

VII. *Observations on the Vallies and Watercourses of Shropshire and of parts of the adjacent Counties.*

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A SPECTATOR standing on the high ground of Weston Point at the head of the estuary of the Mersey (and thus elevated about 300 feet above the sea), if he directs his view to the south, will seem to have before him a wide and nearly flat valley bounded on the right by the hills on the Welch border, and on the left by those of Delamere forest. At the end of the valley will be clearly seen, in usual states of the atmosphere, a group of hills considerably elevated and shutting up the view in that direction. This group, even without the assistance of the map, is easily recognized to be the Breiddin hills situated on the southern bank of the Severn, and marks the point where this river, having hitherto run from its source in a north-north-east direction, begins to flow east, verging more and more to the south, till at length it falls into the Bristol channel.

The distance between Weston point and the Breiddin hills is almost 44 miles, and as this tract separates the waters which run into the estuary of the Dee from those which run into the Bristol channel, it becomes an inquiry of some importance in the physical geography of England to ascertain its absolute height above the level of the

sea. Data for determining this point with considerable accuracy are afforded by the levels of the Ellesmere canal, the main line of which extends between Shrewsbury and Chester, and, though not entirely executed, has been completely surveyed.

The summit line which separates the running waters lies nearly east and west. It approaches in one or two instances within a quarter of a mile of the valley of the Dee, and extends with a considerably indented outline from the village of Selatyn a little north-west of Oswestry, to the town of Whitchurch. The high level of the canal passes through this latter town, and after a descent of 128 feet joins the Chester canal, which in its progress to tideway in the Dee at the city of Chester, descends 170 feet 10 inches; making the elevation of the summit line or *water-shed* 298 feet 10 inches above the Dee at Chester. By another line between the two extreme points, surveyed but not executed, the difference of level appears to be only 292 feet; the average of the two gives $295\frac{1}{2}$ feet, which I think may safely be assumed as nearly approaching to the truth.

If from the same summit level we compute the lockage of the canal to its intended junction with the Severn at Bagley brook, near Shrewsbury, we shall find it to amount to a fall of 140 feet. Hence the height of the Severn at Bagley brook is $155\frac{1}{2}$ feet above the tideway in the Dee at Chester.

In order to compare this result with that furnished by levels taken between Shrewsbury and the Bristol channel, I must first state that the height of the basin of the Shrewsbury canal at this latter town above the Severn at Bagley brook, amounts (according to information furnished to me by Mr. Telford) to 24 feet 4 inches. From this basin to the termination of the canal at Coalport on the Severn, the descent on the whole is 59 feet; the canal at Coalport is about 16 feet above the Severn; and the fall of the Severn itself from Coal-

port to Gloucester where it meets the tide is 89 feet, according to a series of levels taken by direction of the late Mr. W. Reynolds of Ketley. Hence it appears that the bottom of the tide at Gloucester stands on a higher level by about 16 feet than the tide at Chester, which from the form of the Bristol channel and the well known extraordinary height of its tides, added to the greater distance of Gloucester from the sea, is all very consistent with what might have been *a priori* expected.

From the high level of the Ellesmere canal, already mentioned, a branch proceeds to the limeworks of Llanymynech, and is thence continued up the vale of the Severn as far as Newtown in Montgomeryshire. By combining the measurements thus obtained with the preceding ones, a number of interesting particulars concerning the descent of the Severn during the greater part of its course may be obtained, which I shall proceed to mention in some detail, as the rate of descent of navigable and other streams, although a most important branch of natural geography, has hitherto been almost entirely overlooked.

A number of mountain torrents, rising chiefly on the eastern skirt of Plinlimmon, unite at the town of Llanidloes into one main stream called the Severn, which from that place to its entrance into the plain of Shrewsbury flows north-north-east, winding through a valley a mile or more across. It receives on each hand the contributions of numerous brooks and small rivers, and thus serves as the common drainage into which the superfluous waters of a mountainous tract of considerable extent discharge themselves.

From Llanidloes to Newtown, a distance of at least fifteen miles measured along the bank of the river, are several rapids but no perpendicular fall: the rate of its descent through this space I am unacquainted with. During the remainder however of its course,

namely from Newtown to tideway at Gloucester, a distance of between 130 and 140 miles, not only the entire fall, but the descent through particular portions of this space are very correctly ascertained; and, there being neither weir nor lock nor any other artificial obstruction to the free course of the stream from the source of the river to its mouth, the ambiguity arising in other cases from these causes has no place in the present inquiry.

The Severn continues to be a torrent incapable of navigation to Pool-Quay, about twenty miles below Newtown, in which space it descends 220 feet, being at the rate of 11 feet per mile. From Pool-Quay to Bagley brook at Shrewsbury, a distance of twenty-six miles, the entire fall is 96 feet, being at the rate of 3 feet 8 inches per mile. The descent however through this space is by no means equable; for the river, which while in its own valley has banks only a few feet in height, no sooner gets into the alluvial plain of Shrewsbury than it has the appearance of a ditch bounded by steep banks of gravel from 12 to 20 feet deep, the banks themselves at the same time not being sensibly higher than the rest of the marshy district which is thus intersected. Formerly, when these marshes had not been embanked, the greater part of the flood waters extended themselves over this open space, and returning slowly into the bed of the river kept up for many days a depth of water amply sufficient for the purposes of navigation. At present however, now that all these low lands are secured by substantial embankments, a heavy fall of rain of thirty-six hours duration swells this part of the river into a turbulent torrent, rising from 10 to 20 feet perpendicular in as many hours, and declining almost as quickly from its greatest height to its usual shallowness.

From Bagley brook at Shrewsbury to Coalport (about two miles below Coalbrook-dale), the entire distance is about twenty-one

miles ; the perpendicular descent is 50 feet 8 inches, being at the rate of about 2 feet 5 inches per mile. The greater part of this space is a sandy alluvial tract, terminated by a ridge of limestone, called the Wenlock Edge, the beds of which rising directly opposite to the course of the stream, no doubt contribute in some degree to hold up the water. It is through a breach in this limestone ridge that the Severn escapes out of the plain of Shrewsbury, and at the same time changes its easterly course for one nearly due south, which it retains to its junction with the sea. From Coalport to Bridgenorth, a distance of seven miles, it descends 14 feet 6 inches, being at the rate of almost 2 feet 1 inch per mile. From Bridgenorth to Stourport, the fall is 41 feet 9 inches during a course of eighteen miles, being at the rate of 2 feet 4 inches per mile. In the next thirteen miles, between Stourport and Worcester, a fall of 23 feet takes place, being at the rate of 1 foot 9 inches per mile ; and, lastly, from Worcester to tideway at Gloucester, a distance of thirty miles, the fall is only 10 feet, or about 4 inches per mile.

From the autumn of the year 1789 to the end of 1800, a register was kept at Coalport, exhibiting the depth of water in the Severn every day (except Sundays) ; as however no pains were taken to render the banks of the river at this place perpendicular, it is obvious that equal increments in height imply more than equal increments of water, even not taking into consideration the greater rapidity of the stream in times of flood. I shall however make a few extracts from this document* for the purpose of shewing the quickness with which remarkable changes in the quantity of water discharged take place.

On January 8, 1793, the depth of water was 7 feet ; on the 9th it rose to about 17 feet, and on the next day had subsided to 3 feet.

* See Archdeacon Plymley's Agricultural Survey of Shropshire.

On January 23, 1800, the depth was 5 feet; on the 24th the water had risen to 10 feet; on the 25th to 12 feet; from the 26th to the 29th inclusive, the river had overflowed, and probably was from 18 to 20 feet deep; on the 30th it had fallen to 9 feet; and on the 31st was at 6 feet.

On January 10, 1795, the depth of water being only 2 feet 4 inches, the river was frozen over; it continued in this state till the 9th of February, on which day a rapid thaw began; on the 10th the ice broke up in consequence of the rise of the water; on the 11th the flood was far above all former marks, and continued so till the 15th; on the 16th it was already sunk as low as 5 feet.

On March 10, 1800, the depth was 4 feet; on the 14th, 15th, and 16th, the river had overflowed its banks, and therefore was at least 17 feet deep; and on the 16th it had fallen to 5 feet 6 inches.

On the 4th April, 1792, the depth was 6 feet; on the 5th and 6th the banks were overflowed; and on the 7th the depth of water was reduced to 7 feet 6 inches.

On April 18, 1792, the depth was 3 feet 6 inches; on the 19th and for the two succeeding days the banks were overflowed, and by the 23d the river had fallen again to 3 feet 6 inches.

On May 29, 1792, the depth was 3 feet 4 inches; on the next day the banks were overflowed; and on the following day the water had fallen to $6\frac{1}{3}$ feet.

In the months of June, July, August, and September, no floods occurred during the twelve years that the register was kept.

From October 7th, 1789, to the 9th inclusive, the depth of water was about 6 feet 4 inches; on the 10th it rose to at least 17 feet, continued at the same height during the next day, and on the 12th had already fallen to 7 feet 6 inches.

On the 31st October, 1792, the depth was 5 feet; on the 1st November the banks were overflowed; and by the next day the water had fallen to 7 feet.

In December, the water, generally speaking, stands higher than in the other months, the floods remain longer, and are also longer in subsiding. In those cases where the water has been remarkably low for a week or more successively, the river has at length, notwithstanding its rapidity, been frozen over. Of this phenomenon there are four records in the register before me namely, December 2d, 1796, the depth of water being 1 foot 8 inches; on the 15th of the same month the ice broke, and the water rose to 3 feet; it continued nearly at the same height till the 22d, when the river again froze over, the depth of water being 2 feet 10 inches, and so continued till the 29th.

On the 27th December, 1798, the depth of water being only 2 feet, the river froze over and continued so till January 15th in the next year. Lastly, on the 21st December, 1799, the depth of water being 1 foot 7 inches, the river was frozen over and continued so till January 4th.

The annual quantities of rain in the district from which the Severn derives its water, would be a most desirable and indeed almost necessary element in many important deductions from the facts already mentioned: I believe that no such observations have ever been made in this part of the country. It is well known however, that the mountainous Welsh part of this district suffers considerably in its agricultural produce from frequent and long continued rains; and from a register kept for six years, (from 1796 to 1801 inclusive,) about eight miles south of Shrewsbury, the annual number of days in which rain fell is 191. The entire district may therefore, upon the whole, be called rainy.

From the above mentioned facts it may be concluded that the navigation of a river is very precarious, and liable to long and frequent interruptions, even in a rainy climate, when the descent of the water exceeds 3 feet per mile; and that the highest floods run off in a few hours, even when the descent amounts to but 2 feet 5 inches in the same space.

The highest flat land in the county is Corndon marsh, elevated between 900 and 1000 feet above the sea. From this marsh arises a large brook, which after a southward course of five or six miles, arrives at the village of Moor 730 feet above the sea, and situated in the valley in which Montgomery and Bishopscastle are built, and which forms an oblique connexion between the great Montgomeryshire valley in which the Severn flows, and the valley of the Teme. From Moor the ground slopes so equally both east and west that the very uncommon circumstance here occurs of the stream dividing itself: that portion which goes off to the west, being soon joined by other streams forms the river Camlet, which after an indirect and circuitous course of about seventeen miles, falls into the Severn, above Welsh pool, having descended in this space nearly 300 feet, being at the rate of $17\frac{1}{2}$ feet per mile. The eastern branch after the junction of a few brooks, forms the Onny river and falls into the Teme at Bromfield three miles above Ludlow, having run a course of nearly equal length and fall with the Camlet.

The length of the Teme from its junction with the Onny to its termination in the Severn, about three miles below Worcester, is nearly forty-two miles, in which space it falls 367 feet, being at the rate of about 8 feet 9 inches, per mile: nearly the whole of its course is directly opposite to the rise of the strata over which it flows, which, added to the rapidity of its descent, is obviously the

cause of the numerous rapids and rocky ledges, and deep pools by which this river is so remarkably distinguished.

The most rapid part of the course of the Dee is between Corwen and Llangollen, where it falls over ledges of rock, and its channel is contracted by the near approach of the steep banks. The perpendicular fall through the latter six miles of this space, namely from Llandysilio to Pontycysyllte, as estimated from the feeder of the Ellesmere canal, is at least 131 feet, being at the rate of 22 feet per mile, which is by far the steepest descent that I have as yet had an opportunity of measuring. The remainder of its course to tideway at Chester, is about thirty-four miles, during which it falls 174 feet, being at the rate of 5 feet 1 inch per mile. In its natural state it is wholly innavigable, but by means of a weir at Chester, the water is held up so as to allow the passage of small boats for two or three miles.

I shall mention only one more river within this district, namely the Stour. It rises about two or three miles north of Wolverhampton, and after a course of twenty-seven or twenty-eight miles falls into the Severn at Stourport. The entire country through which it flows is coarse sand, sandy gravel, or friable red sandstone. Its source is at least 130 feet lower than the basin of the old canal at Birmingham, and therefore it may be considered as belonging rather to a flat country; its entire fall however is 294 feet, being at the rate of $10\frac{1}{2}$ feet per mile.

If the above facts and the deductions which obviously flow from them are of importance even when relating to a district of comparatively small extent; if they tend, as I think they do very materially, to elucidate the physical geography of a country, and by consequence a very interesting part of geological research, namely, the present diversity in the surface of the earth, and the cause of that diversity, it is manifest that the more these observations are extended, the

greater will be the accumulation of facts, and the more assured and general the reasonings founded upon them. There are few parts of England and of the south of Scotland which are not either intersected by canals or in which proposed lines of canal have not been surveyed, or the principal watercourses of which have not been levelled. All these by moderate activity on the part of persons resident on the spot may be obtained from canal offices, civil engineers, and land surveyors. The Geological Society seems to offer itself as the natural repository of these documents, being the only Institution by which they can be arranged, and classified, and applied to use, and in which their real value can be duly appreciated. May I, therefore, be permitted to recommend the subject to the industry and zeal of the members in general, and especially of those whose profession or local situation give to them peculiar facilities of inquiry.