Gloucestershire Geology.

Having Special Reference to the Commercial Value of the County’s Mineral Deposits

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The geology of Gloucestershire presents so many points of interest that in the following brief notice but one aspect of the subject can be considered—the present and prospective commercial value of the county’s mineral deposits. To describe at length the general geological characteristics of the county, and to investigate the causes which have given it a topography of so great a diversity and charm, would be far too alluring a theme to pursue in the limited space allowed me here.

Gloucestershire’s quite remarkable achievements along industrial lines were no doubt owing, originally, to its wealth of timber, building-stone, iron, coal, and water power. Of these essential factors of production, timber and water power do not come within the scope of the present article; except it should be noted that the large forest reserve in the Forest of Dean and the considerable extent of wooded country on the Cotswolds still supply in large part the material for a number of flourishing industries, such as the charcoal and chemical works at Lydbrook, the turned-wood works at Longhope, the stick factories in the Stroud valley, and the sawmills at various places throughout the county, and that the water power, which in other counties has been almost superseded by steam, is so abundant and so easily available that it is still one of our most valuable assets. Indeed, it may be said with entire accuracy that no other county in England possesses greater available water power; the configuration of Gloucestershire, arising from the sea-level to a height of nearly 1,100 feet, and being traversed from Moon Hill on the north to Lansdown on the south for a distance in a direct line of fifty-seven miles by the Cotswolds, giving rise to scores of unfailing streams capable of turning innumerable wheels.

Of our mineral deposits iron was probably the first to form the basis of the iron industry. It is well known that the Romans largely used Gloucestershire iron-ore, and that for several centuries subsequently its extraction and manipulation gave employment to a considerable number of men, particularly in the Forest of Dean district. However, owing to more extensive and more accessible deposits elsewhere, and the improved transportation which has made the new fields available, iron mining has become practically a lost industry in the county.

Iron.

The iron deposits in Gloucestershire cover an area of considerable extent. The Gothite and brown Hematite ores occur in the carboniferous Limestone, Millstone and Pennant-grits, as well as Limestone; the clay-ironstone occurs in the Coal-Measures, especially in the Kingswood district, near Bristol; and Mr. R. Etheridge noted that along the Frampton Cotterell, Iron Acton, and Ear万吨light Tights much ore occurred. Hematite also occurs in the Doolmitic Conglomerate, but as the thickness of this deposit is so very variable any iron mining in connection with it is uncertain. It may be that in the future a growing use will be made of it, or of the application of more scientific methods, will again make iron mining and smelting a profitable industry in the county.

Coal.

The Gloucestershire coal deposits occur near Bristol and in the Forest of Dean. Professor E. Hull stated that the area of the Forest of Dean Coalfield is 34 square miles. The Coal-Measures attain a thickness of 150 feet, the beds being only 2 feet thick in some places, and 12 feet thick in others; this is due to the presence of a thickness of 3 feet or more, the thickest seam being about 5 feet. The structure of this coalfield is very simple, being a complete "basin." The Bristol coalfield is a near-shore basin, having the broad end to the north. In places it is much affected by faults, and is traversed by an anticline near the southern end. Resting upon the Millstone-grit are the Lower Coal-Measures; then comes about 1,000 feet of Pennant-grit, succeeded by the Upper Coal-Measures. Writing about the year 1896 Dr. G. M. Tavener notes "there is a difference of 13 feet in the level of coal, possessing a united thickness of 42 feet of workable coal." In the Pennant-grit there are three or four workable seams, nearly all in the lower portion. Owing to the thickness of the grit no shaft has as yet been sunk through it to the Lower Coal-Measures, and workable seams are found near the sides of the basin. According to Mr. H. B. Woodward, these Coal-Measures "yield but four workable veins." Of the 150 square miles which Professor Hull stated is the extent of this basin only 45 are not concealed by newer formations, such as the Trias. Under the upper part of the Severn estuary and east of Chepstow, Coal-Measures have been prospected by borings, but it is uncertain to what extent they are coal-bearing.

The last published census gives the number of employees engaged in mining coal and shale as 8,420. It should be added that, owing to the nature of the Coal-Measures which come between them, the surface of the Mingstowe coal field is free from fire-damp and other objectionable features. Several of the collieries—notably in the Forest of Dean district—use electricity both as a motive power and for lighting purposes.

Building-stones.

As regards building-stones, Gloucestershire may be fairly said to be better off than the adjoining counties, because the extent of the Pennant-grit, the "yellow-wells" of the North Cotswolds, and the freestone (such as is quarried at Leckhampton Hill) near Cheltenham is very considerable and easy to open out. In Somerset there is an equal variety, if not more, of workable stone, but the respective deposits do not extend over very large areas. The following partial enumeration will give some idea of the diversity and character of the principal building-stones in the county.

"Millstone-grit," or firestone—an exceedingly hard, tough rock, composed of grains of sand cemented by a siliceous cement—is found. A cubic foot of the rock, according to Professor C. Lloyd Morgan, weighs about 80 pounds. It is the core of the large machine in the University College, Bristol, a cubic inch of a close-grained variety of this rock began to split at 10,710 tons, and broke down at 13 tons. The extreme hardness of the rock renders it difficult to work, and as it is porous the exposure of its surface size be obtained. It is, however, an exceedingly durable stone, and its rich, red colour, and somewhat rough facing, is not unpleasant to the eye.

"Pennant-sandstone" is the favourite building-stone of modern Clifton, but it does not appear to be very desirable for ecclesiastical structures. It is largely quarried at Hanham, Fishponds, and Stapleton, near Bristol. This is a coarse-grained rock, harder than Millstone-grit and a denser stone, but much less hard and durable. The colour is greenish-grey, bluish-grey, or red. For house-building it is now generally regarded as the best stone, and it is also a good paving-stone. The Pennant-sandstone is also a very durable rock which is used as a dressing-stone in the Upper Coal-Measures. Whilst dealing with sandstones mention must be made of the Old Red Sandstone, a rock often seen in buildings near Bristol, but which is not a good weatherstone.

"Mountain Limestone"—the rock so well exposed in the gorge of the Bristol Avon at Clifton—is much used in that neighbourhood, and, indeed, wherever it is present, as at Wickwar, for rough walling and occasionally for houses. Fringing the Carboniferous or Mountain Limestone are the Doolmitic conglomerate and Doolmitic Conglomerate. The upper beds of it are usually of much finer texture than the lower, and such rock has been used in the construction of Clifton College and many walls in the city.

The "lazic limestone," which occur at the base of the series, are poor in quality, and are seldom used except for common walling and for house walls when better material cannot be obtained. In the southern portion of the mines, near the mouth of the Severn, is the old quarry on the River Clifton, called Cliftonpit; in the northern part, around Tewkesbury and at Elmore, While in South Gloucestershire the chief building-stone is Pennant-grit, in North Gloucestershire its place is taken by the freestone obtained from the Inferior Oolite.

Between Cleeve Hill and Stroud the best freestone comes just above a deposit called "Pea-grit," which is made up of small concretions resembling flattened pebbles. But in the North Cotswolds the equivalent of this Pea-grit is the most important stone. The freestone of the Cheltenham district is of a yellowish-white colour, and is quarried at Cleeve Hill, Brockhampton, Whittington, Leckhampton Hill, Cowley, Cooper’s Hill, Panamby and Stourpier Hill, and the 14th Quaker; while it is also worked at Uley Bury, Selsley Hill, Nailsworth, and Stroud. Southwards it gradually thins out. In the North Cotswolds the chief building-stone is a yellowish-brown stone, known as the "yellow-well". It is a very fine sandstone, about 40 cubic feet in size are to be obtained, weighing 16 cubic feet to the ton. There are quarries at Wotton Hill near Chipping Campden, Evington Hill, Bourton-on-the-Hill, Saintbury Hill, and Tewkesbury. The Quittingstone, a very flabby concretion, has been used locally for roofing purposes. "Ragstone-beds" are also worked locally for road-metal. With regard to working the Cottswold freestones, such as those at Leckhampton Hill, there is one point which may be mentioned, and that is that the stone should be broken in the required shapes as soon as it is quarried as possible, because afterwards the water formerly absorbed exudes, and upon evaporation leaves a coating of carbuncle-like ornament on the stone, forming an effective covering. If the stone be cut or scraped afterwards, when dry it will be seen that it cannot be expected to withstand atmospheric ravages to the same extent.
The "Stonefield Slate," which occurs at the base of the Great Oolite, furnishes good "slates" in places, such as have been used in the roofing of St. Matthew's Church at Cheltenham. It has been largely worked in the past on Sevenhampton Common and Eyford Hill and much smaller areas are still worked, but at present the slate is derived from two at the latter. These beds have been opened out through to Thrumham, near Bisley, Stroud.

The "Great Oolite" has been extensively worked for a long time on Mincleham Common. As Mr. H. B. Woodward has observed: "The Weatherstone is a hard oolitic and shelly limestone of coarse aspect and sandy in places, but very durable when dried by exposure to the sun. The Great Oolite does not usually contain much mudstone and consequently it resists the action of frost. A careful selection is, however, necessary." The Great Oolite is useful for road-metal when other stone cannot be obtained, and the same may be said of the Forest Marble. Both these stones are found near Burstow and Stanmer. The Forest Marble is worked at Ampney Crucis, near Cirencester.

From the foregoing brief reference it will be seen that the county contains the most valuable building-stones, exhibiting almost every variety of colour and texture, and, for the most part, easily quarried. The number of men engaged in quarrying, cutting and dressing stones in the county is nearly 2,000, as given in the last census.

CLAYS.

Clays suitable for making bricks and shaped ware are found in Gloucestershire, and are known as Alluvium and Lias. The former deposit borders the Severn and Bristol Avon at various parts of their course. The Alluvium, or mud, brought down by the rivers is usually loamy, although, of course, its composition depends mainly upon the nature of the rocks traversed by the rivers; it is higher up. The most extensive deposits occur near the Severn, and cover a larger area between Porton Passage and Avonmouth than between the Passage and Tewkesbury, although more use has been made of the deposit in the latter district, no doubt owing to the fact that the pits are nearer means of communication with the markets than those in the southern portion of the county. In the past many pits have been opened out close to the banks of the Severn, and the numerous old excavations testify, and there are now pits open at the Upper and Lower Lodes, Tewkesbury, and near Gloucester. There are many places left, however, where pits might be opened out to advantage. The clay at Gloucester has been very largely worked, and is known to be close upon 10 feet in thickness, but it soon thins out as the river is left. Between Oldbury and Berkeley there is a tract of Alluvium, and again between Aust and Avonmouth, aggregating nearly 25 square miles in extent, and containing very rich deposits, these latter are somewhat difficult of access, but this will be remedied when the line from Avonmouth to Pilling is completed.

The other deposit which is valuable for brick-making purposes is the Lias. As the maps at the disposal of the agriculturist and others are those published by the Government Geological Survey, it is necessary to adopt their nomenclature; and for economic purposes, certainly in North Gloucestershire, it is more suitable to accord to the old convenient interpretation of that body, the clays found in the vales of Gloucester- shire and Evesham belong to the Lower Lias, and the junction of this stage with the middle is near the foot of the Cotswold escarpment, and is usually indicated by a bursture of springs and damp ground. In the southern portion of the county the Lower Lias does not cover a large area, and the clay-beds are thinner, although there are deposits which might be worked. In North Gloucestershire the clays are of considerable thickness, though it is doubtful if as much is usually thought. However, each zone of deposit has a considerable superficial extent, and this fact is important. Also, in most of these beds which are worked for clay, fossils are of small size; another point for consideration. Several pits are now being worked at different places, and other deposits are available.

About the best place to open a pit is at the junctions of the Middle and Lower Lias. Here the clay is more loamy, and the beds are, therefore, better adapted for brick-making. One or two matters may be mentioned to serve as a guide to locating this deposit. The Middle Lias is composed of this sandy shale and a "rock-bed" or Marlstone along which is the sub-division of the deposits, naturally it constitutes a feature in the Cotswold escarpment, and on the outliers such as Alderton and Dunsmore, Oxenton, Bredon, Churchdown, and Robins' Wood Hills. Below it there are the sandy clays, or shales, and their base is indicated by the outburst of springs and wet ground. Gorse-bushes, being particularly fond of a sandy soil, are also frequently useful in indicating its presence; indeed, in the North Cotswolds this phenomenon is most noticeable.

North of Stroud these beds and the succeeding stage, the Upper Lias, occur at rather too high an elevation to be profitably worked; but at Stroud, coming to various causes, the beds are at a lower contour, and accordingly pits have been opened out both here and at Stonehouse, the line works of the Stonehouse Brick and Tile Company being located at the latter place. At Pilkington, Cheltenham, beds containing some impure limestone occur, but the grit and ironstone-nodules have to be picked out of the clay. At Robins' Wood Hill the same and higher beds (almost up to the Marlstone) are worked, and the clay obtained is excellent for brick-making.

The south side of Churchdown Hill would be a good site for a pit in the valley of Crumham is a pit, presumably in Upper Lias clay, which has been worked since the time of Queen Elizabeth, if not earlier. Flower-pots, pans, drain-pipes, etc., are manufactured here.

OTHER MINERALS.

At Wick Rocks, near Mangotsfield, pits have been sunk in the Keuper Marls for ochre, which is found at the rolling-mills near at hand. In 1890 the ochreous rock was about 4 feet thick, and occurred about 8 feet below the surface.

Celestite or Strontium, is largely worked at Yate and Wotton. It occurs on the Upper Marls, and is obtained at several places in the Bristol area. It is exported to Germany for use in the refining of beet sugar. Gypsum also occurs somewhat abundantly in the Keuper Marls at Ayst Cliff near Pilling.

DEPOSITS OF SAND AND GRAVEL.

Deposits of "gravel" and sand—the Superficial Deposits—cover a very considerable part of Gloucestershire, especially the low-lying areas. Stretching down the central portion of the Lower Severn Valley is the accumulation of pebbles of quartzite and other hard rocks known to geologists as the "Northern Drift." It has been found a useful gravel for drives and mending the local roads, and pits have been opened out in it at Bredon, Shatton Common, and Twyning Green; while in the past it has been worked on Sandhill Hill—perhaps better known as Wandle Hill. A similar deposit covers much of the Vale of Moreton. Sometimes sand predominates, sometimes pebbles. Deposits of sand are fairly thick in places. According to Dr. Wright, a trial-boring at Hopwood's Nurseries proved as much as 30 feet. Certainly it covers a large area around Cheltenham, but sometimes much "gravel," composed of fragments of limestone from the Cotswold Hills, are found mixed with it. Pits may be seen near Overbury, Prestbury, Charlton Kings, and Barnwood. Indeed, there are many localities where it might be worked. Nearer the hills, of course, the "gravel" is mainly composed of the rocks which are exposed in the escarpment, and the deposit frequently furnishes a very good gravel for paths. In the southern portion of the county gravel deposits are more rare. There is one of the sub-divisions of the Inferior Oolite is a sand-deposit. It occupies a considerable area on the Cleve Hill plateau, and was once dug for use in the Staffordshire potteries.

MINERAL SPRINGS.

It may be proper to add a word as to the mineral and hot springs to be found in the county. Four groups (saline and sulphatic) exist at Cheltenham, the chief spa; hot springs occur at Clifton, and petrifying springs at Kemerton; and warm saline springs occur at Gloucester, Newent and Ambleton. In 1899 Sir Rodenck Murchison called particular attention to the fact that the springs at Cheltenham, "are the true source of all the mineral waters, so far as the springs on the Cotswold-downs are concerned, are merely the flow of any of the numerous sources which are so numerous in the vale of Gloucester—those of Walton, the bottom of Churchdown Hill, etc., for instance."