NATURAL ENVIRONMENT RESEARCH COUNCIL INSTITUTE OF GEOLOGICAL SCIENCES

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British Regional Geology

The Welsh Borderland

(THIRD EDITION)

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Based on previous editions by

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Foreword to Third Edition

The content of former editions of this compact digest of Welsh Borderland geology, the second edition of which ran to 10 impressions, has remained substantially unchanged since the first edition was published in 1935. Since then almost every geological formation within the region has been the subject of further research so that a wealth of new literature is now available.

This edition attempts to take account of all significant work done in the region during the past 35 years, while retaining the layout and scope of the original publication. Chapters 2, 3, 4 and parts of 9 and 11 have been prepared by Dr. Hains and the remainder by Dr. Earp who has also edited the work. It is hoped that the somewhat greater attention to detail and the use of a more modern scientific vocabulary has not impaired the value of the work as a semi-popular guide to the geology of this fascinating region which has nurtured and stimulated so many generations of field geologists.

The authors' grateful acknowledgments are due to:

The University of Cambridge Committee for Aerial Photography for permission to reproduce Plates I, II and XA.

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Institute of Geological Sciences, Exhibition Road, South Kensington, London, S.W.7. 4th January, 1971

K. C. DUNHAM Director

An EXHIBIT illustrating the geology and scenery of the region described in this handbook is set out in the Museum of Practical Geology, Institute of Geological Sciences, Exhibition Road, South Kensington, London, S.W.7.

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(A 11101)

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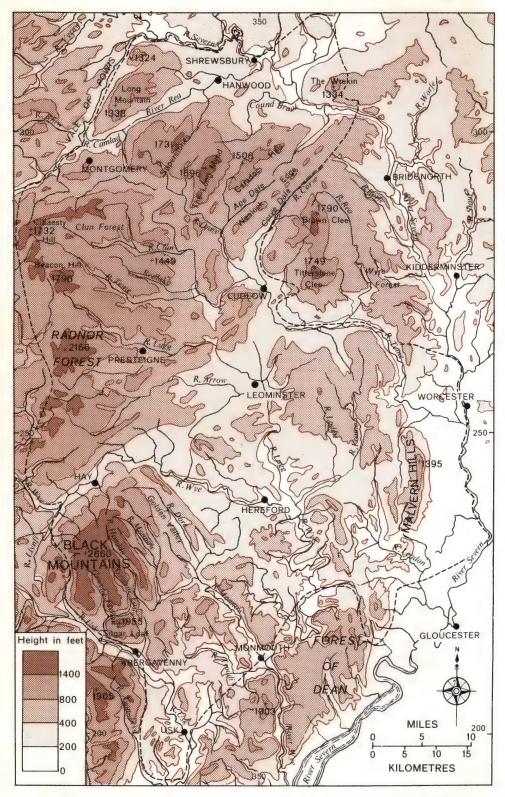


FIG. 1. Map to show the boundary and main physical features of the region.

I. Introduction

In its wider sense the Welsh Borderland is the area adjacent to the boundary between England and Wales from Chester in the north to Newport in the south. The region covered by this account (Fig. 1) excludes the Marches north of the latitude of Welshpool and Shrewsbury and in the south it includes only part of Monmouthshire. It takes in a portion of the county of Worcestershire east of the Malvern and Abberley Hills which would not normally be considered to be Welsh Borderland country at all.

History of Research

Since the earliest days of the history of the science of geology the Welsh Borderland has attracted the attention of geologists by the great variety and interest of its formations; for in no other area perhaps can the sequence of the Palaeozoic rocks be seen to such advantage and within such a comparatively small district.

The first comprehensive investigation of the rocks of the area was made by Sir Roderick Murchison, who, in 1835, introduced the well-known name 'Silurian' for the series of rocks which he had studied in the land of the old British tribe of the Silures (the southern Marches); he divided this system

into an upper and a lower series.

In the meantime Professor Sedgwick had worked out the succession of the Palaeozoic rocks of North Wales and, in 1835, proposed the name Cambrian for this sequence, adopting Murchison's name Silurian for the overlying rocks in the Berwyn Mountains. It was then found that the lower part of the Silurian of Murchison and the upper part of the Cambrian of Sedgwick were in part equivalent, and in 1879 Professor Lapworth suggested the name 'Ordovician' (from the tribe of the Ordovices which inhabited North Wales) for the middle portion of the Cambro-Silurian sequence, the designation of which was in dispute. Lapworth's classification of the older Palaeozoic rocks into Cambrian, Ordovician and Silurian is now accepted.

Murchison's great work *The Silurian System*, published in 1839, still remains a fund of information and a basis for the work of investigators in the region and, with his *Siluria* published in 1854 (and four later editions), forms a monument to the knowledge and industry of this pioneer in the science, whose researches embraced not only the older Palaeozoic rocks but also the earlier Pre-Cambrian and the later Old Red Sandstone and Carboniferous

rocks of the district.

Among other early workers whose well-known names may be mentioned are Aitkin, Lewis, Prestwich, Phillips, Salter, Aveline, Lightbody, Allport, Bonney, Maw, Morton, Callaway and Blake, who have all contributed to the elucidation of the geology of this complex region. We may also refer to W. S. Symonds, who, in his *Records of the Rocks*, 1872, dealt in a charming and interesting manner with the geology, natural history and antiquities,

and to J. D. La Touche, whose *Handbook to the Geology of Shropshire*, 1884, was a useful guide to the more important localities and contained numerous

drawings of typical fossils.

The original maps of the Geological Survey on the scale of one inch to one mile were published between the years 1844 and 1855, and there were revisions up to 1873. A number of horizontal sections were also produced on a scale of six inches to one mile.

In the later nineteenth century and early twentieth, research was stimulated by Charles Lapworth and W. W. Watts; the former was the discoverer of the 'Olenellus' fauna in the Lower Cambrian rocks of Shropshire and worked on the Ordovician rocks of the Shelve district, while the latter improved our knowledge of the geology of the Breidden Hills, and other areas.

Important work was also done by W. S. Boulton on the Uriconian rocks, by E. S. Cobbold, C. J. Stubblefield and O. M. B. Bulman on the Cambrian, by G. L. Elles, I. L. Slater, E. M. R. Wood, C. I. Gardiner, W. F. Whittard, B. B. Bancroft and W. T. Dean on the Ordovician and Silurian and by W.

Wickham King on the Old Red Sandstone.

In the structurally complex Malvern and Abberley areas the work of John Phillips, Charles Callaway and others was followed by that of T. T. Groom whose papers were published around 1900. At least six successive attempts to improve upon Groom's interpretation of the structure of this line of disturbance have been made since 1947. In Radnorshire small inliers along the structurally complex line of the Church Stretton Fault have been investigated by J. E. Davis, T. C. Cantrill, A. H. Cox and, the largest at Old Radnor, by E. J. Garwood and E. Goodyear.

Since the first World War the Geological Survey has mapped on the sixinch scale and published explanatory memoirs on the areas covered by the Shrewsbury (152), Church Stretton (166) and Droitwich (182) sheets, and, in the extreme south of the region, there are recent six-inch maps and memoirs relating to small areas which fall within the Monmouth (233), Newport (249)

and Chepstow (250) sheets.

Following the work of S. H. Straw on the Ludlow succession at Builth just outside this region, the Silurian rocks, especially those of the Ludlow Series, have been extensively investigated. From 1952 onwards this work was much stimulated by collaboration among a group of geologists who formed a 'Ludlow Research Group', its activities co-ordinated for many years by J. D. Lawson and V. G. Walmsley. The Old Red Sandstone has also been the subject of many recent papers, especially by members of the Geological Department of the Natural History Museum on its fish faunas and early terrestrial plants. Sedimentological studies on almost every formation in the Welsh Borderland have tended to swell the volume of literature relating to the region in the past decade.

Physical Features and Drainage

The main physical features of the Welsh Borderland may best be described from north to south.

The district is bounded on the north by the great plain of north Shropshire, floored by Coal Measures and Triassic rocks which rest upon the northern

slopes and spurs of the old Palaeozoic mass to the south and are largely obscured by a mantle of drift deposits, consisting of boulder-clay and glacial sands and gravels, brought into the district by ice both from the Irish Sea and from the Welsh Mountain area to the west.

The River Severn, descending from the high ground of Wales, enters upon the Shropshire plain a few miles below Welshpool, meanders eastward along its southern border, cutting, in places, across spurs of the older rocks that project into it, and finally leaves the plain by the narrow gap of the Ironbridge Gorge to flow southwards to the Bristol Channel.

The first important feature met with south of the river is the striking mass of the Breidden rising to 1202 ft (366 m), with Moel-y-Golfa, 1324 ft (403 m), the former a remarkable laccolite of dolerite the general structure of which is anticlinal, and the latter an intrusion of andesite.

To the south of the Breidden mass lies the syncline of the Long Mountain composed of Upper Silurian rocks rising to a height of 1338 ft (408 m).

The Shelve district of Ordovician rocks, rising to a culminating point of 1684 ft (513 m) in the great laccolite of dolerite known as the Corndon, is separated from the Long Mountain syncline by a broad valley cut in soft Silurian shales and drained by small streams flowing in opposite directions; actually at times from the same pool (Marton Pool) on the low watershed. The Shelve Ordovician area is bounded on the south-east by the impressive ridge of the Stiperstones, formed of Arenig quartzite; the jagged crags of this resistant rock, piercing the skyline, can be seen from a great distance.

A valley cut in Cambrian shales separates the Shelve Ordovician mass from an area of Pre-Cambrian rocks including the plateau of the Long Mynd, which is composed of an immense thickness of Pre-Cambrian grits, flags and conglomerates with high to vertical dip. This plateau, 4 to 5 square miles (10 to 13 sq. km) in area, rises to a maximum height of 1696 ft (517 m) and, though approximately level, slopes gradually to the north and south. Its steep edges are deeply trenched by streams forming the valleys known locally as 'batches' or 'gutters'.

A spur of the Longmyndian rocks extends north-eastwards in Bayston and Sharpstone Hills and, beyond the River Severn, rises again in the outstanding mass of Haughmond Hill.

The Long Mynd is flanked on either side by outcrops of Pre-Cambrian volcanic rock—the Western and Eastern Uriconian groups. The Western Uriconian gives rise to the prominent mass of Pontesford Hill and smaller igneous areas to the south-west. The Eastern Uriconian is developed along the great Church Stretton Fault, in the remarkable range of hog-backed hills, Ragleth, Caradoc, the Lawley and, in continuation of their line, those of the Wrekin, Ercall and Lilleshall to the north of the River Severn.

Ordovician and Silurian rocks form a succession of ridges and valleys south-east of, and parallel to, the Eastern Uriconian range. The lowest beds of the Ordovician are the grits which give rise to the scarp of Hoar Edge. The Wenlock Limestone forms the very regular lower scarp of Wenlock Edge, about 16 miles (25 km) long, and the Aymestry Limestone a parallel but more dissected scarp along which the best known eminences are Callow Hill, Norton Camp and View Edge.

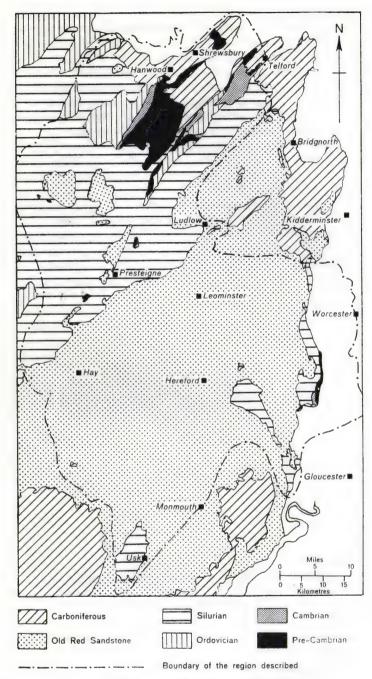


Fig. 2. Sketch-map of the geology of the region

To the south-east of the Aymestry Limestone ridge and separated from it by the broad valley of Corve Dale lies a triangular plateau formed of the higher beds of the Lower Old Red Sandstone. Two table-topped masses rise from this plateau, the Brown Clee, 1792 ft (546 m), and Titterstone Clee, 1749 ft (533 m) (see British Regional Geology, Central England). These are outlying relics of Coal Measures which have been protected from denudation by thick coverings of contemporaneous dolerite or basalt.

The southern slopes of the Long Mynd and Shelve country are drained by the rivers Onny and Camlad, which also drain the northern slopes of the plateau of Clun Forest—an area of Ludlovian and Downtonian rocks rising to a height of 1796 ft (547 m) in Beacon Hill.

The central part of the Clun Forest district is drained by the rivers Clun and Teme; the latter, flowing by Downton Castle, Ludlow and Tenbury, forms the southern boundary of the tracts of high ground mentioned above, most of which lie within the county of Shropshire.

Ludlow is situated on the north-eastern rim of a plunging anticline of Silurian rocks in the core of which lies the Vale of Wigmore on the Wenlock Shale. In this area the wooded ridges formed by the Wenlock and Aymestry limestones are well-marked scenic features.

South of Ludlow, around Leominster, Hereford and Monmouth, an extensive area, mainly of Old Red Sandstone, presents a landscape of rather subdued hills or rolling terrain traversed by the broad plain of the River Wye and by the valleys of its tributaries the Lugg and the Monnow. On the west of this area the continuation south-westwards of the Church Stretton line of faulting brings to the surface the interesting area of Old Radnor, where Silurian strata can be seen resting unconformably on Pre-Cambrian (Longmyndian) rocks. Here also are the igneous masses of Hanter, Worsel Wood and Stanner, the age of which is probably Pre-Cambrian, and nearby is the prominent mass of Radnor Forest, rising to a height of 2166 ft (660 m) and formed of siltstones of the Ludlow Series. Farther south the most striking feature of the landscape is the great plateau of the Black Mountains, composed of near-horizontal Old Red Sandstone, which forms a bold scarp overlooking the Wye Valley and rises to a height of 2660 ft (811 m) at Waun Fach and to 2624 ft (799 m) at Pen y Gader Fawr. South-east of the main scarp the plateau is deeply dissected by southwardly flowing streams such as the Afon Honddu, which joins the Monnow, and the Grwyne Fawr which joins the Usk.

The region includes in the east the Silurian, Cambrian and Pre-Cambrian rocks of the Malvern range, beyond which lies the Triassic plain of Worcester. The summit of North Hill, Malvern, 1307 ft (398 m), is the highest point of the range.

The Silurian inlier of May Hill lies on the continuation southward of the Malvern axis and, with the Silurian district of Ledbury and the Silurian inlier of Woolhope, shows the same type of scenery (due to alternation of wooded limestone scarps with valleys cut in the intervening soft shales) as that in the Ludlow and Wenlock country.

The Old Red Sandstone tract continues southward between Abergavenny and Monmouth to the Silurian inlier of Usk flanked by the Carboniferous

Limestone outcrops of the South Wales syncline on the west and of the Forest of Dean syncline on the east.

Geological History

Traces of the remote Pre-Cambrian history of the region are preserved in the metamorphic rocks of Rushton, Primrose Hill and the Malvern Hills, and the prolonged and complex events which produced these highly metamorphosed rocks may have ended considerably before 1200 million years ago. This ancient phase of metamorphism was followed in early Proterozoic times by a major outburst of volcanic activity during which mainly andesitic and rhyolitic lavas were poured out and much volcanic ash was ejected along lines of crustal weakness trending broadly from north to south. Small scale intrusive activity also occurred. After an interval of unknown duration. following the vulcanism and spanning a long period some time between 1200 million and 600 million years ago, sedimentation occurred in a fairly narrow crustal depression the margins of which may have been controlled by lines of weakness approximating to the present disturbances of Church Stretton and Pontesford-Linley. During this phase something of the order of 25 000 ft (7620 m) of sediment was accumulated with only one significant break in continuity. The immense panorama of Pre-Cambrian history was completed by a phase of earth movements followed by a long period of erosion.

The Cambrian period was heralded by a great transgression of the sea. The Pre-Cambrian formations had been strongly folded and denuded to an almost level surface before the oldest Cambrian rocks were laid down. The type of sedimentation met with in the Lower Cambrian suggests that the sea was then shallow and subject to current and wave action. Earth movements took place during Cambrian time, as proved by unconformities within the system, while the presence of a great thickness of uniformly fine sediment in the Upper Cambrian seems to indicate a progressive lowering of the sea floor.

At the close of the Cambrian period a shallowing of the sea took place not only by the accumulation of sediment but also by an elevation of the sea floor, which seems to have brought much of Shropshire and the Midlands above sea-level, where the Cambrian and Pre-Cambrian rocks suffered erosion. This episode may be regarded as the precursor of the great 'Caledonian' mountain-building movements which reached their maximum in

post-Silurian time.

At the beginning of Ordovician time progressive subsidence again began in this district, and the basal Stiperstones Quartzite represents the sandy deposit of a shallow sea which was subsequently followed by the grits, flags and shales of the lower part of the Ordovician. At this time also there was a great outburst of volcanic activity, both submarine and subaerial, producing the tuffs and lavas of the Shelve district. Further subsidence carried the sea into the eastern parts of Shropshire and the Upper Ordovician (Caradocian) grits, sandstones and limestones were laid down unconformably on Cambrian and Pre-Cambrian rocks, while deposition of shales and ashes proceeded without break in the western areas.