certain rocks of a similar character in Derbyshire; and though the sand itself is fine in character, there are numerous layers of small pebbles which would supply a sufficiently coarse material to produce such action. This was held by Dr. Abbott as only partially satisfactory, and he thought that the action of wind-blown sand was aided by the more laminated structure of the sandstone forming the pedestal on which the Toad rests. There is another outlier of Weald Clay at the highest part of the hill here, and from this spot the chief features of the view were pointed out. To the north was the long and well-marked escarpment of the Lower Greensand, while nearer was the lower line of the Bidborough Ridge; to the south the range of the Ashdown Sand was seen with its two culminating points of Crowborough Beacon and Saxonbury Hill.

The party then crossed the Happy Valley to the High Rocks. At the bottom of the valley is a patch mapped Wadhurst Clay, and some clay was seen at the side of the stream. Nearer the High Rocks the rock of the Tunbridge Wells Sand appears abruptly just N. of the road owing to a fault which runs in a north and south direction, east of the High Rocks, and then bends to the north-west, thus bringing the Wadhurst Clay against the Tunbridge Wells Sands at this point. Owing to the inaccuracy of the old Ordnance Map the geological mapping is a little difficult to follow. At the High Rocks the rock masses were again seen, on a larger scale than those on the other side of the valley, and the peculiar straight-sided fissures between them were remarked.

At the top is another patch of Weald Clay, which is cut off on the east by the fault already mentioned. Tea was obtained at the High Rocks Hotel, and the party returned to Tunbridge Wells in time for the 8.5 train to Cannon Street.

REFERENCES.

Geological Survey Map, Sheet 6.

1875. TOPLEY, W.—“The Geology of the Weald.” *Mem. Geol. Survey*.
For previous visits to the locality, see *Record of Excursions*, pp. 38-44.

LONG EXCURSION TO BELFAST, THE COAST OF ANTRIM, AND THE MOURNE MOUNTAINS.

MONDAY, 29TH JULY, TO SATURDAY, 3RD AUGUST, 1895.

Director: A. MCHENRY, M.R.I.A., GEOLOGICAL SURVEY OF IRELAND.

(*Report by* R. S. HERRIES; *revised by* THE DIRECTOR.)

THIS excursion was the outcome of an invitation to visit Belfast, given by the Belfast Naturalists' Field Club to the Association during their visit to Dublin and Wicklow in 1893. The Field Club, to a great extent, undertook the somewhat difficult arrangements necessary for the accommodation and

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transport of the members of the Association during their drive round the coast ; and it was to the excellence of these arrangements that the success of the excursion was largely due. The thanks of the Association in this respect are particularly due to Miss S. M. Thompson and Mr. F. J. Bigger, the honorary secretaries of the Field Club ; and this opportunity may be taken of thanking those gentlemen, such as Mr. R. Lloyd Praeger of Dublin, Messrs. R. Welch and W. Gray of Belfast, and Mr. W. A. Traill, C.E., of Bushmills, who accompanied the party on various days, and were always ready to impart all the information in their power about the sections visited to any members of the Association that asked for it.

For the first two days the headquarters of the Association were at the Shaftesbury Hotel, Belfast, and here the members assembled at various times and by various routes. For the early arrivals, a preliminary excursion was arranged to Scrabo Hill, near Newtownards, to which place the party proceeded by train. This hill is between Belfast and Strangford Loughs, and consists of Trias, Keuper above and Bunter below, capped by basalt, and penetrated by numerous dykes of the same material, both vertical and horizontal. Good examples of ripple-marks, rain-pittings, etc., were seen on the fallen blocks of sandstone, and the spheroidal structure of the basalt capping was noticed.

On *Monday, 29th July*, the party started about 11 o'clock to drive to Cave Hill Quarry. Here they found the Chalk overlain by basalt, and resting on Upper Greensand, beneath which again at one end of the quarry the Lias Clays were seen. The Director explained that the Chalk here, as elsewhere in Antrim, was Upper Chalk, while the Lias was Lower Lias. Several specimens of *Belemnitella mucronata* were obtained from the Chalk, but the Lias was not in a good state for fossil collecting. The basalt here, which is not columnar, but somewhat coarse in texture and full of amygdaloidal cavities, belongs to the Lower Basaltic Sheet,* which spread over a large part of the county of Antrim as the result of great volcanic activity in Eocene times. The Chalk was much altered and hardened by the contact of the basalt, and this is apparent several feet from its upper surface, although the Director said that he did not attribute its hard and compact nature entirely to this cause. At one end of the quarry, later dykes of basalt were seen traversing the Chalk and the basalt sheet above. Cave Hill was then ascended, and a very fine view was obtained, including Belfast and Strangford Loughs. Lough Neagh, the Mourne Mountains, and the Scottish coast. Coming down the north side of the hill, the Whitewell Quarries were visited, where the Chalk and overlying basalt were again

* See "Sketch of the Geology of County Antrim," by A. McHenry, *Proc. Geol. Assoc.*, vol. xiv, p. 129 (at p. 138). The references in the text throughout this account are to this paper, or to that on "The Mourne Mountains," by R. Lloyd Praeger, B.E., B.A., *loc. cit.*, p. 148.

seen. Here the amygdaloidal cavities in the latter were found to be filled with several varieties of zeolites, the pretty needle-like crystals of which were much admired. The carriages were now rejoined, and the drive continued to the quarry in Carnmoney Hill (Fig. 13, p. 144). Here is a great mass of basalt, showing a distinctly columnar structure, and the Director gave reasons for believing that this represents one of the volcanic necks or vents through which the lava was erupted, which now forms the uppermost Basaltic Sheets. The basalt here contains small cavities filled with a glassy material, which has been described under the name of "Hullite," but it is probably Tachylite. The party next drove to Macedon, the residence of Mr. James Thompson, who most hospitably provided afternoon tea; after which, and a ramble round the pretty gardens, the members grouped themselves in front of the house, and an excellent photograph was taken by Mr. Welch. The return was then made to Belfast by the shore road.

On *Tuesday, 30th July*, an early start was made by the 7.30 train from the County Down Station to Newcastle. After breakfast at Lawrence's Rooms the party, reinforced by a strong contingent of the Belfast Naturalists' Field Club, drove to Trassey Bridge, and thence proceeded on foot under the guidance of Mr. Praeger, who was acting as assistant-director, up a mountain valley on the north side of the Mourne Mountains, to the Hare's Gap. From this point a very fine view was obtained of this remarkable group of mountains. Slieve Donard, Slieve Commedagh, Slieve Lamagan, Slieve Bingian, and other fine peaks were conspicuous, while northwards the Antrim Basalt plateau, Lough Neagh, and the nearer granite range between Castlewellsan and Newry were seen. The Director explained that these mountains consist of a great mass of granite which has burst through Ordovician rocks, and is of uncertain age; but it is, at any rate, newer than the Castlewellsan granite, and older than the latest basaltic eruption. He thought it very probable that it was contemporaneous with the Rhyolites in county Antrim, and therefore in age between the Upper and the Lower Basaltic Sheets of that county (p. 144), and with this opinion Mr. Praeger agreed (p. 152).

The Diamond rocks (p. 150) were then visited, and in the cavities of the granite many fine specimens of crystals of smoky quartz, mica, and felspar were obtained, and not a few crystals of white topaz and pale blue beryl rewarded the diligent searchers. The walk was continued to the "Castles" of Commedagh (p. 150, and Fig. p. 151), where the granite, owing to the well developed cross-jointing, has weathered into great detached masses, which look exactly like masonry on a large scale, and are particularly impressive when seen from below. Slieve Commedagh (2,512 feet) was then ascended, and a still more extensive view obtained than that from the Hare's Gap. It included Carlingford Lough, Lambay Island, Howth Head, the Wicklow Sugar Loaf, and the

Isle of Man. The descent was then made to Newcastle, the junction of the granite with the Ordovician rocks in the valley of the Glen River being noted on the way, and after tea at Lawrence's Rooms the party returned to Belfast by the 6.40 train.

On *Wednesday, 31st July*, the members left Belfast, with their luggage, by the 9.5 train from the Northern Counties Station to Larne Harbour. Near Larne there is a good section of Basalt upon Chalk in a large quarry, well seen from the railway. While the luggage was being packed into the *machines* that were to convey the party along the coast road, the Director led the way to the gravels of the old raised beach (p. 146), and several specimens of marine shells and worked flint flakes were soon found. Coming to the shore, the fine section at Waterloo was next examined. Here the Keuper, Rhætic, and Lias (p. 134) occur in succession as flat scars on the foreshore, rising up into a low cliff with a northerly dip. From the Rhætic, *Avicula contorta*, *Pecten*, *Valoniensis*, and *Cardium Rhæticum* were obtained in abundance, and from the Lias, *Ammonites planorbis*, *A. Johnstoni*, *Gryphæa incurva*, *Cardinia*, etc., showing the beds to belong to the lowest zones. The carriages were now ready, and the drive round the coast, northwards, was begun, the stage for the day ending at Cushendall. The road is very picturesque, and, the day being clear, beautiful views were obtained of the Scottish coast, including Stranraer, Ailsa Craig, the Isle of Arran, the Mull of Cantyre, and in the far distance the Islands of Jura and Islay.

The cliffs are generally Chalk with the overlying basalt, with Greensand, Lias, and New Red below, these being mostly concealed by slips (Fig. 2, p. 135). At Ballygally Head is a fine mass of intrusive basalt (p. 145). A halt was made at Glenarm, and while the horses were being changed the party inspected the whiting factory here, for the purposes of which a large amount of chalk is quarried in the immediate vicinity. There is also stacked here, waiting to be shipped, a considerable quantity of pisolitic iron ore, bauxite, bole, and lithomarge from workings in the neighbourhood. These beds of ironstone, bole, bauxite, etc., occur between the Upper and Lower Basaltic Sheets (p. 138), and it is by means of the presence in them of lignite beds with plant remains that the age of the period of volcanic activity can be fixed. This was formerly considered to be Miocene, but the researches of Mr. Starkie Gardner have shown that it is more probable that the plants belong to the Lower Eocene period.*

At Garron Point there are some very big slips of the Chalk over the Lias, and a little farther on, in Red Bay, there are fine sections of Triassic conglomerate (p. 133). Cushendall itself is on the junction of the Old Red Sandstone conglomerate and the earlier Quartz Porphyry, which occurs immediately to the south

* *Quart. Journ. Geol. Soc.* vol. xli, p. 82.

(p. 145). This Quartz or Felstone Porphyry, as it is variously called, is traversed on the sea-shore by veins of red jasper, of which some beautiful specimens were obtained. In the neighbourhood of Cushendall is an isolated hill of basalt, called Tieveragh, which is another volcanic neck (p. 144). The headquarters of the Association here were at the Glens of Antrim Hotel, but the members were mostly distributed throughout the village, and some amusement was caused by the fact that most of the houses were owned by families of the same name, which necessitated their being described as 1st, 2nd, or 3rd MacSoandso, according to their distance from the hotel.

On *Thursday, 1st August*, the drive was continued, the destination being Ballycastle. At Cushendun some remarkable caves in the Old Red Sandstone were visited, the deposit here consisting of a massive conglomerate of quartzite pebbles, many of them of great size, and occasional fragments of porphyry and schistose rocks (p. 131). The whole mass is crushed and sheared in every direction. The carriages were now abandoned, the steepness of the coast road compelling them to go by the longer but easier road farther inland. The members proceeded on foot to Torr Point, passing on the way a quarry near Runabay Head, opened in a dyke of quartz porphyry, with large crystals of red orthoclase. Between Cushendun and Torr Point the country is occupied by a series of metamorphic rocks, schists, etc., of uncertain age, which are very well seen at Torr Point itself, which presents an extraordinary tangle of schists, crystalline limestones, and intrusive epidiorites (pp. 130 and 145). From Torr Point the first view was obtained of Rathlin Island, its white chalk cliffs contrasting finely with the overlying black basalt. At the top of the hill above Torr Point, the carriages were met, and the drive continued to Ballycastle, some sections of boulder clay and river gravels (p. 146) being pointed out by the Director on the way. At Ballycastle the headquarters were at the Antrim Arms Hotel.

On *Friday, 2nd August*, the party drove to Colliery Bay, so-called from the fact that coal used to be worked here. The coal seams occur in the Lower Carboniferous, which here consists of shales and sandstones (p. 132). The carriages were left here, and the members descended to the beach and proceeded to collect from the highly fossiliferous shales. Many examples of *Productus*, *Spirifer*, *Orthoceras*, *Crinoids*, *Stigmaria*, etc., were found. Walking eastwards a very fine view was obtained of Fair Head, one of the most striking cliffs in Ireland (Fig. 1, p. 131). It is 630 feet high, and the uppermost 250 feet form a solid wall of basalt, composed of very massive vertical columns. The lower part of the cliff is a huge talus of fallen basaltic columns and masses of carboniferous sandstone. The basalt here is intrusive in the Carboniferous as well as the Cretaceous strata (p. 145),

and the Director stated that it is one of the very latest basaltic intrusions in Ireland, or indeed in Britain. The Head was now ascended by a path which gradually degenerated into a sheep-track and finally led up a nearly perpendicular cleft in the face of the basaltic wall, which taxed the climbing powers of the Association to the utmost. All, however, got safely to the top, and here the columns could be seen in section, and they were found to be scored in several places by ice-scratches, the general direction of which was, as the Director pointed out, westwards from the Firth of Clyde. Some perched blocks of granitic rocks were also noticed. A good view was obtained of the coast to the westward, and of Rathlin Island, and Jura in the far distance. The "Grey Man's Path" is a somewhat similar path to that by which the Association came up, and it is marked by a column of basalt which has fallen over the chasm, so as to form a sort of natural bridge. Near here the basalt was remarkable for the fine large crystals of augite which it contained. The walk was continued to Murlough Bay, where the party came down by an easy descent. In this bay the Chalk rests directly on the Trias, with only a bed of pebbles representing the Greensand, and the Lias entirely absent. Below are the Carboniferous Sandstones, and the junction of these with the metamorphic series occurs on the foreshore in the Bay. At Miss Clark's cottage on the beach the members were most hospitably entertained to tea, and much interest was displayed, especially by the ladies, in Miss Clark's spinning-wheel. A return was then made to the top of the cliff, not far from which the carriages were found, and the homeward journey was made to Ballycastle. In the evening the usual speeches were made, and votes of thanks passed, and as Mr. Leighton had announced that this was the last long excursion which he would undertake in the capacity of excursion secretary, his health was enthusiastically drunk, and he was cordially congratulated on the great success of the Irish visit.

On Saturday, 3rd August, an advance party drove direct to the Giant's Causeway, and on to Portrush to catch the mail train there. The remainder drove first to Kinbane Head (Fig. 5, p. 138) which is a low projecting point of chalk, which, along with the overlying Lower and Upper Basaltic Sheets, has been lifted out of its proper place by a later intrusive mass of basalt, the cliffs to the east being similarly penetrated by basaltic dykes. In ascending again to the carriages the Director pointed out the ash-bed, which is composed of *débris* of chalk and basalt, thrown out by the Carrick a Raide volcano (p. 144). The next stoppage was at a small, but very interesting, quarry in the Upper Basaltic Sheet, which showed a beautiful example of columnar structure below, merging almost imperceptibly into the starch like and amorphous form above, due, as the Director explained, to the different rates of cooling of the surface and interior of the mass. The basalt here, as

generally in the Upper Sheet, is extremely compact in texture. The journey was then continued to Carrick a Raide with its famous swinging bridge, over which many of the members, including several ladies, crossed without the slightest hesitation. The rock of Carrick a Raide is a great volcanic vent, and is composed largely of an agglomerate of masses of chalk and basalt (p. 144), and considerable ash-beds spread out in all directions from it. More of these ash-beds were seen in ascending to the carriages at Ballintoy, whence the party drove to the Giant's Causeway, which was duly inspected. It is unnecessary to describe this celebrated locality; it is sufficient to say that it is caused by the lowest bed of the Upper Basaltic Sheet, which in the adjoining cliffs is underlain by the Lower Basalt, being brought down to the sea level by a sharp dip, and that the Causeway itself is composed of the upper surface of the columns composing this bed, which is seen in the cliff a little further east, where it is known as the "Organ Pipes." The columns composing the Causeway are much smaller and more regular than those at Fair Head, and the "ball and socket" structure is particularly well shown, in connection with which it was noticed that there was no regular system, the upper ends of the columns sometimes presenting a ball and sometimes a socket. The cliffs eastwards, as far as Bengore Head, are very fine, but cannot be compared in grandeur with Fair Head. The distinction between the Upper and Lower Basaltic Sheets is particularly well seen at the "Amphitheatre," a little east of the Causeway (Fig. 6, p. 139), the Upper being columnar, and the Lower not. The beds are separated by the Bole-bed, consisting of red ochreous clay, smaller bands of which occur above and below, marking successive outflows of the lava sheet. Many of the party took up their quarters at the Causeway Hotel, but the remainder continued the drive to Portrush, passing the fine section of basalt on chalk at the "White Rocks," and seeing the intrusive basalt and baked Lias at Portrush itself (p. 134). Several specimens of *Ammonites Johnstoni* were obtained from the Lias here, which, except for the fossils, can hardly be distinguished from the basalt. Here the excursion ended officially, but many stayed on for some days, Mr. Traill kindly accompanying a party along the cliffs near the Causeway on the Sunday afternoon, when the numerous later dykes of basalt were pointed out. Many of the members also visited White Park Bay, near Ballintoy, where most were interested in the kitchen middens and worked flints to be found there (p. 146), though the writer preferred to confine his attentions to the Lias, which crops out every here and there under the Chalk (p. 134), and from it he obtained a fair collection of fossils. Altogether, both in point of arrangements, weather, and geological interest, the long excursion of 1895 must be pronounced a decided success.

For References see p. 146.