

W. A. E. USSHER HIS WORK IN THE SOUTH-WEST

by D. L. Dineley

British geology in the latter half of the nineteenth century owed much to the remarkable work of the Geological Survey of Great Britain. The pattern and standard of excellence for the New Series One Inch to the Mile geological maps was to no small extent established by the Survey's work in the southwest of England. H. T. De la Beche, who became the Survey's first Director, had mapped the counties of Cornwall, Devon and parts of Somerset and his report appeared as the Survey's first Memoir in 1839. When William Augustus Edmond Ussher was appointed as Assistant Geologist in the Geological Survey in April 1868 the Director General was Sir Roderick Murchison and the revision of the geology of the west of England was in hand. Ussher was to spend the greater part of his active life in carrying forward the survey of this region and his achievement has been rarely excelled even among such vigorous and intelligent geologists as have entered the Geological Survey. He also served for some time in the London area and the Midlands.

Ussher was nineteen when he took up his appointment in 1868 and was sent in 1870 to join H. B. Woodward on the survey of the Wellington (Somerset) sheet. He retired in 1909, having carried out field work for nine further New Series sheets which include the Taunton and Bridgwater sheet, and those covering the region from Sidmouth around the southern flank of Dartmoor through the South Hams to Plymouth, Bodmin and St. Austell. The descriptive memoirs followed some years after the maps, the last concerning sheet 339, the geology of the country around Newton Abbot (1913).

In addition to his work as a Survey geologist, the many papers that Ussher published in several journals between 1869 and 1914 make an impressive collection and range in content from a consideration of the origins of the Cornubian granites through the stratigraphy and structure of the Palaeozoic and Mesozoic rocks to the Pleistocene and Recent deposits and the effects of solifluction. He contributed to the *Geological Magazine*, the *Quarterly Journal of the Geological Society of London*, the *Proceedings of the Somersetshire Archaeological and Natural History Society* and to the journals of other local learned societies, and to the Reports of

Section C of the British Association. He led field excursions to South Devon for the Geologists' Association (1900, 1901, 1907) and contributes to its *Proceedings*.

In recognition of his work he was awarded the Wollaston Fund of the Geological Society of London in 1890, the William Bolitho Gold Medal of the Royal Geological Society of Cornwall in 1903 and the Murchison Medal for 1914 again by the Geological Society of London.

Perhaps among the most important influences upon Ussher's work and career were his Friendship with Arthur Champernowne of Darlington Hall in South Devon, and with Professors Gosselet of Lille and Kayser of Marburg. With Champernowne he made significant discoveries in South Devon, having corresponded with him at some length before he was sent by the Geological Survey to continue the geological mapping that Champernowne had been carrying out. Unfortunately Champerowne died in that same year, 1887.

Cosselet and Kayser not only conducted Ussher over their own ground (the Franco-Belgian and Eifel outcrops of the Devonian) but also visited Devon to see the Devonian and Carboniferous there under his guidance. The result was that more than a simple stratigraphic account of the British succession was produced; the correlation with the now classical scheme of stages and "horizons" which was provided has remained remarkably intact since then.

In his scientific papers Ussher showed himself to be observant, methodical and aware of the pitfalls awaiting the stratigrapher and structural geologist in Southwest England. He was not afraid to change his mind nor to advance a provisional working hypothesis where other geologists would have remained mute. He seems to have been a very direct personality, stating his mind clearly and replying with vigour when he felt that his work was under criticism.

At the end of his life, in 1920, Ussher could have justly felt that he had made a major contribution to the geology of the west country, a contribution which has enabled others since then to enter the area with a shrewd idea of the difficulties and the attractions of Cornubian geology.

Stratigraphy

From the outset Ussher was concerned with setting up usable stratigraphic successions in rocks of wide variability. His earliest paper (1869) deals with the local New Red Sandstone succession in West Somerset and in this and several later papers on rocks of this system Ussher emphasised the need to describe the critical or principal lithologies and to determine the range of lateral variations from them.

In due course when he worked upon both the Meadfoot Beds and the Culm Measures he used the word "*type*" to describe its range of associated lithologies in these formations. Thus a *type* within such a set of beds was a laterally variable association of closely related lithologies, constituting perhaps what today would be called a *facies* or perhaps, in some cases, a *lithosome*. Ussher showed the distributions of some of these types on his own maps, as for example in "The British Culm Measures" (1892) and there the word is also used where today the term "formation" might be employed.

It is another feature of these studies that the standard English stratigraphical rock terminology is rarely used. Series, stage, zone and group are words that appear infrequently and may not have the meaning they have today. On the other hand the term "horizon" occurs frequently and may refer not to a single plane or to a single bed but to as large a body of strata as the Lower Culm. Whether or not Ussher deliberately used such terms in a loose fashion is not clear but in the case of "horizon" he seems to have in mind the German "Horizont" which may be a bed or stratum. Ussher's terminology was essentially pragmatic: it reflected his bent as a field geologist. Perhaps, because he felt that continuing study would refine and improve the rough stratigraphy he outlined, Ussher intentionally used rather imprecise terminology. He seems to have felt that for the purposes of mapping the Palaeozoic rocks in Devon the detailed description of stratotypes would not have been very useful, and perhaps he was right.

Ussher made frequent and seemingly appropriate use of European terminology in his descriptions of Palaeozoic strata. A few examples are given below: they are terms which can be used today as effectively as at the beginning of the century.

Knollenkalk
Krammenzelstein } = a nodular limestone. These rocks are found in the red Upper Devonian strata in South Devon and are now locally thought to represent a disruption of interbedded limestone and slate rather than the products of diagenesis in unconsolidated sediment (Riddolls, 1970).

Schalstein = a pyroclastic rock. Rietschel (1966, p.18) sets out a field distinction between *Schalstein* (rarely well-bedded, little colour variation, grain-size highly variable, particles angular) and *Kerntophyr-Tuff* (almost always well-bedded, strong parting parallel to bedding, often multicoloured, particles often of one size, frequently well rounded).

Cypridinenschiefer = slates with ostracodes. According to Rietschel (1966, p.26) the term was first used in 1846 by F. Sandberger.

Büdesheim fauna = Ussher made numerous references to this classic German occurrence of ammonoids (mid-Frasnian). But he was not always as exact in this as modern work would require (see House 1963, p.8) - i.e. references in Ussher's memoirs to the Büdesheim fauna are not in every case to be taken at their face value.

In North Devon and West Somerset Ussher's work on the Devonian rocks began early and occupied him periodically all his life. His geological map of the area appears in the Victoria County History of Devonshire (1906) and was adopted by Hamling (1910) (Goldring 1952). The Foreland-Hangman Beds argument occupied his attention and although he found some favour in Champernowne's suggestion that Foreland Beds and Hangman Beds were the same formation, he eventually rejected it for lack of sufficient positive evidence (1886, 1889, 1891). Following the visit of his European friends his correlation of the successions with those on the continent has remained virtually intact.

In South Devon, too, Ussher's principal contribution has been in the ordering of the sequence of the many different Devonian formations and facies. He recognised the differences between the rocks of a southern (or eastern) area and a western and by collecting fossils wherever possible was able to show the age equivalence of rocks of widely different lithology (see *Memoirs of the Geological Survey*). The stratigraphic position and distribution of the "Ashprington Volcanic Series" was included in this work.

The Culm Measures were studied and mapped as part of Ussher's duties in the Geological Survey only in South Devon, but he visited and studied the outcrops widely in the north of the county and in Cornwall. In 1892 he published an account of the general stratigraphy of the Culm Measures, reviewing previous work and setting out his own classification of these rocks into Upper, Middle and Lower groups and describing the Eggesford, Morchard, Exeter and Codden Hill types. The fossils and associated volcanic rocks were considered and a useful comparison with the German Culm (Westphalia, Upper Harz, etc.) was made. Further information was included in a paper published by the Institute of Mining Engineers (1901, 1902) together with a map on the scale of one inch to four miles. Subsequent work during Ussher's lifetime added little to change his accounts of these rocks and it was not until sedimentology and the biostratigraphy of the Carboniferous had advanced substantially in the 1950's and 1960's that much serious revision could be undertaken (see Edmonds *et al.*, 1969).

Ussher's descriptions of the Permo-Triassic rocks of the Southwest provide much local detail and the broad divisions that he used in his work for the Survey have largely stood the test of time. He regarded the successions in South Devon as probably of Permian age and older than the similar conglomeratic or breccia-bearing rocks in West Somerset (1889).

In 1877 Ussher spent part of his leave in Normandy to examine the Triassic rocks there: he also succumbed to the temptation to visit the local small outcrops of Devonian. He hoped to establish whether or not the Normandy Triassic formed an easterly prolongation of that system from Southwest England, and if the Palaeozoic of N. France had contributed fragments that were incorporated into the Triassic strata of Devonshire.

A close acquaintance with the "Post-Tertiary" geology of Cornwall seems to have been Ussher's early in his career. In 1879 he published privately an account of this topic with a long preface describing how the failure of the Geological Society of London to accept his two papers on the Cornish Pleistocene left him no alternative but to print the work himself. There is a candour in this preface that suggests that Ussher had a command of purposeful prose equal to that of any geologist of his day. The paper itself seems today not extraordinary in its findings and one is left feeling that the Geological Society's referees may have had cause for second thoughts as time went by.

Ussher's grasp of the geology and genesis of recent deposits was good and in a paper on "terminal curvature" (1878) he recognised the effects of solifluction of the 'head' over fissile strata.

Structure

The determination of a detailed stratigraphic succession in the Palaeozoic rocks of Devon and Cornwall and its correlation with the European standard remains a major concern in local geology, the recognition of the major structural features and tectonic style or fabric of the country are no less matters of lively debate today. Following the pioneer work of De la Beche and others in the first half of the nineteenth century, little real advance was made until Ussher's work began to appear. Most of his contribution is displayed on the One-Inch Geological Maps, and the Memoirs add both necessary detail and an outline of the structure present. Although the writing may lack modern terminology Ussher's work conveys the 'feel' of the geology and the maps provide outcrop patterns that are accurate even if views on the boundaries may have changed. Palaeontological and other evidence now directs us to interpret some of the latter as involving inverted strata and this evidence was not known to Ussher.

Ussher's palaeontological and stratigraphical work led him in

South Devon and Cornwall to suspect structures which have since been proved. He correctly delineated the Watergate Bay and South flants anticlines in the Dartmouth Beds and he postulated both strike-faults and wrench-faults of considerable magnitude. Thrusting, the NW-SE large dextral faults and later wrench-faulting he regarded as essential components of the later phases of deformation of the Palaeozoic rocks.

The emplacement of the granites and especially the intrusion of the Dartmoor mass together with the resulting deflection of strike in the beds on the eastern flank of the moor were discussed in 1892 and again in 1912 and 1913. He regarded the Dartmoor granite as remelted pre-Devonian basement.

Ussher's mapping of the contact between the schists of the Start-Bolt area and the Meadroot Beds was more detailed and accurate than previous attempts and he favoured (1904) the view that the metamorphosed rocks south of the contact were altered equivalents to those to the north. He gave no ultimate opinion as to whether the contact was a thrust, fault or a sharp non-diastrophic metamorphic boundary.

Another topic investigated by Ussher (1891) is of interest here. It concerns the evaluation of the Palaeozoic rocks south of the Mendips in the search for coal, and it led him to examine the Cannington Park Palaeozoic inlier. He recommended that a boring be put down to test the ground within the area Otterham-Pulsham-Wedpiore-Brean, the site of a possible coal basin. The Mesozoic cover was suggested as less than 1,000 feet and probably no more than 400 feet. Sixty years later Wills (1956) suggested that coal-bearing rocks may underlie the nappes of the Mendip hills, and perhaps extend even farther south, but he has no more evidence than had Ussher. At Cannington Park Ussher recognised that the inlier consists of Carboniferous Limestone, much deformed, and that an important fault cuts out part of the local Devonian succession between it and the other (Devonian) inliers. Ussher thought this dislocation might be a thrust. In recent years other geologists have returned to the idea of a thrust here and underlying Exmoor (Falcon *in* Cook, Hospers and Parasnis, 1952; Bott *et al.*, 1958; Webby 1965; Wills 1973). On the grounds of geophysics and structural geology the idea is appealing, but the existence of such a thrust has yet to be proved.

Ussher's work remains a model of its kind and the rapid progress made in the geology of Southwest England in the last decade or so would have pleased him greatly. In many cases where his work has been superseded (by new studies) later authors acknowledged the accuracy, acumen and insight of the man after whom this Society is named; which is as it should be.

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**USSHER'S PUBLICATIONS EXCLUSIVE
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