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thus projects the imagination into the future, while at the same time it recalls the instincts of the past; for the simplicity of desert life, the persistent uniformity of its conditions, and the merciless severity of its forces, all awaken the feelings of early man. The traveller with a small caravan in the desert meets the conditions of prehistoric man, but he regards them with the thoughts of the twentieth century. And to face mystery and the unknown free from the fears that paralysed primitive people, gives that stimulus to the imagination which is the highest joy man can know.

I have, therefore, tried in this lecture not only to give some account of the present conditions and to show photographs of the scenery of the vast plains of central Australia, but to hint why the Australian bushman loves that country so dearly; for though in general accounts of travel there, the discomforts loom large, they are really insignificant compared with the deeper and more lasting impressions for which we shall always remember with gratitude our sojourn in the desert places round Lake Eyre.

THE RIVER MASSAN.

By FREDERICK MORT, M.A., B.Sc., F.G.S.

(With Sketch-Map and Section.)

THE district of Cowal, comprising the Highland area between Loch Long and Loch Fyne, presents numerous interesting problems in river development. Many of the streams illustrate nearly all the typical features of river-erosion in the most beautiful manner and for this alone are worthy of detailed study. In addition, their past history will have to be thoroughly investigated before the present drainage system of Scotland is properly understood, for in this district evidence must be looked for connecting the present rivers of the Southern Uplands with their former head-waters which, it is supposed, may have arisen even west of the present coast-line of Scotland.

In dealing with the River Massan a brief account will first be given of typical examples of river-work well illustrated by this stream; and secondly, some consideration must be given, necessarily more speculative in character, to the former history of the Massan and its relations to neighbouring streams. Pupils in schools or students in colleges might well spend a whole day in tracing such a stream from mouth to source. Such an excursion, under competent guidance, would be of great educative value, and it is to be hoped that at no long distant time such practical study will be an integral part of the geography curriculum of every school and college.

The Massan is represented in maps and is generally thought of as a tributary of the Echaig which flows into the head of the Holy Loch. A glance at a map, however, will show that the Holy Loch was not formed by the Echaig but by the Massan, for the loch and Glen Massan are in one straight line. A person in a boat about the middle

of the loch can see a long way up Glen Massan, while the Echaig glen is invisible, as it bends off almost at once towards the north. If we neglect the sizes of the rivers, then the Massan is the main and the Echaig the tributary. Below the confluence of the two streams the combined Massan-Echaig flows gently towards the sea in a beautiful series of swinging meanders over the old raised beach. From the

Sketch-map showing the relation of the Massan to neighbouring streams.

junction to the falls, a distance of about two miles, the Massan is cutting a young channel through morainic material and alluvium spread over the flat floor of the old valley. The channel is from 6 to 15 feet deep and but a few yards across. Like so many other rivers in Scotland, the stream here seems absurdly small for the great valley in which it flows, on the bottom of which the present channel excavated since glacial times seems a mere trench. An explanation of this will be suggested later.

The falls of the Massan are not large, but in many ways are strikingly beautiful. They are worth a visit if for nothing more than the splendid examples they present of corrasion by means of pot-holing. In one place the rock is continuous from one side to the other and the stream flows beneath a complete natural arch. A small slip has piled up great masses of rock in tumultuous confusion in the stream channel, adding considerably to the wildness of the scene. The falls have been caused by the occurrence at this point of a hard band of schistose grit with much quartz, the foliation planes of which strike directly across the stream. The softer rocks below have been eroded more rapidly than this band, and in this way a series of falls has been produced. About this point a large quantity of morainic material has been deposited in the valley and good sections of it are to be seen at the roadside below the falls.

Whenever a waterfall is found in a stream, one may look with confidence for a broad alluvial flat above it. This is well shown in Glen Massan, the valley opening out above the falls in a most striking manner

The Massan from its source to a point two miles from the Sea.

into a broad alluvial flat of great extent and consisting partly of well-bedded deposits of fine sand. The stream has been unable to corrade its channel below the level of the falls, and the available energy has therefore been utilised in lateral corrasion. Consequently we find the course of the Massan falling into two natural divisions, one from the source to the falls, the other from the falls to the sea. This is well shown by the accompanying section which exhibits two typical curves of river-erosion, a temporary base-line having been established in the part of the stream above the falls.

The alluvial flat stretches upstream above the falls for over two miles. It is divided into two by a deposit of moraine-stuff through which the stream is cutting and in which it has exposed a fine section of boulder-clay, from ten to thirty feet high. The stream here flows fairly rapidly, the increased slope being just perceptible in the section. Above this point occur some pretty examples of old river-terraces. In addition to the present fairly broad river-flat, two older terraces are shown quite distinctly.

Towards the head of this flat near the farmhouse of Glen Massan, two tributaries join the main stream practically at the same point, the Allt Coire Mheasan on the left bank, and on the right bank the Allt nan

Columan, not named on the one-inch ordnance map. The relation of these streams to their main will be referred to later. Above the farmhouse of Garrachra the valley narrows again, and from this point to the source is called Garrachra Glen. The straightness of this glen is probably due, not only to the fact that it runs along the strike of the rocks but also to a line of fault which coincides for some distance with the direction of the stream. The former fact is also the cause of the asymmetry of the valley in cross-section. The east slope is smooth and grassy and not nearly so steep as the west, which presents a series of rocky cliffs. The foliation planes dip to the west, thus giving rise to a typical case of crag and dip-slope. The invariable tendency for a fall or rapid to be accompanied by a flat plain above is shown in this glen in an interesting way, where a recent rock-slip has partially dammed the stream. Above it can just be detected a tiny alluvial flat due to lateral corrosion working for a comparatively short time.

When the head-waters of the Massan are reached at the top of Garrachra Glen, it is obvious that we have to deal with abnormal conditions. The stream rises in a broad, marshy flat, and a walk of 150 yards farther brings one to the head of the Shellish, which flows in the opposite direction. The divide between the two streams is imperceptible. Yet though we have reached the head of the river, the valley in which it flows continues unchanged. On each side the ground rises for hundreds of feet above the broad, flat floor of a mature valley that is quite continuous from the Massan to the Shellish. Glen Shellish and Glen Garrachra are not two glens but one, and the conclusion is forced on the observer that a single river must have flowed in the valley now occupied by the two streams mentioned.

So far there can be little difference of opinion. In suggesting the former history of the original un-beheaded stream we enter less sure ground. The river must have flowed either north or south, and a good many considerations prevent us from thinking the former. It is suggested, therefore, that the river Cur, which now drains into Loch Eck, originally flowed along Glen Shellish and Garrachra Glen. The Finart, working backwards, was able to capture the head-waters of the Cur, for its gradient was steeper, since it reached the sea in 8 miles, while by the present course of the Massan the distance from the sea is about 14 miles. The valley thus cut off then naturally drained in two directions, one part being occupied by the present Shellish, the other by the present Massan. The abnormal direction of the Shellish is now clear; at the present time for most of its course it is running almost exactly opposite to the direction of its main river. The later history of the Finart has been told by Cadell (*Scot. Geog. Mag.*, vol. ii.). The Echaig working backwards, beheaded it and gave rise to the wind-gap between Whistlefield and Ardentinnny. That this was a later event is indicated also by the fact that this gap is just over 600 feet above sea-level, while the gap between Glen Shellish and Garrachra Glen is a little more than 800 feet above the level of the sea.

A similar problem is encountered when the Allt nan Columan is considered. As already mentioned, it joins the Massan just opposite

another tributary, the Allt Coire Mheasan. The valley in which the Allt nan Columan flows is really a part of Glen Tarsan, which runs into Loch Striven and grooves deeply right through the ridge between this loch and the Massan. That this broad valley was eroded by one river, no one who has walked through it can doubt. The Allt nan Columan is an interloper, its trickling head-waters six inches wide forming almost a ridiculous contrast to the splendid glen which it pretends to have excavated. On the broad floor of this glen lower down, the stream flows in its own valley, a narrow, deep, V-shaped trench with all the characters of youth. We have obviously here another case of beheading. The fact that Glen Tarsan is quite continuous with the Allt Coire Mheasan can hardly be a coincidence. This latter stream originally flowed into Glen Tarsan until cut off by the Massan. In fact the great size of the wind-gap into Glen Tarsan makes one wonder if Garrachra Glen and Glen Tarsan were not once continuous. The Massan has been able to capture these head-waters by reason of its greater gradient. It reaches the 200-foot contour-line in two miles, while the Tarsan stream takes four miles to reach that level. The strike direction of the foliation seems to have had little effect on the rate of excavation at this point. The foliation planes can be seen over and over again, lying quite flat in the bed of the Allt nan Columan.

The foregoing paper has been confined to the Massan and its tributaries, but similar problems await examination in other parts of Cowal. The district is one full of instructive lessons for the most elementary student of physical geography, and in addition presents many difficult and interesting studies for the most expert investigator.

EARTH AND MAN: A REVIEW.¹

No apter illustration of the width of outlook demanded of the geographer could be found than in Elisée Reclus' last great work. It is at once a work of history and a work of geography, and puts the somewhat ambiguous subject of historical geography into its true place: in the present instance it must be judged rather from its geographical standpoint, but certainly it could, with equal justification, be looked at from an historian's point of view. *L'Homme et la Terre* was a fitting culmination to the life labours of this greatest of synthetic geographers, and takes its place as a unique work, surveying the progress of man from a standpoint from which few writers have looked before, and perhaps none with so all-embracing a vision.

Here the whole story of man's progress, from his earliest beginnings to the dawn of our own era, is traced; step by step the tale is unfolded from the earliest civilisations of the Euphrates basin to the eighteenth century. Man is not treated as an abstraction apart from his environment; his struggles and his progress, his wars and his alliances, his religions and his discoveries are all interpreted in terms of his changing

¹ *L'Homme et la Terre*. By Elisée Reclus. 4 volumes. Paris: Librairie Universelle, 1908. Price 20 frs. each volume.