XIII. *An Account of the great Derbyshire Denudation. By Mr.* J. Farey, Sen. *In a Letter to the Right Hon. Sir* Joseph Banks, *Bart. K. B. P. R. S.*

Read March 21, 1811.

SIR,

I HAD but recently entered on the survey of Derbyshire and its environs, which under your kind patronage I was induced to commence in the autumn of 1807, and had only cursorily examined the strata, in my way from Charnwood Forest and Breedon in Leicestershire, in order to meet you at Overton Hall, before I perceived clearly, that those principles which contemplate the terrestrial strata as terminating or *ending* in one direction (simple and important as they are), which I had learned under Mr. WILLIAM SMITH in 1801, and which he has so successfully applied in the filling up of his maps of the strata in the south-east and east, and some of the middle parts of England, would fail me, in their application to the strata of Derbyshire, without taking into consideration along with them, not only the denudation, or local stripping off, of patches of strata, some of immense extent and thickness, and even more considerable than those which I had discovered to be missing*

* And such as Dr. WILLIAM RICHARDSON had found to have been removed, in several places, from off the basaltic area in the counties of Derry and Antrim in Ireland, and has named *abruptions*, in his very admirable paper on this district, in the Philosophical Transactions for 1808.

from off the Wealds of Kent, Sussex, and Surry, and had explained to you, by a rough section across this great southern denudation in 1806, and such as the valley of Ashover then appeared to present, a more perfect instance of, around us: but that previously to such denudations of the Derbyshire strata, immense dislocations or vertical derangements of very large piles of strata, separated by the fissures, called *faults* by the miners, needed also to be taken into account, for explaining the appearances of the strata and surface of the district, which I was then about to explore: *faults*, exceeding immensely in their extent and quantity of *lift* on one side (or sink on the other) any which had occurred to Mr. SMITH, in the tracing of the south-eastern strata of England, where no faults had been discovered, so considerable as to cut off entirely the connection of the strata, or in other words, to bring strata in contact on the surface, whose places in the series were too distant to be known, and readily traced in their order, in the neighbourhood. And in consequence, I judged it necessary, on my return to town, when the winter arrived, to set about the consideration of stratified masses, broken and dislocated, and then cut or denudated in all the variety of cases and degrees of each, the results of which investigation, will appear in my Report to the Board of Agriculture on Derbyshire, the first volume of which is now in the press.

With ideas thus extended, I found, on resuming my Survey in the spring of 1808, that some conclusions that I had formed, and had unfortunately committed to paper, in a sketch of a section across the county, were erroneous, and that immense *faults* occurred, in places where their existence had not been proved by miners, or generally understood, which combined

with the denudations, that were so apparent in my first journey across the county in the preceding autumn, offered, as I proceeded afterwards in filling up my map, a considerably different explanation of the structure of the county, or section of its strata, from that which I had previously made, and permitted some persons to copy. The first volume of my Report to the Board of Agriculture, abovementioned, has compressed into it, all the most essential particulars of my Survey, which manuscript you did me the honour to examine, and to recommend its adoption to the Board; but as the plan of that Report did not admit of taking an extended or connected view of the great faults or dislocations of the district, I have troubled you with this Letter, in order to describe them: previous to which it may be right just to recall to your recollection, a few particulars respecting the British stratification. It is now well known to great numbers of observers, that the thick clay and other strata, on which the metropolis is situated, extend eastward through Essex, Suffolk, and Norfolk to the eastern coast, and in all their extent cover the chalk strata: that these again (the chalk) extend from the Isle of Wight to Flamborough Head, and cover other known strata, which have their regular *basset-edges*, or appearances at the surface, in continuity, to the westward of the limits of the chalk, and of each other; and thus it has been imagined by many, that the whole surface of England could be referred to, or explained by, an uninterrupted series of basset-edges of strata, dipping to the SE. and ranging in continuity from SW. to NE. in certain undulating lines, conformable to the surface, from one sea to the other, just as a certain number at the upper part of the series have been shown to do, by Mr. SMITH'S manuscript maps. But, after

passing the edges of the *lias* limestones and clay strata, in our progress to the westward, from any of the south-eastern and eastern parts of England, we find on the surface marks of an immense stratum of red earth or marle, which basseting from under the lias clay and sand, seems once to have extended over all the remainder of the British islands, without being now any where covered by patches of upper strata,* much beyond the continuous edge of the lias strata, abovementioned. Instead, however, of seeing the middle and all the western and northern parts of Britain covered by the same red strata, we find now, in this space, numerous local and many very large tracts of strata, surrounded by vertical and connected *faults*, and greatly lifted and tilted; from the surface of which lifted tracts, the upper red earth, and vast and very unequal thicknesses of strata, that lay in regular succession below this red earth, have been denudated, "abrupted," or carried off, leaving thus, a great variety of what have been called coal-fields, or *mineral-basins*,† in which limited tracts, great and most important series of strata, are to be seen basseting (owing to the local denudations), of which the basset-edges, or continued endings, can no where be traced in these islands, as far as I can learn. Large tracts of the intervening spaces, between these denudated mineral basins, are still occupied by the red marle, containing local strata of gypsum, rock-salt, sand, micaceous grit-stone, &c. &c. in its substance, or exposed by denudation; and in others, local strata, or

* Gravels, peat, &c. not being included in this term.

† Of which a fine instance is described by Mr. EDWARD MARTIN, in the Philosophical Transactions for 1808, and of which the Forest of Dean presents a smaller, but similar instance.

nodules of great extent, or rather, perhaps, rudely crystallized masses of slate, green-stone, sienite, basalt, &c. &c. forming hills or mountains (often intersected by mineral veins) from the tops of which masses, the red marle has in most instances been denudated. It remains a task of great difficulty, yet to be accomplished, to ascertain the lower part of the British series of strata, thus only exposed to view, in local and unconnected tracts, or basins, which are in part often concealed by gravel (frequently so, near their borders), and towards which investigation, little has yet been done. It seems to me, that there are three distinct series of coal-measures, if not more, separated by thick strata of red earths, or marles, not easily distinguished from the upper one above the coal series, or that which underlays the lias strata, as abovementioned, and by thick strata of limestones; each of which red earths, probably, produce anomalous and local strata, or crystallized mountain masses, in different places, where they form the surface, and the fact of such containing no organic remains, may not have arisen from their having been formed before organized beings existed, as those contend who call them *primitive* rocks, but because the circumstances proper to crystallization, were unfitted to the propagation and life of either animals, or vegetables; and may it not be doubted, whether crystallized masses, great or small, are ever the seats of reliquia?

The northern part of Derbyshire, and the adjoining parts of the surrounding counties, present a denudated tract, and partake of this uncertainty, as to what place in the lower part of the British series of strata, its strata should be referred: from many circumstances, I am inclined to consider the coal-

field of Derbyshire, Nottinghamshire, and Yorkshire, underlaying the yellow-lime rock, as lower in the series than any others of the coal-measures alluded to above, and that the fourth limestone rock, which extends from Castleton in Derbyshire, southward to Weaver Hill, near Wooton and Ramsor in Staffordshire, is the very lowest which is known in Britain, and which may account for the circumstance, that the mineral veins and the strata in which they occur in Derbyshire, present some phenomena, which are said to occur no where else.

I shall proceed now to describe the circumstances, under which this great elevation and denudation of part of the Derbyshire strata seems to have happened, which is, by a series of three or four separately lifted tracts, one within the other, as represented in the small sketch map annexed. The outer or least lifted of these tracts is bounded on the south by a fault, that I have distinguished by a full line, where ascertained, and by slight dots where only inferred, and denominated it the great Derbyshire fault, which is perfectly defined from near Nottingham across Derbyshire, to the north side of Stone in Staffordshire (except in a few places where gravel covers it), by having red marle, lying nearly horizontal, on all its south side, and different strata on its north side, as will be mentioned further on: the eastern fault or side of this first raised tract is not visible within the limits of my Survey, like the southern, on account of the vast accumulation of quartz gravel in Sherwood Forest, and the peaty alluvia north of it: but it seems probable to me, that its range is from about the town of Nottingham, east of Mansfield, east of Worksop near Bawtry, west of Thorne in Yorkshire, and how much further

north this fault proceeds, before it turns to the west, I am unable to state from my own observations; but from the correspondence of my friend WILLIAM SMITHSON, Esq. of Heath Hall near Wakefield, a very able observer, I conclude, that the boundary fault on the north of the outer lifted tract, ranging not far from the lower part of the course of the Wharf river, suddenly cuts off, or terminates the great Derbyshire and Yorkshire coal-field to the north, and continues S. of Otley and Keighley * near Colne in Lancashire and Clitheroe, bounding still the coal-field of Lancashire to the north. I am not sufficiently acquainted with the Lancashire strata to hazard a conjecture, as to where this fault turns (or branches perhaps) towards the southward again; but on the west it probably passes not far from Manchester, Stockport in Cheshire, Macclesfield, Congleton, Church-Lawton Salt-works, and joins the great Derbyshire fault, or southern boundary of this very large raised tract, somewhere to the NW. of Stone in Staffordshire, as I judge, from the information which I have received, of the red marle occupying the surface withoutside this raised tract to the westward, in Cheshire and Staffordshire,

* It seems probable, from the accounts which I have received from Mr. SMITHSON, of the many small coal-basins, or swilleys, as they are called, which occur in the space between Keighley, Hawes, and Richmond, viz. on the N. side of Keighley; on Fountain Fell in Craven; Thorpe Fell near Burnsall, Threshfield near Linton, and Anter-Heights near Kettlewell, on the Wharf river; Netherdale Forest near Middlesmoor, on the Nidd river; Slapestones near Hawes, West-Scrafton SW. Leyburn NW. and Braithwait-Bank near to Middleham on the Yore river; Hudswell Moor SW. of Richmond on the Swale river, &c. that all these belong to the lower or calcareous part of the Newcastle coal series, as exhibited in Mr. WESTGARTH FORSTER'S "Treatise on a Section of Strata," lately published, wherein near 4100 feet thick of strata are described in order.

as well as south of it in Staffordshire, Derbyshire, and Nottinghamshire, as abovementioned, and on the east of it from Nottingham to Thorne in Yorkshire, and perhaps further northward.

This border, or plain of red marle, has the tract within it so raised, that the yellow, or magnesian lime rock, probably abuts against the marle at the surface of the strata on the east side, under the gravel, &c. from near Nottingham to near Wetherby in Yorkshire. From Lenton E. of Nottingham, to Allestry N. of Derby, the upper parts of the coal-measures in the first raised tract, abut on the red marle: here another great fault, called the zig-zag fault, intersects the boundary fault; from Allestry to the SE. corner of the Weaver Hills near Wooton in Staffordshire, the second inner tract, with a vastly greater rise than the first, abuts on this southern fault, so as to bring the great limestone-shale (which underlays all the coal-measures) against the red marle on the surface; at this SE. corner of the Weaver Hills, another great fault (called the great limestone fault) intersects the southern boundary (or great Derbyshire) fault of the raised tract; and from this place to the SW. corner of the Weaver Hills near Ramsor, a third inner tract, with four hundred yards or more of perpendicular rise, in addition to the last, occasions the fourth, or lowest limestone rock, to abut against, and even make a high hill above the red marle at the foot of it, on the other side of the great Derbyshire fault; which here occasions a sudden derangement of the strata (and a corresponding denudation of the large tract of country to the northward has taken place), far exceeding any thing which has hitherto been mentioned by authors, or conceived probably by any one.

At the SW. corner of the Weaver Hills abovementioned, the great limestone fault again leaves the south boundary, or great Derbyshire fault, and proceeds northward, after which a corner of the second interior raised tract again presents itself, and the limestone-shale again abuts on the marle, as we pursue the great Derbyshire fault to the westward, owing to the rise being less here by four or five hundred yards, than it was in the third interior tract; but as we proceed south-westward, owing to the dip of the measures on the N. side of the great Derbyshire fault towards the west, the first grit, the first coal-shale, and the second grit rock successively abut against the marle, before the gravel covering commences, east and south of Cheadle, which prevented my tracing this fault any further, within the limits of my Survey.

It seems probable, however, that somewhere SW. of Cheadle in Staffordshire, a branch sets off from the great Derbyshire fault, or southern boundary of the lifted tracts, and proceeds northward, near to Endon and Bosley in Cheshire; the triangular tract beyond which, to the westward, shewn in the map, forming the pottery coal-field, is much less raised, perhaps, than any of the other tracts which have been here mentioned.

If we return to Allestry N. of Derby abovementioned, and trace the zig-zag fault, through Little Eaton, West Hallam, and Ilkeston in Derbyshire, Awsworth, Greasley, Annesley, Kirkby, and Dirty-Hucknal in Nottinghamshire, Alt-Hucknal, Bolsover, Clown, and Barlborough in Derbyshire, Harthill, South-Anston, North-Anston, Dinnington, &c. in Yorkshire, we shall find coal-measures on both sides of it, through its whole length, except in two or three instances, where the

yellow lime strata at the top of these coal-measures abut against it for short distances, and between Allestry and Little Eaton, where the limestone-shale below these coal-measures abuts on its W.; but the rise is very considerable and unequal on the N. and W. sides, through its whole length, compared with the other sides, as I have particularly shewn in my Report to the Board, and pointed out the great difficulties which this zig-zag fault has presented, to the right understanding the entire of the great Derbyshire and Yorkshire coal-field, by the many very intelligent and able colliers who are found in it.

The first, or outer raised tract, thus bounded by faults (except, perhaps on the N. where my Survey has not extended), shews no very rapid dips or inclinations of the strata, except in very limited spots, and presents on the surface either the yellow lime rock, or the parts of the coal-measures not very far beneath that rock, compared with the whole thickness of these coal-measures.

The great limestone fault (which has been mentioned above) commences in the town of Cromford in Derbyshire, in the first or upper limestone rock, and proceeds through Middleton, Wirksworth, Hopton, Carsington, Ballidon, Parwich, Newton-Grange, and Thorpe in Derbyshire, Ilam, Blore, and Thornwood in Staffordshire, and joins the great Derbyshire fault near Wooton (as abovementioned), with which it coincides along the S. end of the Weaver Hills to near Ramsor, where it again leaves this fault and proceeds near Caldon, Water-Houses, Water-fall, Grindon, Wetton Mill, S. end of Ecton Hill, near Gateham and Narrowdale in Staffordshire, Wolfscote, Beresford, Hartington, Ludwell,

Pilsbury, Crowdycote, Dowall, Booth, Thirkelow, Edge-end, Buxton Baths, Black-edge, Dove-hole, crosses to the W. side, and again to the E. side of the *Grand Ridge* * of the island, passes near Sparrow-Pit, Perry-foot, Odin-Mine, Lane-head, Castleton Town, Pindale, Edingtree, Bradwell, Hazlebadge, Quarters-house, and Windmill-houses, and terminates in the first lime rock between Wardlow-Mires and Litton in Derbyshire. If now a line be traced on the same first lime rock, through Wardlow, W. of Little Longsdon, W. of Ashford, through Sheldon, Callenge Low, Middleton by Yolgrave, S. of Gratton, Elton, Winster, Wensley, and Snitterton, W. of Matlock Church, Starkholmes, and Willersley Castle to Cromford Town, shewn by very fine dots in the map, this line on the first limestone, may be considered as a kind of hinge, or joint, on which the second inner raised tract, and the third inner raised tract have turned a little, and altered their inclinations with respect to each other and the surrounding tracts (without any vertical derangement at this hinge), so that the great limestone fault above described, from Middleton by Wirksworth, round to the westward through Staffordshire, as above, to Quarters-house near great Hucklow (with the exception of the short distance between Wooton and Ramsor, and some other trifling ones) has the limestone-shale (or the shale-limestone, &c. belonging to it) on its outside on the surface of the second inner raised tract, for more than fifty miles; but on its other side, owing to the great tilt or rise of the western side of the third inner raised tract, if we begin in Cromford, and pursue the course of the great limestone fault, up Bonsal-Dale, we have at first the first lime on its right or N. side (as

* See that article in Dr. REES'S Cyclopœdia lately published.

well as on its S. side), then the first toadstone, next the second limestone, then the second toadstone, and after its turning to pass through Middleton by Wirksworth, the third limestone also abuts against it, and continues so to do, till the third toadstone appears against it at Hopton, and then the fourth limestone, or lowest known rock of the district, abuts against it all the way round, through Staffordshire to Castleton (with the exception of the hummocks of third limestone at Buxton and at Barmoor in Peak Forest, and a few sunk gulfs of shale) through a length of more than forty-five miles. At the SE. end of Castleton Town, the third toadstone abuts again on the right or S. side of this great limestone fault, and from thence to the SW. side of the Windmill-Houses, the third limestone abuts against it, then the second toadstone, the second limestone, the first toadstone, and at length the first limestone, before the fault terminates or becomes too inconsiderable to be readily traced, owing to its no longer deranging the order of the strata on the surface, but has the first limestone on both its sides; and thus it happens, that the third inner raised tract, or mineral-field, consisting of the four limestone rocks and three interposed toadstones, and containing about 105,000 acres, has about 51,500 acres of these on its eastern side, occupied by the three upper limestones and the toadstones, and the remaining 53,500 acres in Derbyshire and Staffordshire is occupied by the fourth, or lowest limestone rock, in which only a few mineral veins occur among its numerous open fissures and caverns.

In the sketch map which accompanies this, I have shewn a smaller, or fourth inner raised tract, on which Bakewell is situated, in great part surrounded by a fault, which I have

thence denominated the great Bakewell fault: I have selected this tract, among other small local raised ones, on account of its approaching in shape and position to the others which surround it, and because it explains several curious appearances of the strata in these parts, which have been, and are still likely to be greatly misrepresented.

The fault to which I allude, may be said to commence in the limestone-shale on the E. side of Beeley, to pass on the S. side of the village, across the Derwent and on the S. of Haddon-Hall, continuing across the pastures to the Lathkil river about a quarter of a mile above Alport, then turns S. past the W. end of Alport to the upper mill, thence WSW. for about one mile, where this fault again turns to the N. and crosses the Bradford river, and proceeding across the Meadow-place Liberty, crosses Robinstye Mine and the Lathkil river above Over-Haddon mill; bears then a little to the east of the north, and crosses the new Bakewell and Buxton road at the rise of the hill, passes the N. end of Bird's-head Mine, crosses the Wye river about a quarter of a mile above Bakewell Cotton Mill, proceeds near to Rowdale, turns E. towards Nether Burchill, then NE. following nearly the course of the brook, it continues the same direction until about half a mile E. of Hassop, where it turns to the E. crosses the Derwent again half a mile above Baslow, and terminates in the limestone-shale in Barbrook Dale, as it began. The western side of this fourth inner tract being most raised (similar to the third tract) occasions the great elevation of the shale, and its freestone in the hills E. of Bakewell and NE. of Haddon-Hall; the sudden appearance of the limestone, on which Haddon-Hall stands, and in the quarry SSW. of it, on the W. of the

road, and thence across the pastures to the Lathkil river; the sudden elevation of the limestone knowls SW. of Yolgrave, near the shale; and by this same lift, it happens, that the vale of the Bradford suddenly cuts through the first lime rock, as soon as it has crossed this fault, and shews the first toadstone to a considerable height up each side of the valley, but which declines with the dip of the measures in this tract, until the Bradford again gets upon the first toadstone, and then on the first limestone. In like manner, the greater rise of the measures at this fault, on the SW. of Over-Haddon village occasions the valley of the Lathkil river, which till then had been excavated in the first lime rock, to enter abruptly so deep into the first toadstone, as to lay bare a patch of the second limestone under it in the river, both of which however descend again below the bed of the river, before we get down to the crossing of the Ashburne turnpike road.

This fault also occasions the sudden appearance of shale-limestone on the surface NW. of it, opposite to first limestone on the other side in Bakewell Fields, and of the first toadstone on the NW. of Bakewell Cotton-Mill, almost excavated through by the vale of the Wye river, where it abuts against shale or shale-limestone at the northern end of this noted patch of toadstone, the situation and circumstances of which, when compared with those of the other two patches, at the edge of this same raised tract, as above, will be divested of much of that singularity which has been ascribed to it; for we see, that each of the three rivers, which pass on to this fourth inner raised tract, have their excavations cut through the first limestone, so as to expose the first toadstone for some distance, until the more rapid descents of the measures than

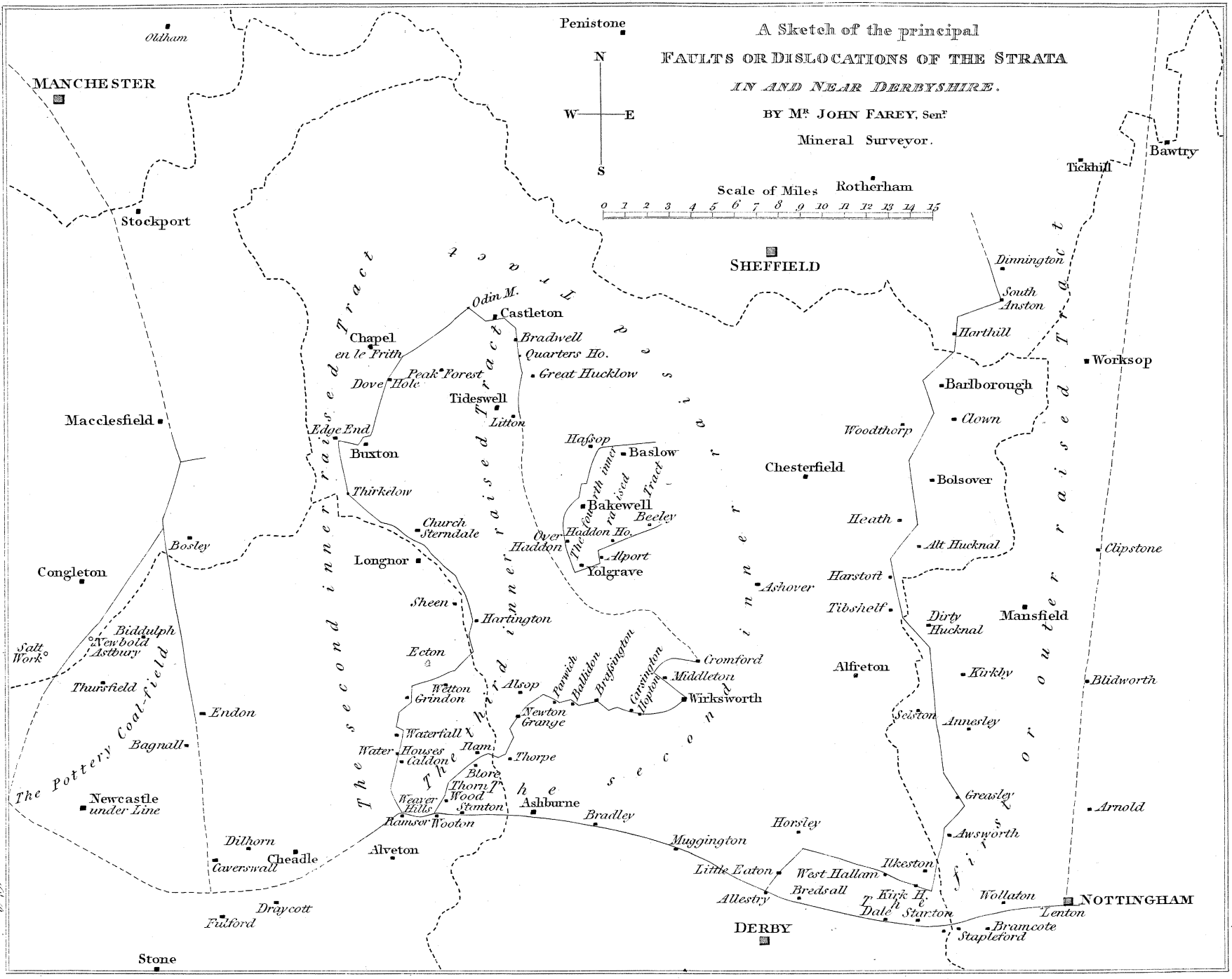
of the vales, occasion them again to dip and disappear in the bottoms of each of these vales.

I am, Sir,

your obliged and very humble servant,

J. FAREY, SEN.
Mineral Surveyor.

Upper Crown-street, Westminster,
January 31, 1811.



Phil. Trans. MDCCCXI. Plate II. p. 256.