid beach, *s.l.*

Figure 268 Horizontal minor thrust, Gwichiaid cliff

Figure 269 The Carmel Head thrust-plane at Gwaen-ydog, *map*

Figure 270 The Carmel Head thrust-plane at Carmel Hea, *s.l.*

Figure 271 Detail of (Figure 270)

Figure 272 The Cannel Head thrust-plane, Llanfairynghornwy

Figure 273 Cleavage at Rhosneigr

Figure 274 Shredding along cleavage at Rhosneigr

## **In Chapter 20. The Old Red Sandstone**

Figure 275 Section from Coed-y-gell to Lligwy Bay, *s.l.*

Figure 276 Section on the north side of Bodafon Moor, *s.l.*

Figure 277 Section from Mynydd Bodafon, across the Vale of Lligwy, *s.l.*

Figure 278 Section parallel to part of (Figure 276), *s.l.*

Figure 279 Wedging out of cornstones, Porth-y-môr

Figure 280 Section near Llangefni, *s.l.*

Figure 281 Contemporaneous contortion, Traeth-yr-ora, *s.l.*

Figure 282 Isoclinal anticline, Lligwy Bay, *s.l.*

Figure 283 Isoclinal syncline, Lligwy Bay, *s.l.*

Figure 284 Thrust-planes, Lligwy Bay, *s.l.*

Figure 285 Turning of cleavage round monoclinial fold, *s.l.*

## **In Chapter 22. The Carboniferous Limestone**

Figure 286 Lump in limestone-conglomerate

Figure 287 Penetration of limestone-lump

Figure 288 Anomalous junction, Borth-wen, Benllech, *s.l.*

Figure 289 Succession above the sandstone pipes, *s.l.*

Figure 290 Floor of sandstone pipe

Figure 291 Section across contemporaneous disturbance, Lligwy, *s.l.*

### **In Chapter 23. The detail of the Carboniferous Limestone**

Figure 292 Section at Moryn, Porth-y-forllwyd, *s.l.*

Figure 293 Section across Moelfre Point, *s.l.*

Figure 294 Section along the coast at Benllech, *s.l.*

Figure 295 Section through Castell-mawr, Red Wharf, *s.l.*

Figure 296 Section across the Vale of Lligwy, *s.l.*

Figure 297 Carboniferous outlier, Glan-aber, Llangefni

Figure 298 Section through the base, Bodorgan

Figure 299 Section across the Strait-side Carboniferous Area, *s.l.*

Figure 300 Section through the base at Plâs Llanfair, *s.l.*

Figure 301 Section from Penmon to the East Point, *s.l.*

### **In Chapter 24. The Millstone Grit and Coal-Measures**

Figure 302 Section across the Anglesey coalfield, *s.l.*

Figure 303 Base of the Millstone Grit at Bodorgan, *s.l.*

### **In Chapter 25. The Red Measures**

Figure 304 Polyzoön from pebble in Red Measures

### **In Chapter 27. The tectonics of the Carboniferous rocks**

Figure 305 Folding at the Berw Fault, Ceint [after Henslow]

### **In Chapter 28. The Later dykes**

Figure 306 Palaeozoic and later Dyke, near Gaerwen

### **In Chapter 30. The Drifts and glaciation**

Figure 307 Glacial furrow at Amlwch Port

Figure 308 Plan of deflected striae, Trwyn-dwlban

Figure 309 Undercut furrow, Trwyn-dwlban

Figure 310 Undercut shelf, near Valley

Figure 311 Undercut shelf, Huslan, Benllech

Figure 312 Ice-modelled sea-cliff, Aber-cawell, *s.l.*

Figure 313 Glacial disruption, Porth-delisc

Figure 314 Glacial disruption, Porth-delisc

Figure 315 Boulder-clay under Dolerite, Plâs-bach

Figure 316 Boulder-clay on boss, Plâs aelog

Figure 317 Boulder-clay on boss, Bodior

Figure 318 Boulder-clay on boss, Castell Eden

Figure 319 Boulder-clay between bosses, Llyn Badrig

Figure 320 Boulder-clay on slope of boss, Rhytty

Figure 321 Penial Drum, *s.l.*

Figure 322 Llanfachraeth Drum, *s.l.*

Figure 323 Clymwr Drum

Figure 324 Drumlins near Valley, *map*

Figure 325 Chart. The path of the ice

Figure 326 Chart. The principal boulder streams

Figure 327 Carboniferous Limestone of Bryn-gwallen, *map*

### **In Chapter 31. The detail of the Drifts and glaciation**

Figure 328 Gravels and boulder-clay, Penrhos, Holyhead, *s.l.*

Figure 329 Section in Penrhos Drum, Holyhead, *s.l.*

Figure 330 Sand and gravel, Ty-gwyn, Llangefni

Figure 331 Rhydgroes and Werthyr Drums, Rhosbeirio

Figure 332 Drumlins of the Northern Valley, *map*

Figure 333 Boulder-clay bluffs, Bull Bay, *s.l.*

Figure 334 Buried escarpment, Llanbedr-goch

Figure 335 Gravels, Ty'n-y-caeau, Menai Bridge

### **In Chapter 32. The later Superficial Deposits**

Figure 336 The gravel of, Porth-dafarch, *s.l.*

Figure 337 The exit of Cremlyn, *map*

### **In Chapter 33. The sea-floor**

Figure 338 Sketch-map of the Sea-Floor

### **In Chapter 34. The development of the land-surface**

Figure 339 Holyhead Mountain, from Rhoscolyn, *s.l.*

Figure 340 Stages of development of the Menai Strait, *charts*

Figure 341 Undercut sea-cliff, Tr, wyn-dinmor *s.l.*

Figure 342 Post-glacial coast erosion, Trwyn-bychan, *s.l.*

### **In Chapter 35. Economics**

Figure 343 The Coal Measures at Berw, *map*

Figure 344 Shaft and boring Sections, by *Mrs. Greenly*

### **In Appendices**

Figure 345 Index-chart to the 'Solid-geology' maps

Figure 346 Index-chart to the ' Drift ' maps

## **Plates**

The scale is indicated by a hammer, stick, bag, or compass, or by a hin figure, and when there is no such object, the dimensions are 'stated'. hammer used is 12½ inches long, and the diameter of the compass is 1½. inc.

Plate 1 The Folding of the & Iona Complex, from the foot of the South Stack, Holyhead Frontispiece to Vol 1

Plate 2 Microphotographs of the Mona Complex. See App. 3

Plate 3 Ellipsoidal spilitic lava. Dunes of Newborough

Plate 4 Jasper between spilitic ellipsoids. Dunes of Newborough

Plate 5 Microphotographs of the Mona Complex. See App. 3

Plate 6 Rose-Limestone with ellipsoidal structure. Dunes of Newborough

Plate 7 Autoclastic Mélange. Coast near Porth Cadwaladr, Bodorgan

Plate 8 Gwna Green-schist with quartz-augen. Menai Strait

Plate 9 Microphotographs of the Mona Complex. See App. 3

Plate 10 Microphotographs of the Mona Complex. See App. 3

Plate 11 Folded Penmynydd mica-schist with quartz-augen. Graig-fawr, Holland Arms

Plate 12 Microphotographs of the Mona Complex. See App. 3

Plate 13 Albite-pegmatite in hornblende-gneiss. Clegir-mawr, Gwalchmai

Plate 14 Gneiss with knots of albite-granite. Coast of Gader Inlier

Plate 15 The Banded Gneisses. Henblâs, Llandrygarn

Plate 16 The North Stack and the sea-cliffs of the Holyhead Quartzite. Note — The feature determined by the North Stack fault runs on, from sea-cliff, up the mountain-side, below the sky-line.

Plate 17 The Namarch Fault. Porth Namarch

Plate 18 Minor Isoclines in the South Stack Series. Near Porth Rhwydan, Holy Isle

Plate 19 Minor Isoclines in the New Harbour Beds. Holyhead Breakwater

Plate 20 Isoclinal folding and thrusting. Salt Island, Holyhead

Plate 21 Microphotographs of the Mona Complex. See App. 3

Plate 22 Lenticular quartzites in Autoclastic Mélange, with late basic dyke. Porth Wnol

Plate 23 Folding of Autoclastic Mélange. Menai Strait

Plate 24 Bedding and foliation. Seaward end of South Stack

Plate 25 The Hwch lower thrust-plane. Porth-yr-Hwch

Plate 26 The Skerries. From near Carmel Head

Plate 26b Careg-onen Cliffs. Mona Complex, Careg-onen Beds, Ordovician Shales, and Carboniferous Limestone [Note — The crags in the foreground are composed of the Careg-onen Beds, ex where to (1 3/4 to 2 1/8 inches from right hand edge of view) the sharp anticline of G Green-schist (Figure 194) (Figure 195) rises from under them.]

Plate 27 Boulder from the Mona Complex in Arenig conglomerate. Tywyn Trewan

Plate 28 Microphotographs of rocks later than the Mona Complex. See App. 3

Plate 29 Glenkiln conglomerate resting unconformably upon the Mona Complex. Ogo Gynfor

Plate 30 Paleozoic dolerite dyke on the Menai shore

Plate 31 The Carmel Head thrust-plane at Carmel Head - Frontispiece to Vol 2

Plate 32 Brecciation at the Carmel Head thrust-plane. Gwaen-ydog

Plate 33 Silicification obliterating cleavage. Parys Mountain

Plate 34 Cleavage and bedding, Old Red series. Porth-y-môr

Plate 35 The-Lligwy Bay conglomerate. Careg-ddafad

Plate 36 Limestone conglomerate. Borth-wen, Benllech

Plate 37 Carboniferous coral-beds. Penrhyn, Traeth-bychan

Plate 38 Sandstone-pipe in Carboniferous Limestones. Trwyn-dwlban

Plate 39 Large sandstone pipe near Castell-mawr

Plate 40 Bedded cherts resting upon Carboniferous Limestone. Castell-mawr

Plate 41 Undercut cliff of Carboniferous Limestone. Trwyn-dinmor

Plate 42 Late olivine-dolerite Dyke. Henborth, Holy Isle

Plate 43 Glacial strite deflected into mouth of pipe. Trwyn-dwlban

Plate 44 Glacial sands and gravels, beneath red boulder-clay. Lleiniog

Plate 45 Boulder of hornblende-picrite. Mynydd-mwyn-mawr, Llanerchymedd

Plate 46 Boulder of Galloway granite. Porth-yr-ysgaw, Llaneilian

Plate 47 Transported block of Carboniferous Limestone. Lleiniog

Plate 48 Boulder of Penmynydd mica-schist, with tree growing in crack. Trefarthen

Plate 49 Desert scenery. Dunes of Newborough

Plate 50 The Menaian Platform and the Bodafon monadnock. From Mynydd-mwyn-mawr

Plate 51 The Eastern Reach of the Menai Strait. From the Suspension Bridge

Plate 52 The Menai Strait at the submerged watershed. From the top of the column

Plate 53 The Middle Reach of the Menai Strait. From the top of the column

Plate 54 The Western Reach of the Menai Strait. From above Port Dinorwic

Plate 55 Typical scenery of the Mona Complex. Amlwch Port Moor

Plate 56 Rock table of Carboniferous Limestone. Near Marian-glas

Plate 57 Llangwyfan Church Islet at half-tide

Plate 58 The same. From the headland

Plate 59 Blocks moved by the Sea. Holyhead Breakwater

Plate 60 The West Pit and the summit. Parys Mountain

## **Folding plates at end of book**

The horizontal base-line of the sections indicates sea-level, and the vertical scale is the same as the horizontal in all except 16.

### **Plate**

Folding Plate 1 Section along the sea-cliffs from the South Stack to Henborth.

Folding Plate 2 Section parallel to the coast at Rhoscolyn.

Folding Plate 3 Section through Holy Isle from the North Stack to Cymyran Bay.

Folding Plate 4 Section through the Western Region of the Mona Complex..

Folding Plate 5 Section through the Northern Region of the Mona Complex.

Folding Plate 6 Section through the Middle Region of the Mona Complex, from Trefor to Glan-traeth.

Folding Plate 7 Generalized Section through the Aethwy Region of the Mona Complex,

Folding Plate 8 Section through Mynydd Llwydiarth.

Folding Plate 9 Section through Mynydd-y-garn.

Folding Plate 10 Section from Carmel Head to near Rhos-y-Cryman

Folding Plate 11 Section across the Principal Ordovician Area from Llanol to Prys-Owen.

Folding Plate 12 Section through the Principal Carboniferous Area from the Vale of Lligwy to the mouth of the Pentraeth River.

Folding Plate 13 The North-West corner of Anglesey. Reproduction of manuscript six-inch map.

Folding Plate 14 The Skerries. Reproduction of manuscript six-inch map.

Folding Plate 15 Llanddwyn Island. Reproduction of manuscript six-inch map.

Folding Plate 16 Sketch-section across Anglesey from Torllwyn to Moel-y-don.

Folding Plate 17 Sketch-section across Anglesey from Amlwch to Garth Ferry.

## Corrigenda

Page 35: After Line 13 — Insert '1907. Greenly, E. " Sandstone Pipes in Carboniferous Limestone, Anglesey." *Geol. Mag.* p. 238'.

Page 201: Line 26 — For 'p. 201 ' read 'p. 244'.

Page 202: Line 3 from bottom — For 'Fig. 37' read 'Fig. 38'.

Page 205: Note — For 'Appendix 9 ' read 'Chapter 41, pp. 909–402

Page 207: Line 31 — For 'Fig. 36' read 'Fig. 37'.

Page 207: Line 3 from bottom — For 'Fig. 38' read 'Fig. 39'.

Page 230: Line 23 — For '17' read '18'.

Page 242: Note — For 'Appendix 9' read 'Chapter 41, pp. 907–8'.

Page 303: Line 30 — For 'Bryn-llywd ' read 'Bryn-llwyd'.

Page 311: Line 13 — For 'Dynas Cynfor' read 'Dinas Cynfor'.

Page 329: Line 'Drudwy ' read 'Ddrydwy'.

Page 347: Line 12 — For 'Porth Tywyn-mawr ' read 'Porth Twyn-mawr'. They are two distinct places.

Page 362: Line 4 above Fig. 168 — For '[E6091](#) [SH 583 745] ' read '[E6090](#) [SH 588 752]'.

Page 409 Line 29 — For '(1911) ' read '(1912)'.



Page 498: Bottom — For 'Appendix 9' read 'Chapter 41, pp. 892–3'.

Page 515: Line 30 — For 'evidently older ' read 'apparently older'.

Page 520: Line 12 from bottom — For 'spherulitic ' read 'spheroidal'.

Page 557: Line 24 — For Appendix 9' read 'Chapter 41, pp. 900–1'.

Page 739: line 4 — For 'Trwyn-yr-eryr ' read 'Trwyn-cerig-yr-eryr'.

**Note** — In the text (see p. 3), Welsh place-names are spelt as on the one-inch map, of which this book is an explanation; but inconsistencies as to hyphens, capitals, &c., in compound names have crept in, owing mainly to the different usages on the six-inch and one-inch-maps. In the Index, care has been taken to follow the usage of the new geological one-inch map.

## **Abolition of Appendix 9**

The matter that was intended to have been placed in this has been transferred to Chapter 41. Consequently, on pp. 205, 242, 498, 557, (as indicated in the Corrigenda-list) for Appendix 9' read Chapter 41, pp. 909–10, 907–8, 892–3, 900–1' respectively. See *also* the Table of Addenda, p. xl.

## **Six-Inch Map names not quoted as such**

It is stated at the top of p. 3 that the place names used in this book will be those found on the published One-inch Geological Map, except in a small number of cases, which are indicated in the text. In 23 other cases, however, I have inadvertently made use of names taken from the six-inch maps without indicating that they are such. By means of the following table they can be translated into equivalents that will be found on the one-inch map.

Page 78: Analysis I — For 'Capel Soar' read 'Soar'.

Page 281: Line 14 from bottom — For 'Bryn-palma ' read 'Three-eighths of a mile west-south-west of Llynnon Hall'.

Page 281: Line 14 from bottom. For 'Pen-yr-argae' read 'Three-eighths of a mile north-east of Tan-yr-allt'.

Page 326: Line 4 — For 'north end of Ty-croes lane' read '277-foot level'.

Page 371: Lines 16–17 — For 'about Bryn-tirion' read 'east of the 178-foot level'.

Page 406: Lines 19–20 from bottom — 'For Gorlan-goch' read 'Bonw lane'.

Page 407: Line 9 from bottom — For '275 yards north-west of Gorlan-goch ' read '660 yards south-east by east from Bonw'.

Page 416: Line 14 — For Gorlan-goch ' read ' Bonw lane'.

Page 434: Line 11 from bottom — For at Tan-y-gwreiddyn... east-north-east' read '270 yards south of Llanddona Church, the other at a farm 200 yards to the west-south-west'.

Page 434: Line 5 from bottom — For '233 yards... Ty'n-y-pistill ' read '700 yards south-west by south from Llanddona Church'.

Page 456: Lines 13–14 — For 'Tyddyn-bach' read 'The farm north-east of Glan-y-gors'.

Page 456: Bottom — For 'Cefn-du-mawr' read 'Cefn-du'.

Chapter 9 p.253 The Age of the Mona Complex.

Chapter 10 p.291 The Thrust-planes at Porth-yr-hwch.

Chapter 10 p.336 The Bodafon Moor Flags.

Chapter 10 p.367–8 The Plâs Newydd Boring.

Chapter 10 p.384 Soldier's Point beds to the west of the Namarch Fault.

Chapter 10 p.386 The Penmynydd Zone.

Chapter 12 p.397–9 The Age of the Careg-onen Beds.

Chapter 16 p.498, 516 Later Vulcanism.

Chapter 16 p.510, 516 The Age of the Palaeozoic Intrusions.

Chapter 25 p.670 Red Measure Erosion.

Chapter 28 p.689 Later Vulcanism.

Interpolation on pp. 615–16. After the paged proofs of Chapter 41 had been passed, papers were read before the Geological Society (Jan. 8, 1919) by Prof. Kendall and Dr. Gilligan, in which they suggested that certain irregularities of bedding in the Coal Measures of England might be due to contemporaneous earthquakes. Their views should, accordingly, be combined with those of Prof. Hobbs and the Comte de Ballore.

Note to p. 799. For the history of Cemlyn pebble-ridge, as well as for several other matters of local history, we are indebted to my friend Mr. Ellis of Llanfairynghornwy.

Note to pp. 264–7. The colour-band on the one-inch map represents the passage-beds, where the basic band itself may be barely visible, as at the spot illustrated by (Figure 112), where also the curved line indicates the base of the zone of passage.



*(Plate 1) The Folding of the Mona Complex, as viewed from the South Stack, Holyhead. Height seen: 445 feet. Frontispiece to Vol 1..*



*(Plate 38) Sandstone-pipe in Carboniferous Limestone. Foreshore, Trwyn-dwlban.*



(Plate 43) Glacial striae deflected into mouth of pipe. Foreshore, Trwyn-dwlban.

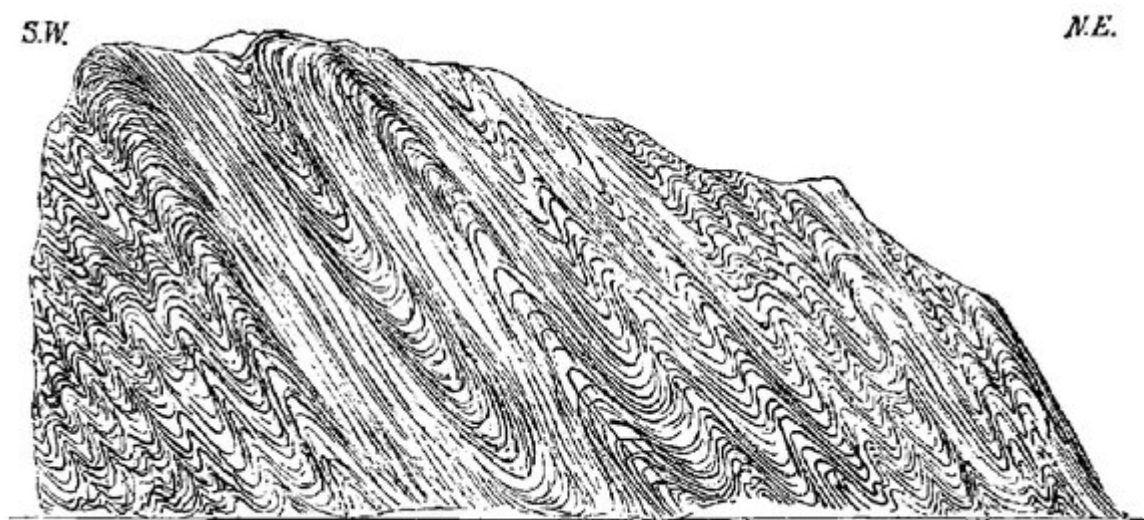


FIG. 135.—ISOCLINAL FOLDING IN AMLWCH BEDS.

(Figure 135) Isoclinal folding in Amlwch Beds. Behind rectory, Llanfairynghornwy. [Matley.]

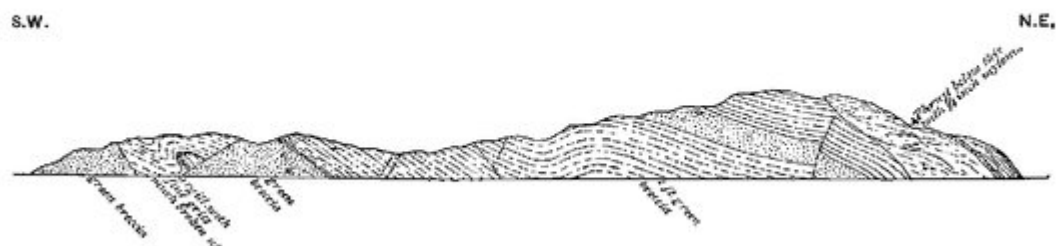
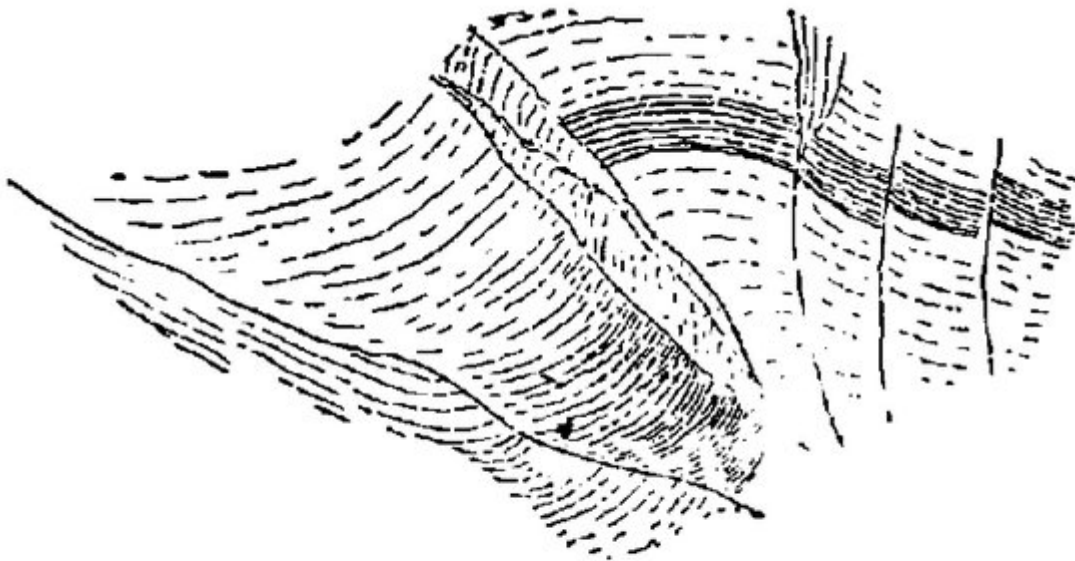


FIG. 189.—THIRD BOSS ON BARON HILL DRIVE.

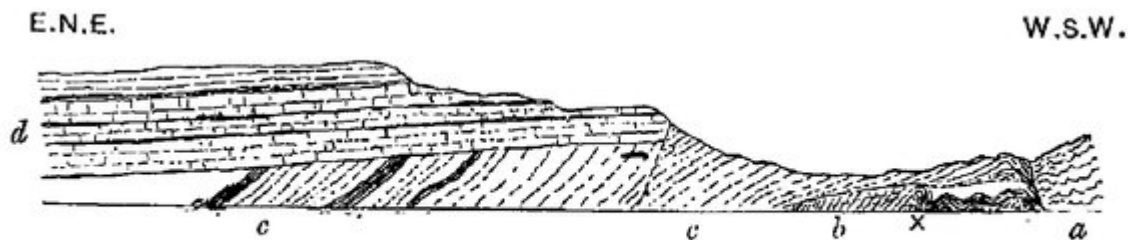
(Figure 189) Third boss on Baron Hill Drive. Scale: one inch = 50 feet.



(Figure 190) Fourth boss on Baron Hill Drive. Scale: one inch = 50 feet.



(Figure 191) Face of cliff. Two and three-quarter inches below the thrust shown under x in (Figure 189) Natural size.



(Figure 194) Section along the cliffs at Careg-onen. Scale: one inch = 440 feet. Gwna Green-schist (a); Careg-onen Beds (b); Ordovician Shales (c); Carboniferous Limestone (d).

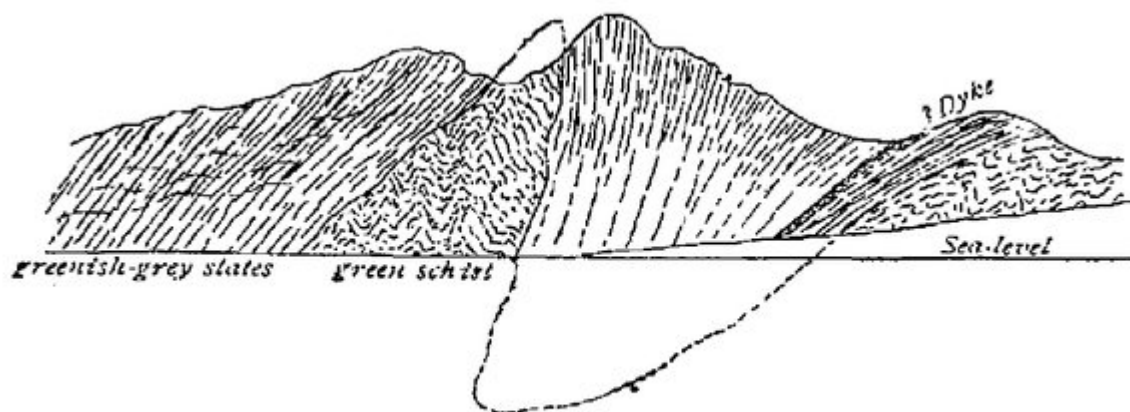


FIG. 195.—THE ANTICLINE AT X IN FIG. 194.

(Figure 195) The anticline at x in (Figure 194) [Section along the cliffs at Careg-onen]

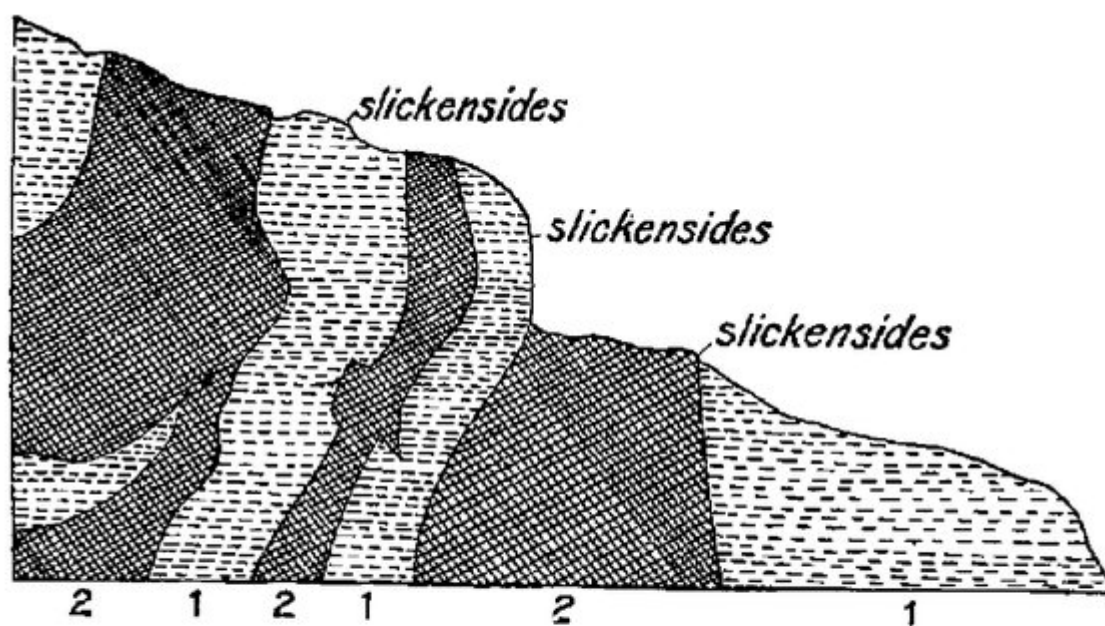


FIG. 260—SECTION IN THE COMPOSITE DYKE  
WEST OF LLANFECHELL. (Matley.)

Width shown = about 16 feet.  
1 = Felsite. 2 = Dolerite.

(Figure 260) Section in the composite dyke West of Llanpechell. (Matley.) Width shown = about 16 feet. 1 = Felsite. 2 = Dolerite.

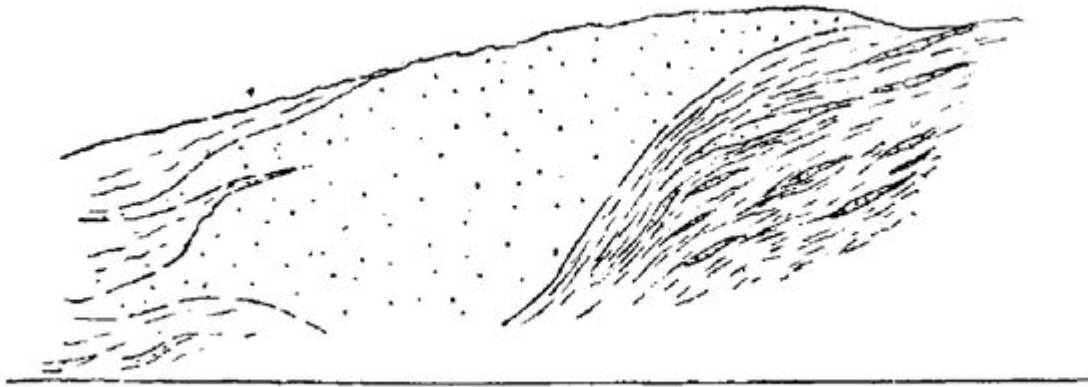


FIG. 169.—LENTICULAR QUARTZITE.

(Figure 169) Lenticular quartzite. Three and a half feet long. In Gwna Mélange, Llansadwrn.



FIG. 258.—DOLERITE ON COAST WEST OF CAREG-ONEN.

(Figure 258) Dolerite on coast west of Careg-onen.

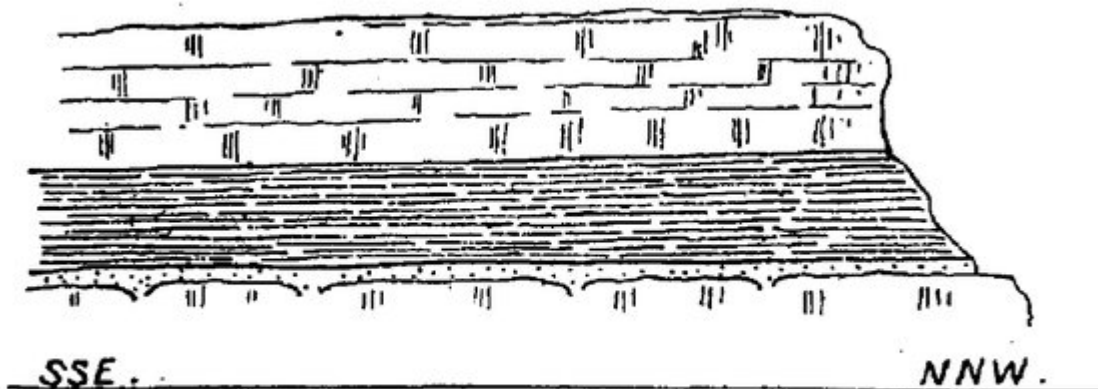


FIG. 289.—THE SUCCESSION AT TRWYN-DWLBAN.

(Figure 289) The succession at Trwyn-dwlban. (piped limestone, pipe-sandstone, shale, upper limestone.)



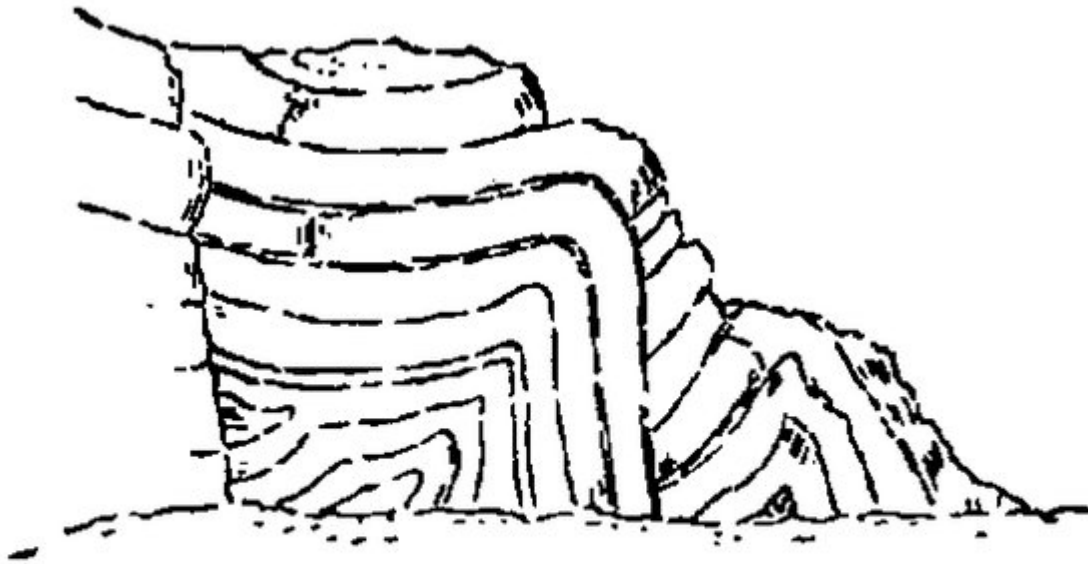


FIG. 305.

# FOLDING AT THE BERW FAULT, CEINT.

(Figure 305) Folding at the Berw Fault, Ceint. (after Henslow.)

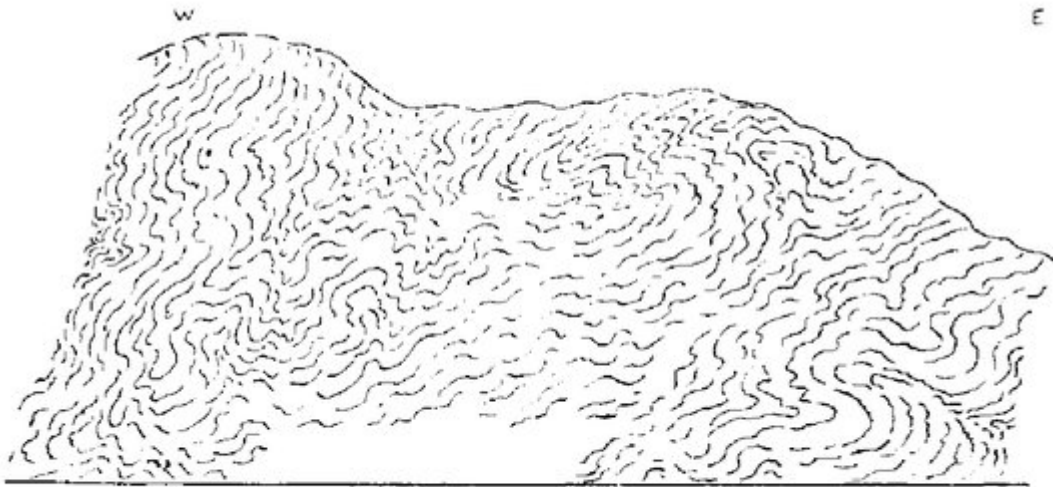


FIG. 59.—POLYCLINAL MINOR FOLDING.

(Figure 59) Polyclinal minor folding. 250 yards west of Ty'n-y-mynydd-east, south of dry pool. Height three feet.

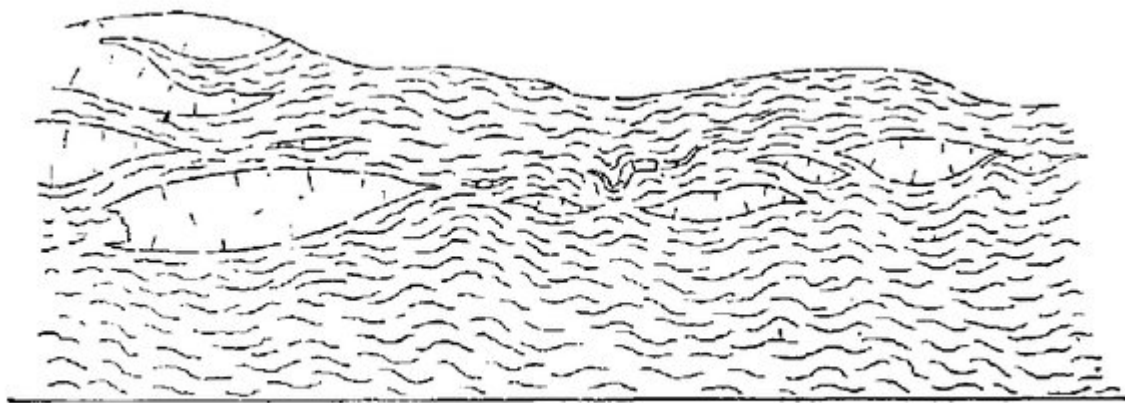


FIG. 78.—LIMESTONES IN GWNA GREEN-SCHIST.

(Figure 78) Limestones in Gwna Green-Schist. Baron Hill drive, at 'M' of 'Meurig'. Height about 15 feet.



FIG. 118.—SECTION ALONG PORTH NAMARCH.

(Figure 118) section along Porth Namarch. Height of cliff: 50–60 feet. HQ = Holyhead Quartzite. BC = boulder-clay. SSS = South Stack Series. BT = Breakwater Thrust-plane. Nf = Namarch Fault.



FIG. 165.

BASE OF LIMESTONE.

(Figure 165) Base of limestone. South-west of Pen-y-parc, at Bath House, Menai Strait. Height: about 10 feet.



FIG. 253.

## THRUST IN DYKE AT PANT-HOWEL.

(Figure 253) Thrust in dyke at Pant-howel. Height about 20 feet.

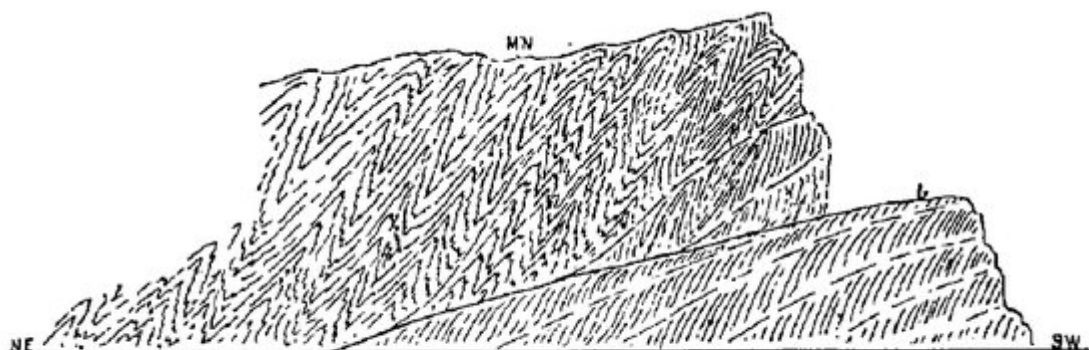


FIG. 270.—THE CARMEL HEAD THRUST-PLANE AT CARMEL HEAD.

MN = Amlwch Beds.

b = Cleaved Ordovician Shale.

(Figure 270) The Carmel Head Thrust-plane at Carmel Head. MN = Amlwch Beds. b = Cleaved Ordovician Shale.



Fig. 276.—SECTION FROM THE NORTH END OF BODAFON MOOR, THROUGH THE OLD RED SERIES, TO THE SMITHY.

Scale: eight inches = one mile.

M = Bodafon Moor Schists } Mona  
MQ = Bodafon Quartzite } Complex.  
b = Ordovician.

Symbols used in Figs. 275, 276, 277, 278.  
g = Old Red Sandstone Series.  
c' = " Cornstones.  
c = Lligwy Sandstone (Carboniferous).

d' = D<sub>1</sub> Subzone of Carboniferous Limestone.  
d = D<sub>2</sub> " " " "  
BT = Bodafon Thrust plane. " "

(Figure 276) Section from the north end of Bodafon Moor, through the Old Red Series, to the Smithy. Scale: eight inches = one mile. Symbols used M = Bodafon Moor Schists, Mona Complex, Mq = Bodafon Quartzite, Mona Complex. b = Ordovician. c = Old Red Sandstone Series. c = cornstones d = Lligwy Sandstone d2■ = D1 Subzone of Carboniferous Limestone. d2■ D2 Subzone of Carboniferous Limestone. BT = Bodafon Thrust-plane.



FIG. 112.

## PASSAGE BEDS.

(Figure 112) Passage Beds. South-west of Millbank Gardens; north of 't' of 'Stryd'. With infolds of South Stack Series.