VIII. Observations on the Wrekin, and on the great Coal-field of Shropshire.

By Arthur Aikin, Esq.

Member of the Geological Society.

Among the many interesting features which the mineral formations of the County of Salop present to the geological observer, there is none more worthy of study than that line of hills of which the Wrekin is the most celebrated. It has attracted the notice of several mineralogists, and especially of Dr. Townson;* but even this acute observer appears to have fallen into some important errors on the subject, principally from not having investigated with sufficient accuracy the nature and bearings of the different beds on each side of the elevated central ridge. I shall not therefore, I trust, be considered as occupying unprofitably the time of the Geological Society by the following general sketch of my own observations on the same district.

The red sandstone, which forms the surface of so large a portion of Cheshire and of the northern half of Shropshire, extends but a few miles south of Shrewsbury to the west of the confluence of the Tern and Severn; from this latter point a line drawn N. E. to the town of Newport will form the boundary of the sandstone in this quarter; but from Newport this rock passes nearly due south between Shifnal and Prior's Leigh to the Severn, crosses this river

* Townson's Tracts, p. 158.
three or four miles above Bridgenorth, and accompanies its course to Wire forest, the extreme south-eastern point of the county. The eastern limit of this tract extends into Staffordshire, approaching within a few miles of the county-town, whence it proceeds south to the village of Tettenhall near Wolverhampton, and then passes by Kidderminster to beyond Droitwich.

This rock consists for the most part of rather fine grains of quartz with a few spangles of mica, cemented by clay and oxyd of iron. Its colour is generally brownish-red, and it has but little cohesion; on which account large tracts of loose deep sand are found in many parts of it. Sometimes it occurs nearly of a cream colour, and is then sufficiently hard to form an excellent building stone: it does not effervesce with acids, and, to the best of my knowledge, never contains shells or other organic remains. Rolled stones of quartz, of granite, of greenstone-porphyry, and of other primitive rocks, are found dispersed over its surface and imbedded in the loose sand, but are rarely, if ever, observed at any considerable depth in the solid rock. It rises at an angle of 10° or 12° between S. and S.W. At Alderley Edge in Cheshire, it is mixed with grey oxyd of cobalt, and contains veins of heavy spar with galena and yellow copper ore; and is tinged green by oxyd of copper at Hawkestone, at Pym-hill, and elsewhere in Shropshire. The salt deposit of Northwich, and the salt-springs of Droitwich, of Adderley near Drayton, and of Admaston and Kingley-wich near Wellington are subordinate to this formation. Its southern extremity in Shropshire rests upon highly elevated strata of grauwacke. It is covered in several places by thin strata of sandstone-slate, which passes into slaty marl containing shells: these beds rise in the same direction as the sandstone on which they rest, but with an angle rarely exceeding 6°. The general face of this tract is an undulated country, having usually the southern decli-
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...vities of the hills considerably steeper than the northern, and sometimes even quite precipitous, where they constitute the boundary of the valleys of the Severn, and the other principal streams that flow through it. None of these hills, in the Shropshire part of the district, exceeds the height of four hundred feet above the level of the Severn at Coalbrook-dale. Another circumstance remarkably characteristic of this kind of sandstone, is the great number of meres, or deep pools, which it contains. The outline of all these pools more or less approaches to circular: they receive no streams, and very often do not transmit any, the loss by percolation and evaporation being nearly supplied by the springs that occupy the middle and deepest part of their bottoms; I say nearly, because all that I have examined bear evident marks of gradual diminution: in many, this change has advanced so far as to convert the whole area, with the exception of a deep pit or two near the centre, into a peat-moss, and some of the smaller and shallower ones are not only entirely filled up, but are even converted to the purposes of agriculture. The above characters seem to identify this rock with the old red sandstone formation of Werner.

That portion of it which lies between the great coal-fields of Staffordshire on the east, and of Shropshire on the west, is about twelve miles wide. The Staffordshire strata dip rapidly towards it in a western direction, while those of Shropshire decline towards it, at a lower angle, in an eastern direction. Whether they actually pass under the sandstone, or terminate abruptly on coming in contact with it, has not yet been demonstrated; many intelligent miners are of the former opinion: but to me, the latter appears the more probable, from an observation that was made a few years ago in Welbach colliery near Shrewsbury. In this coal-field, as in the two before mentioned, the strata dip towards the sandstone; and there
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being occasion to put down a drainage pit, its place was fixed upon about one hundred and fifty yards further in the dip of the work than a pit which had already been sunk through the regular coal-strata to the depth of about one hundred yards: when the new pit was begun, the workmen were surprised on finding themselves in the sandstone; they nevertheless persevered till they reached the depth of fifty yards, when the work was abandoned, the entire sinking having been in an uniform bed of red sandstone.

The town of Newport may be considered as marking the apex of an acute angle formed by one line passing to the S.W. through a trap-formation including the hills of Lilleshull, the Wrekin, the Lawley, Caer Caradoc, and Ragleath; and by another line running nearly due south and coinciding with the western edge of the red sandstone. The stratified rocks included within this angle rise to the west or north-west, and of course have their dead level or line of horizontal bearing between N. and S. and N.E. and S.W. being inflected towards the one or the other of these points apparently by their proximity to the sandstone or to the trap. They are also much more closely accumulated on each other, and are generally elevated at a higher angle, as they advance from the south to the north: thus, the same succession of strata, which occupies a line of between four and five miles in the parallel of Caer Caradoc, is contracted within a space of less than three quarters of a mile in the parallel of the Wrekin.

I now proceed to give a brief detail of the several strata and beds, beginning with the most recent.

The independent coal-formation is found immediately adjacent to the red sandstone from Wombridge in the parallel of Wellington to Coal-port on the Severn, a length of about six miles; its greatest breadth is about two miles. It rises west a little to the north at an
angle of about $6^\circ$. It is composed of the usual members, namely, of quartzose sandstone, of indurated clay, of clay-porphry, of slaty-clay, and of coal, alternating with each other without much regularity, except that each bed of coal is always immediately covered by indurated or slaty-clay and not by sandstone. The series is the most complete in the deep of Madeley colliery, where a pit has been sunk to the depth of seven hundred and twenty-nine feet through all the beds, eighty-six in number, that compose this formation.

The sandstones which make part of the first thirty strata, are fine-grained, considerably micaceous, and often contain thin plates or minute fragments of coal. The thirty-first and thirty-third strata are coarse-grained sandstone entirely penetrated by petroleum; they are, both together, fifteen feet and a half thick, and have a bed of sandy slate-clay about four feet thick interposed between them. These strata are interesting, as furnishing the supply of petroleum that issues from the *tar-spring* at Coalport. By certain geologists this reservoir of petroleum has been supposed to be sublimed from the beds of coal that lie below; an hypothesis not easily reconcilable to present appearances, especially as it omits to explain how the petroleum in the upper of these beds could have passed through the interposed bed of clay so entirely as to leave no trace behind; it is also worthy of remark, that the nearest coal is only six inches thick, and is separated from the above beds by a mass ninety-six feet in thickness, consisting of sandstone and clay strata without any mixture of petroleum. At the depth of four hundred and thirty feet occurs the first bed of very coarse sandstone or grit; its thickness is about fifteen feet. The next bed of sandstone deserving notice occurs at the depth of five hundred and seventy-six feet, is about eighteen feet thick, is fine-grained and very hard, and often mixed with a little petroleum; the name given to it by the colliers is the *big flint*. 2 b 2
The lowest sandstone, called the little flint, is the eighty-fifth in number, and is about fifteen feet thick; the lower part of it is very coarse, and full of pebbles of quartz; the upper is of a finer grain, and sometimes is rendered very dense and hard by an intimate mixture of iron ore; it occurs at the depth of seven hundred and five feet. Vegetable impressions are met with in most of the sandstone beds, but I have not heard of their containing any shells.

The clay porphyry occurs only once in the whole series; it forms a bed nine inches thick, at the depth of seventy-three feet from the surface. The basis of this rock is a highly indurated clay of a liver-brown colour, in which are imbedded grains of quartz, of hornblende and of felspar.

The indurated clay is mostly of a bluish-brown colour with a tinge of olive, which by decomposition passes to bluish-grey and ash-grey, and, when containing much iron, to ochre yellow and red, and becomes very tough and plastic. In some beds it is compact, dull and smooth, but somewhat meagre to the touch, and is then usually distinguished by the name of clod; in others it is glossy, unctuous, and tending to a slaty texture, and is then called clunch. It incloses subordinate beds of clay ironstone in the form of balls more or less compressed, or in flat pieces of considerable magnitude, and two or three inches thick. Besides vegetable impressions, it contains a few shells; small mytili in particular are found in the iron ore, called crawstone, which lies immediately above the little flint. One of the most remarkable beds of this clay is called the pinny or penny-measure. It is the sixty-third in number, lying the next below the big flint, and occurs at the depth of five hundred and eighty feet. Its thickness in Madeley colliery is scarcely seven feet, but at Ketley is full twenty-seven feet; in the latter district it contains subordinate beds of ironstone in flattened nodules, called pen-
nystone, and also of a singular substance, here called curlstone. This latter is a bluish-grey limestone intimately mixed with clay ironstone, and occurs in distinct concretions of the size of a cubic foot or more, bearing a rude resemblance to the capital of a Corinthian column, each of which is again subdivided into irregular cones, laterally aggregated, the larger of which contain smaller ones included within them. The singularity and uniformity of structure, observable in each concretion, seem to render the animal origin of this substance very probable.

The ironstone is first met with, at the depth of about five hundred feet, in the twenty-eighth bed from the surface, the thickness of which is nearly twenty-seven feet. Being often wanting in the upper part of this bed, it is named when found in this situation chance iron-stone: that which is met with in the lower part of the bed is of much more general occurrence throughout the whole extent of the coal-field, and is called ball-stone. The other beds of iron ore are five in number, and are distinguished by the following names, viz. yellow-stone, blue-flat, white-flat, pennystone, and crawstone. These all form subordinate beds in indurated clay, each bed being composed of balls or of broad flat masses.

The slaty-clay, called by the colliers basses, is of a bluish-black colour and a slaty texture; it usually contains pyrites and is always either intimately mixed with coal or combined with petroleum; in the former case it passes insensibly into slaty coal, and in the latter into Cannel coal; so that the real beds of coal in some parts are found to degenerate into basses, and on the other hand the basses often contain very tolerable coal.

The beds of coal usually present a mixture of slate coal and pitch coal, rarely of Cannel coal: none of it possesses the quality of caking. Several beds are so penetrated by pyrites that the coal which they
yield can only be applied to the burning of lime: these are called stinking coals. The first coal forms the ninth bed from the surface, at the depth of one hundred and two feet, and is not more than four inches thick: it is very sulphureous. In the space between this and three hundred and ninety-six feet, lie nine other beds of stinking coal, none of which exceeds the thickness of seven inches except the lowest, which is a little more than a foot and a half thick. The first bed that is worked is a five-foot coal at the depth of four hundred and ninety feet, between which and the big-flint sandstone, already mentioned, are a ten-inch and a yard coal.

But the greatest deposit of coal is in the space (about one hundred feet) between the big and little flints, consisting of nine beds, the aggregate thickness of which is about sixteen feet. Beneath this, and the lowest bed of the whole formation, is a sulphureous eight-inch coal.

The depths and thicknesses mentioned above are such as present themselves in the meadow pit in Madeley colliery, which from its offering a greater number of strata than are to be found in any other pit, deserves to be considered as the best authority for the whole coal field, as far as regards the number and order of the beds of which it is composed. But, by consulting the registers of the other collieries, we learn, that some of the strata composing this formation, especially the beds of coal and clay, are by no means so regular, either in their extent or thickness, as is generally represented to be the case with stratiform floetz rocks.

Thus, if we confine our attention only to those beds which lie between the big and little flints, and which constitute by far the most regular part of this coal field, we shall find that the pennystone bed, which in the Madeley pit varies in thickness from six to eight feet, is fifteen feet thick at Lightmoor, about twenty feet at Dawley,
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sixteen feet at Old-park, and eighteen feet at Ketley. That the *Viger* coal, with its superincumbent clay, occupies a thickness of about twelve feet at Madeley, is diminished to three feet at Lightmoor, and is entirely wanting in all the collieries which lie to the north of the latter. That a bed of clay, usually known by the name of the *upper clunches*, bears a thickness of from fifteen to twenty-six feet in all the above mentioned collieries, except that of Ketley, where it is entirely wanting.

The rock upon which the coal formation rests, is either die-earth or limestone.

The *die-earth*, or dead earth as it is also called, is a name given by the miners to this bed as indicative of the fact that from hence downwards all the coal strata *die* or cease. Its colour is greyish; and it consists of fine sand, of particles of limestone, and of clay, mixed together in very various proportions; it is often also micaceous. It has sometimes a strong tendency to a slaty structure and a stratified arrangement, with which also the direction of the spangles of mica that it contains for the most part corresponds. It contains a few bivalves, chiefly of the genus cardium, and the entomolithus paradoxus, or *Dudley fossil*. The thickness of this bed is very various, from a few feet to an hundred yards; it incloses fragments of limestone, and is interposed between the limestone and the coal-formation without possessing the dip or direction of either one or the other.

In order to obtain a clear idea of the *limestone-formation*, it will be necessary to commence our observations at the south-eastern extremity of the district here described, where we shall find two parallel ranges of limestone running nearly N.E. and S.W. Of these ranges, that which lies the most easterly will first engage our atten-
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tion. It consists of a line of hills, between five hundred and six hundred feet above the level of the Severn; and about two hundred feet above the second ridge, hereafter to be described. These hills consist of beds of limestone and sandstone rising to the N.W.; hence their south-eastern sides present an uniform slope, while their north-western are nearly precipitous. They are separated from each other by short strait vallies, which run nearly in the direction of their dip and rise; and from their nearly equal heights, their correspondence of stratification, and the strait line along which they are distributed, there can be but little doubt that the vallies, by which they are separated from each other, are of later formation than the hills, which last at some former period constituted an uninterrupted range. This limestone is characterized by the madrepores which it contains, particularly the catenaria, or chain coral, by the pentacrine, by small ammonites, by a few bivalve shells, and especially by the natural joints of the strata being often lined by flesh-coloured tabular heavy-spar. Detached lumps of galena are often found on the surface, and a few small veins of the same mineral have been traced in various parts, but chiefly near the southern extremity of the range; cavities lined with and occasionally full of petroleum occur at the northern extremity, where it comes in contact with the coal-formation. The names of the hills constituting this tract of limestone are, Mochtre Forest on the borders of Herefordshire, Norton Walls, Feifton Forest, Munslow Hill, Mogg Forest, Benthal Edge, and Lincoln Hill. The elevation of the strata, from the Herefordshire border to the northern extremity of Mogg Forest, does not exceed an angle of 9°; but when, after having crossed the upland valley in which Marbrook takes its rise, we arrive at Benthal Edge, it appears that this latter ridge, though evidently a mere continuation of that already
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described, rises at an angle of 12°. Soon after, the strata change their direction from N.N.E. to east by north, and at the same time acquire an elevation of 36°. Benthal Edge is separated from Lincoln Hill merely by the narrow valley of the Severn, at that place not two hundred yards wide; and the strata of this latter hill have the same direction as Benthal Edge, but their horizontal angle has increased to 45°, and the height of the hill above the level of the Severn is considerably inferior to that of Benthal Edge. Beyond Lincoln hill the strata, as far as they have been explored, preserve the same angle and direction; but their height is not superior to that of the coal-field which they traverse, hence the circumstances of their termination in the neighbourhood of the red sandstone are unknown.

In a geological point of view, the limestone strata above described are remarkably interesting. We see them stretching for several miles, nearly in a straight line, N.E. and S.W. with an elevation not exceeding 9°; and this part may be considered as exhibiting the limestone, with regard to these circumstances, in its original situation. The interval now occupied by the valley of Mar brook points out the direction of a fracture caused by the motion of the whole body of limestone between this brook and the Severn, which has elevated its north-western and proportionally depressed its south-eastern extremity. The narrow valley of the Severn itself points out another nearly parallel fracture, caused by an analogous and probably contemporaneous motion of the strata of Lincoln Hill, by which it is obvious that the present valley of the Severn was formed. With the above unequivocal fact is connected an important object of enquiry, namely, the mode by which the elevation and depression of these beds was effected.

With regard to this question, it may be observed that strata are capable of vertical motion by a force acting either from below up-
wards, or from above downwards; in the former case, the force
must have been applied to the elevated portion, in the latter, to that
which is depressed. It does not appear how a great extent of strata
can be first raised and afterwards supported in its new position other­
wise than by a mass of fluid matter, capable of subsequent consoli­
dation, bursting up from below with a great force; nor on the other
hand is it easily conceivable how an extensive depression can take
place except by some great cavity under the depressed part giving
way. Now, in the present instance, if we examine the elevated
extremity of Benthal Edge, we shall find that between the abrupt
termination of this, and the low range of limestone called Wenlock
Edge, (hereafter to be described) which lies about a mile to the west,
the whole intervening space is occupied by shattered fragments of
limestone strata and great irregular deposits of die-earth, but without
the smallest appearance of basalt, amygdaloid, or those other un­
stratified rocks which by many geologists are considered as the great
instruments by which the heaving up of strata is effected. The non­
existence, at least the non-appearance, of these in the present case,
counters the opposite hypothesis of depression; and this
appears still more probable from an examination of the coal strata
superincumbent on the eastern end of the limestone in the parish of
Brosely, which are full of fractures, thus indicating very considerable
disturbance in that part.

The western range of Limestone runs precisely parallel to that
already described as far as the Severn; its average height rarely ex­
cceeds three hundred feet above the level of this river. It forms an
unbroken range with a nearly even top, on which account it is known
by the name of Wenlock Edge. It is very full of tubulites and other
coralline remains, but I have never seen in it any of the heavy-spar
which characterizes the eastern range. In its line of direction and
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in its rise and dip it corresponds with the before-mentioned limestone, except that the angle which its strata make with the horizon is very uniformly 8°, undergoing no change in this respect as it approaches the Severn. But when it has crossed this river and crops out beneath and to the west of the coal strata at Little Wenlock, it appears elevated at an angle of about 20°, and forms a continuous line parallel to the Wrekin as far as the Steeraway-hill, the northern extremity of the range, where the strata are suddenly raised to between 30° and 40°.

In tracing the outburst of this deposit of limestone it is impossible not to be struck by the uniformity in the line of direction of the whole ridge, at the same time that the elevation of that portion north of the Severn so greatly exceeds the almost horizontal position of the part which lies to the south of that river. A second circumstance peculiar to the elevated portion is its intimate connexion with a green-stone trap of which no traces are to be found in the other part of the range.

This greenstone is perfectly unstratified, and forms two principal deposits; the one constituting the chief mass of the hill on which the town of Little Wenlock is built, the other that of Steeraway-hill.

Of this greenstone there are several varieties. Sometimes it is of a dark bluish-green colour, passing into iron-grey; is massive, glimmering, of a coarse-grained uneven fracture, and breaks into irregular rather blunt-edged fragments; it gives a pale greenish-grey streak, is considerably heavy and difficultly frangible. When immersed in an acid an effervescence is perceived from various parts of its surface: by examination with a lens it appears to be composed of hornblende and felspar, with a little calcareous spar and mica.

In the next variety it is coarser, consisting for the most part of
visible grains of white or greenish-white felspar and hornblende, and often exhibits an arrangement in egg-shaped masses, from a foot to a yard in length, each mass being obscurely composed of thick curved concentric laminae, and pretty uniformly covered externally by a coat, an inch or more in thickness, of hard fibrous calcareous spar. In this variety, where the greenstone is not figurate, it is more or less amygdaloidal, inclosing globules of radiated calcareous spar. Another remarkable variety that it assumes, is where, in addition to the two former component parts, there is a predominating proportion of flesh-coloured felspar giving the rock a sienitic appearance. All these varieties are strongly magnetical, but the figurate is most so.

At Little Wenlock this rock appears for the most part to occupy the space between the coal-formation and the subjacent limestone, and accordingly, at the eastern foot of the hill may be seen the great body of the coal at its usual angle, while the little-flint sandstone (the lowest member of the coal-formation) highly elevated, covers the ascent of the hill, and is found in several detached patches on its summit, but in nearly horizontal strata. The general cultivation of the surface of this hill is a great obstruction to minute research, a difficulty that fortunately does not apply to the other great deposit at Steeraway, where an excellent opportunity of observation is afforded by the limestone quarries at that place. If we begin our research in a little shallow valley, about two hundred yards wide, that lies at the bottom of the eastern side of the Steeraway-hill, we shall first find the flint-coal and the little-flint sandstone cropping out very evenly at an angle of about $6^\circ$ on the eastern side of the valley. The bottom of the valley itself, as far as can be ascertained, on account of the covering of grass which over­spreads its surface, is die-earth. The western side of the valley (the
first step of the ascent of Steeraway-hill) presents fragments of a bed of limestone, between which protrude masses of coarse globular greenstone; then occurs a bed of sandstone slate, or flagstone, at an angle of 35°, which is succeeded by a bed of limestone elevated at nearly the same horizontal angle; then come four more beds at an angle of 40°, being an alternation of sandstone and limestone, and the last of these reaches to about two thirds of the ascent of the hill; the remainder, together with the summit, consists of amorphous and sienitic greenstone, covered with fragments of sandstone-slate strata, the inclination of which, as far as can be ascertained, approaches much more to horizontal than that of the preceding. Although for the sake of brevity and clearness I have characterized the above formation as an alternating series of four beds of sandstone and limestone, yet it must be observed that each limestone bed consists of several strata, each about a foot in thickness, composed alternately of compact limestone and of bluish-grey clayey marl filled with very delicate and brittle tubulites, the direction of the tubes being perpendicular to the plane of the strata.

An important geological question now occurs with regard to these beds, which in their composition and in the general line of their direction bear a close resemblance to the limestone of Wenlock Edge, though they differ so greatly in the amount of their horizontal angle; are they or are they not in the position in which they were first deposited? The negative side of this question appears to be supported by the impossibility of a bed of sandstone, and much more of clay marl (or mud as it no doubt was in its original state) being deposited on a plane at an elevation of from 30° to 40°, in such a manner as to constitute an extensive stratum of an uniform thickness, and that hardly exceeding a foot, for a depth of at least one hundred feet. The position also of the tubulites which pierce...
through the marl is a subsidiary argument of no small weight: these tubes, some of which are very thin and scarcely an eighth of an inch in diameter, with a length of twelve inches, are in a position perpendicular to the plane of the stratum, which, when this latter is at an angle of 40°, causes the coralline tubes to form with the plane of the horizon an angle of 50°; a situation by no means agreeable to the known habit of this class of animals which always affects a vertical position with regard to the horizon.

If then it be conceded that these beds have undergone a vertical motion, what remains is to collect the local probabilities relative to each of the two methods, by which, as already described, mineral beds are elevated or depressed.

The principal argument in favour of motion by depression, is the absence of any unstratified rock between the elevated stratum and that which naturally lies below and in contact with it; to which may be added the fracture and disturbance of those superincumbent beds which lie on the dip of the elevated stratum. These circumstances, however, are directly the opposite of those which take place at the Steeraway-hill; for, in the first place, the coal strata that lie upon the limestone crop out with perfect regularity, and nearly horizontal, along the opposite side of the valley, parallel to the hill and not more than two hundred yards from it, a line which, on the hypothesis of depression, would be the precise situation of the principal disturbance. Secondly, the beds of limestone and sandstone, which a hundred yards south of the Steeraway are found with an elevation of about 24° and resting immediately on a soft and sandy slate clay, are in the Steeraway itself tilted up at an angle of 40°, with a great mass of greenstone interposed between them and the slate clay. Is it not therefore probable that the greenstone has occupied the situation which it now holds, posteriorly to the formation of the stratified
rocks between which it is at present found, and that to this intrusion is owing the high elevation of the limestone? But though the above facts should be considered as justifying the hypothesis of the active agency of the greenstone, and consequently its fluidity, I am by no means prepared to affirm that this fluidity was that of igneous fusion; for neither the sandstone, nor the limestone, nor even the crumbling clayey marl appear to me to have undergone the smallest alteration by the contact or close vicinity of the greenstone.

The bed which lies immediately below the limestone and greenstone is (as I have already mentioned) a soft, rather sandy slate-clay. Its colour is bluish-brown and greyish white, and some of the strata contain egg-shaped nodules highly impregnated with clay iron, inclosing the impressions of marine remains. It is very shivery and easy of decomposition, passing into a tenacious blue clay. On the south of the Severn, along the bottom of Wenlock-edge, it may very distinctly be seen supporting the limestone, and, like this latter, rising west by north at an angle of about 8°; but on the north of the Severn, and especially in the vicinity of Little Wenlock and Steeraway, its place seems to be taken by the greenstone already described.

This bed rests upon another of considerable thickness composed of a fine-grained soft micaceous stone of a dirty bluish-green colour, passing into greenish-grey and ochre yellow. On inspection by the lens it is manifestly a fine-grained mixture of green hornblende and brownish felspar with numerous spangles of mica, and little or no quartz. It is composed of strata which are alternately massive and slaty, and in the latter the direction of the mica is strictly parallel to that of the bed. That part of the bed which lies to the south of the Severn is elevated at an angle of 37° rising N. N. W. and forms a ridge of considerable height in the parallel of the Lawley and Caer Caradoc, on which are situated the villages of Cardington, Church
Mr. Aikin on the Wrekin and on the Preen and Kenley. The texture of this stone is loose, so as readily to admit the infiltration of water, in consequence of which the hornblende decomposes into a yellowish-brown clay, and then the rock is apt to be confounded with clayey sandstone-slate.

The space between the outburst of this bed and of the quartz-grit, hereafter to be mentioned, is a valley, the bottom of which is occupied by patches of a sandstone, varying considerably in its external appearance, presenting no marks of stratification or regular position, and (as I apprehend) not belonging to the series of strata, but quite superficial and composed of the materials of the two beds upon which it is situated, together with small shells, either entire or in fragments, belonging chiefly to the genus Cardium. It always contains mica, but for the most part in small scales, and dispersed irregularly through its substance.

The quartz-grit, which is the next bed, consists essentially of quartz in rounded grains from the size of a pin's head to that of an egg. In some parts it is so entirely free from admixture as to be well fitted for the finer kinds of porcelain, since it acquires a snowy-white colour by calcination; but more generally it is mixed with angular fragments of the bed which lies beneath it, in a state of greater or less decomposition. Its northern boundary is the Arcal hill, the eastern side and top of which it entirely covers; it then skirts along the eastern side of the Wrekin, overspreading it to about one third of its height with conical hillocks. It is interrupted by the valley of the Severn, but re-appears on the south of this river, constituting the high ridge whereon are situated the parks of Acton-Burnwel, and Frodesley; it then runs parallel to the Lawley, but separated from it by a deep valley; the ridge then rapidly declines in height, and applies itself on the eastern side of Caer Caradoc (as it had before done on the Wrekin) accompanying this hill along its whole length, and then terminating.
This bed is very distinctly stratified; it rises N.W. at an angle of about 55° where it rests on the Wrekin and Caer Caradoc, but in the intermediate space at an angle of about 40°.

Beneath the quartz-grit lies a very extensive bed of claystone or compact felspar (for it presents the characters of both these minerals in different places, and even occasionally passes into jasper). Sometimes it is very distinctly slaty and stratified, which is particularly the case with the lowest part of the bed, which rests on greenstone and amygdaloid, and occasionally exerts a pretty strong action on the magnetic needle. The craggy eastern side, both of the Wrekin and of Caer Caradoc, consists of the slaty variety of this rock in nearly vertical strata; at the Arcahill, it appears in the state of compact felspar, covered to a considerable thickness by a mixture of fragments of greenstone and felspar, more or less decomposing into a tenacious clay; it is nearly pure compact felspar at Wrockardine hill, the sides of which are covered by a soft brownish-red very fine-grained sandstone, probably originating from the decomposition of the felspar.

Under the claystone occurs an unstratified trap-formation which constitutes the great mass of the Wrekin, the Lawley, Caer Caradoc, Ragleath and Hope Bowdler hills, the various component parts of which will be best understood by arranging them under the general heads of felspar rocks and greenstone rocks.

1. Felspar rocks.

The basis of all these is a claystone or compact felspar, of a colour between flesh and brick-red, and they serve as the immediate support of the superincumbent claystone. None of them affect the magnetic needle.

The variety which is most prevalent on the top of Caer Caradoc is a cellular claystone, the cavities of which vary in size from that of a small almond to a pin's head, and are all of them, especially the
larger ones, very much compressed. These cells are lined with minute hexahedral prisms of quartz mixed with a greenish-yellow earthy matter, which is perhaps decomposed actynolite. This rock is penetrated by veins containing quartz, flesh-red jasper, and chalcedony, the latter of which fills all the cells of the adjacent rock.

An analogous variety is found on the top of the Wrekin, in which, however, the compression of the cells has proceeded so far as to bring their sides into actual contact, thus giving the rock a waved and striped appearance.

2. Greenstone rocks.

These for the most part appear to lie under the claystone rocks. Their essential component ingredients are dull-green hornblende and greenish or reddish felspar. They all affect the magnetic needle, some of them in a very remarkable degree. They are more easy of decomposition than the felspar rocks just mentioned, and, in consequence, the respective place of each may be easily distinguished in the hills where they both occur, by the bare craggy surface of the one, and the smooth depressed verdant surface of the other.

When the component parts of the greenstone are distinct, and the felspar has its foliated crystalline structure, the only foreign ingredient which I have observed in the rock, is magnetic pyrites, in small grains. But where the hornblende and felspar are more intimately mixed, the rock usually becomes amygdaloidal, and contains globular concretions of felspar, quartz, calcareous spar, haematite, zeolite, and actynolite. Of these amygdaloids there is one of remarkable beauty, (described by Dr. Townson in the tract already referred to), and forming large masses on Caer Caradoc, but which has not yet found a place in the works of systematic mineralogists. It consists of a dull earthy basis, formed by an intimate mixture of dark bluish green hornblende, with flesh-red felspar, inclosing globular concretions of
Great Coal-field of Shropshire.

greenish yellow radiated glassy actynolite, a quarter of an inch or more in diameter, smaller concretions of quartz, intimately mixed with actynolite, and therefore nearly in the state of prasium, together with concretions and irregular veins of foliated white calcareous spar.

Of the above described trap-formation, it is not easy to ascertain its geognostic relations on the western side. The portion north of the Severn, which is by far the most extensive, is bounded by the old red sandstone; and the line of their junction is marked by the course of Strine brook from Newport to its confluence with the Tern, and thence by this latter to the point where it falls into the Severn. Along the greater part of this boundary line the two rocks may be observed adjacent, and in some places the sandstone appears to be incumbent on the trap-formation. The little coalfield of Dryton, on the Severn side, containing only two beds of thin coal, is certainly bounded on the east by the trap, but on the west seems to be adjacent to the sandstone.

With regard to the portion south of the Severn, it may be remarked, that the western and northern sides of the base of the Lawley, Caer Caradoc, and Ragleath, are overspread with a bed of coarse sandstone, consisting of angular fragments of felspar, hornblende, quartz, indurated reddish clay slate, and a little mica. This aggregate has by some been erroneously described as granite, and this mistake has led to the further error of considering the whole of the trap-formation as primitive. There are indeed detached rolled masses of true granite of considerable magnitude, as well as of other primitive rocks, in the near vicinity of the Lawley, but they occur only in a superficial bed of gravel that skirts in this place the southern boundary of the old red sandstone.

Patches of the same coal-formation as occurs at Dryton are distri-
but ed here and there in the flat ground of Stretton valley; they rest on the aggregate sandstone already mentioned, and rise E.S.E. at a small angle towards the Lawley and Caer Caradoc, in the parallel of which they are situated, but they entirely cease in the more contracted part of the valley, a little further to the south, where the trap of Ragleath hill is evidently incumbent on the transition (or, perhaps, newest primitive) clay slate, which breaks out to-day in the streets of Church Stretton.

From these facts it appears that the line of elevated ridge-hills from Lilleshall to Ragleath is an unstratified mass of rocks of trap-formation incumbent on highly elevated strata of transition slate: that on the eastern side of this mass there is a great deposit of stratified rocks, consisting of quartz-grit; of a micaceous sandstone nearly allied to greenstone; of a sandy slate-clay; of limestone, slaty marl and sandstone slate in alternating beds; and of the independent coal-formation: all rising up parallel, or nearly so, with the trap at a horizontal angle, the magnitude of which decreases, in proportion to the distance of each bed from the trap, unless where interrupted by casual and local causes. That on the western side of the trap, the mass of deposits is very small, consisting of a sandstone composed of angular fragments, on which rests a thin broken coal-formation. That the old red sandstone bounds the whole of this series of rocks on the east, north, and north-west, but though in contact, appears to be perfectly unconnected with them.

The trap-formation itself does not seem to correspond with any of those described by mineralogical writers, and its essential characters are, its unconformableness with the transition slate on which it rests, the great abundance of claystone, both massive and vesicular, which it contains, and the presence of actynolitic amygdaloid.
PLAN & SECTIONS OF THE MALVERN HILLS, & PART OF THE ADJACENT COUNTRY.

1. The Red Hill. 2. The Conqueror's Beacon. 3. Avoncliff Hill. 4. The Rockeries Hill. 5. The North Hill. 6. The Conqueror's Beacon. 7. The Stumpy Loop Hill.