THE MALHAM DRY RIVER BED. BY THOMAS TATE, F.G.S.
(*Communicated November 13th, 1895.*)

Eighteen years ago this Society organised an exploration party for the purpose of ascertaining the origin of the River Aire. The diverse opinions held up to that time, are fairly summarised in the words of Whitaker :—"Speaking in general terms, the lake may fairly be considered as the source of the Aire ; but as its outlet quickly sinks into the ground, and is lost, and as several streams which appear below contend for the honour of the connection, it still remains a matter of some uncertainty to which of them the preference is to be given. The inhabitants of Malham plead that the waters of the Tarn actually appear again in two most abundant and beautiful springs about a quarter of a mile below the village, and nearly three miles from the place of immersion. This opinion seems most probable. But from the foot of the Cove, and almost a mile nearer to the Tarn, a copious stream breaks out, which has undoubtedly the second claim. Yet it is well known that a collection of springs rising in the Black Hills, the Hensetts and Withes, is swallowed up in a field called the Streets ; and from the turbid quality of the water, very unlike that of the Tarn, there is little doubt that, after a subterranean course of more than two miles, this is the stream which here emerges again. Thirdly, the Airton Water, from which the village derives its name, seems precluded by its distance from any reasonable pretensions. Fourthly, Gordale Water, which springs in the Great Close, and of which the whole course may be traced, can have no other claim than that of a collateral feeder." "West Yorkshire" contains the following account of the origin of this river :—"The River Aire has its source in several small streams rising in the moorlands at the foot of Fountain's Fell and Hard Flask. The principal stream runs from Capon Hall to the Tarn, and is joined by others in its passage. A second feeder, having its origin near Capon Hall, runs in a more southerly direction for about a mile over the Streets, and sinks in a cleft in the rock near an old smelting

mill. The stream from Malham Tarn runs half a mile southward, and sinks through a large opening in the limestone. Nothing more is seen of the water until the foot of Malham Cove is reached. The water rushes in a powerful stream from an opening at the base of the Cove, and pursuing a southward course passes through the village of Malham, and half a mile below is joined by the stream from Gordale. The Aire then runs nearly due south through Hanlith and Airton to Bell Busk, where it is joined by the Otterburn."

These conflicting statements suggested a series of investigations that should determine, as far as possible, the actual source of the Aire, and a report, with full details of the work done, appeared in our Proceedings for 1879. It was found that the drainage off Hard Flask and Fountain's Fell into Malham Tarn, after flowing south for half a mile, disappeared in the "water-sinks," the bulk of the water reappearing at Airehead Springs, nearly three miles below the Tarn; the remainder emerging at the foot of the Cove.

But the waters of the Aire have not always taken this subterranean course. Hurtley, the Malham Schoolmaster, writing in 1786 says :—"From the apex of this Cove, after what is in this part of the country called a *RUGG*, or a succession of rainy and tempestuous weather, when the water-sink at the southern extremity of the Tarn is unable to receive the overflux of the Lake, there falls a large and heavy torrent, making a more grand and magnificent cascade than imagination can form any idea of. This vast and precipitate cascade, so generally enquired after, and so seldom seen by travellers, in the summer months hath been so much admired as to leave it equally subject of wonder and concern, that the inlets of the stream which might easily be done, have not been stopped, and this lofty and imperious cataract thereby rendered a perpetual object of gratification and astonishment." "Twice within the last forty years the *swollen waters* of the Tarn have made their way over the Cove, but the torrent was dispersed in one vast cloud of spray before it reached the bottom. Its density and the magnificent sight may be imagined from the fact that the spectators could not approach within a hundred yards of the foot of the rock without being drenched through." (Howson).

A dry river bed, extending from the water-sinks to the summit of Malham Cove, forms a marked physiographical peculiarity of this elevated area which, as remarked by Phillips, can be distinctly followed. Yet it is no exaggeration to say, that every summer thousands of pleasure seekers wander in close proximity to this charming dry valley, and pass on unconscious of its existence. This interesting geological and topographical feature is fully illustrated in the following series of admirable photographs, for which the Society is deeply indebted to Mr. Godfrey Bingley, of Leeds. The skill and good taste of the photographer in selecting his points of attack awaken the warm admiration of those who know the difficulties of the situation and the labour which must have attended their production. They give an artistic and accurate representation of the whole length of this interesting little gorge, and on the map, which is added, the place from which each photograph was taken, and the direction of view is indicated by a numbered arrow-head.

(No. 1)—MALHAM TARN (alt. 1246 ft.) View looking north, across the Tarn to Tarn House (the seat of Mr. Walter Morrison, M.P.), with Malham Moor in the background. The sluice-gates are seen at the foot of the Tarn. Silurian rocks occupy the foreground and constitute the floor of the Tarn; the moorlands beyond the house are of Mountain Limestone. The stream leaving the Tarn crosses the north branch of the Craven fault near the Wate-sinks Gate, and the fault may be seen in Gordale Beck, to the east.

(No. 2)—THE WATER-SINKS (1200 ft.), half a mile below the Tarn. Here the waters are swallowed up by fissures in the Mountain Limestone, some of which may be seen at the base of the wall to the right, but the sinks occur chiefly for a short distance down the valley, on the other side of this boundary wall. When the photograph was taken there was no water passing down the water-sinks, the sluices being closed. "Malham Water, a lake embosomed in the cloud-capped mountain (Gray) which, hiding itself as it were immediately on its escape from the parent's confines, traverses the bowels and cavities of the earth till it finds a snug and serene retreat amid the almost inaccessible crags at the foot of Cove." (Hurtley).

(No. 3) COMB SCAR (1220 ft.) entrance to the north end. View

Photographed by Godfrey Bingley, Headingley, Leeds.

I. MALHAM TARN.
Proc. Yorks. Geol. and Polyt. Soc., Vol. XIII., Plate VI.

Photographed by Godfrey Eingley, Headingley, Leeds.

2. THE WATER SINKS.

Proc. Yorks. Geol. and Polyt. Soc., Vol. XIII., Plate VII.

Photographed by Godfrey Bingley, Headingley, Leeds.

3. COMB SCAR (LOOKING SOUTH).
Proc. Yorks. Geol. and Polyt. Soc., Vol. XIII., Plate VIII.

Photographed by Godfrey Bingley, Headingley, Leeds.

4. COMB SCAR (LOOKING NORTH).

Proc. Yorks. Geol. and Polyt. Soc., Vol. XIII., Plate IX.

Photographed by Godfrey Bingley, Headingley, Leeds.

5. DRYWATER FALL.

Proc. Yorks. Geol. and Polyt. Soc., Vol. XIII., Plate X.

Photographed by Godfrey Bingley, Headingley, Leics.

6. VIEW FROM FOOT OF COMB SCAR (LOOKING NORTH).
Proc. Yorks. Geol. and Polyt. Soc., Vol. XIII., Plate XI.

Photographed by Godfrey Bingley, Headingley, Leeds.

7. VIEW FROM SUMMIT OF COMB SCAR ALONG THE WATLOWES.
Proc. Yorks. Geol. and Polyt. Soc., Vol. XIII., Plate XII.

Photographed by Geoffrey Bingley, Headingley, Leeds.

8. MALHAM COVE.
Proc. Yorks. Geol. and Polyt. Soc., Vol. XIII., Plate XIII.

Photographed by Godfrey Bingley, Headingley, Leeds.

9. CAVERN AT FOOT OF MALHAM COVE.
Proc. Yorks. Geol. and Polyt. Soc., Vol. XIII., Plate XIV.

10. MAP OF THE DRY VALLEY OF THE AIRE.

Proc. Yorks. Geol. and Polyt. Soc., Vol. XIII., Plate XV.

looking south. Scar limestone stratified in thick, nearly horizontal, beds, showing typical weathering.

(No. 4) COMB SCAR (1200 ft.) looking north, from a point about two hundred yards below No. 3. The floor of the dry river course is nearly covered by the talus frosted off the vertical joints of the limestone.

(No. 5) DRY WATERFALL between Dean Moor Hill on the left and Comb Hill to the right, looking north. Through much of its course the surface channel of the Aire broadens out, but here, where the primitive river bed makes a sharp bend, it is contracted between precipitous vertical cliffs. Over this precipice, old writers have described a magnificent waterfall, as to be seen after heavy rains. "In a flood the Tarn water not unfrequently rushes over here and forms a second Gordale, but is commonly prevented from reaching the Cove by sinking at the foot of this pass through the shattered and fissured stratum, with singular noise and rapidity." (Howson). This writer also narrates a touching incident occurring here eighty-five years ago :—A boy, bird-nesting, lost his hold and falling was killed. His younger brother, happily ignorant of death, went down and shook him, but, said the little one, "he was asleep."

(No. 6) THE WATLOWES. View taken on floor of dry valley, at the foot of Comb Scar, looking north. The precipice seen in the previous view, is here concealed by a bend of the dry river course to the east, round the base of Dean Moor Hill, the central eminence in this view. The Scars on the right show magnificent weathering.

(No. 7) FISSURAL LIMESTONE PAVEMENT in left corner. Surface weathering into curious rugose hollows and fantastic shapes, with projecting knobs, ridges or pinnacles (often used for rustic work). This is the characteristic surface weathering of limestone developed in high bare tracts of exposed country. Another fine example ("The Woolpacks") may be seen behind the Cove. This view is taken from the top of Comb Scar, looking south, down into the dry valley below the Watlowes, as far as the summit of the Cove (near mid-skyline).

(No. 8) MALHAM COVE (1000 ft.) The dry valley ends about the middle of the skyline. From this depression the "magnificent

cascade," described by Hurlley, descended to the foot of the Cove, a distance of two hundred and fifty feet. The semicircle of limestone cliffs, some seventy yards across, may be traversed along a ledge or natural terrace, about eighteen yards up the face of the Cove. "The tints and colouring of the Cove as it appears at present, are naturally the softest and most elegant that can be conceived. The Rock is silver-grey, delicately although irregularly striped with lines of dark hue, occasioned by the streams of water falling from the *Saxa Sedilia* or shelves in various places and directions; and the entire Mass is embroidered and interspersed with shrubs and evergreens, forming together by a variety of shades and features, an Alcove and Landscape the most splendid and picturesque." (Hurlley).

(No. 9) WATER CAVERN at the foot of Malham Cove, whence emerges a portion of the water disappearing at the sinks. In the foreground is Malham Beck which, lower down, is joined by Gordale Beck and (after receiving the water from Airehead Springs) the Otterburn to form the River Aire.

(No. 10) MAP OF DRY VALLEY. Reduced from Ordnance Sheet No. 133, showing :—

- (a) The station and direction of each photograph.
- (b) The geological evidences of the Craven Fault.

Botanists may be interested to learn that the following are among the rarer plants observed hereabout :—*Trollius europæus*, *Actæa spicata*, *Droba muralis*, *Thlaspi alpestre*, *Hutchinsia petriæa*, *Helianthemum canum*, *Geranium sanguineum*, *Potentilla alpestris*, *Pyrus aria*, *Blysmus compressus*, *Sesleria cærulea*, *Polypodium calcareum*, *Asplenium viride*, *Equisetum hyemale*, *Verrucaria Malhamensis*, and *Lecidea ribidula*.

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