The Pollnagollum Cave, Co. Clare
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THE POLLNAGOLLUM CAVE, CO. CLARE.

By J. C. COLEMAN and N. J. DUNNINGTON.

(Plates XV–XVII.)

[Read 24 April. Published 5 October, 1944.]

Introduction.

Active-stream caves in the Carboniferous Limestone areas of Ireland have so far received very little attention from the speleologist. The only site fully examined is the Marble Arch cave in Fermanagh (Broderick, 1909) and a number of preliminary reports have appeared of the Pollnagollum cave-system in County Clare, now to be described. Active caverns present more difficulties of exploration than dry stream-deserted caves and for this reason possibly they have not been more fully investigated in Ireland.

The area under consideration in the present paper, that of the Slieve Elva district in north-west County Clare, presents an excellently developed shale-limestone boundary with engulfment of surface drainage into swallets and pot-holes in the limestone. The subterranean drainage runs through long actively-forming caverns and appears in part at resurgences where the underground waters again flow as normal surface drainage. The tracing of such subterranean water gives much useful information as to water-supply from a public health point of view, quite apart from purely hydrogeological considerations (Casteret, 1939, p. 121).

The Pollnagollum cave-system extends along the eastern flank of Slieve Elva above Lisdoonvarna and collects the surface drainage of this side of the mountain into a long master-cave of which Pollnagollum pot-hole is the main point of entry. Some of this underground water appears as a resurgence near Killeany church at the southern end of the dry Killeany valley. From here its course can be traced to the Black Bridge near Lisdoonvarna.

In all nearly 3½ miles of cave were surveyed, but this figure could be increased if the unexplored feeder-stream passages, etc., were included. It is the longest cave so far discovered in Ireland, the well-known Mitchelstown New Cave being in length 1½ miles (Hill, 1909). We may

here remark that the survey of Pollnagollum entailed no fewer than 650 measurements and accompanying compass bearings, as well as numerous cross-sections.[1]

Exploration difficulties are in parts considerable, as might be expected in such an extensive linear cavern. In the Main Cave, equipment has to be taken down over 1¼ miles of passage, wading all the time in water, sometimes thigh deep. No outlet is possible at the farthest point of the cave and a return must be made wading against the stream.

Previous Explorations.

The occurrence of caves along the shale-limestone border of Slieve Elva was known for a long time (Foot, 1863; Westropp, 1870), but no attempt was made to explore them until W. H. S. Westropp and others entered the Pollnagollum Cave in 1880 and left their names in a chamber in the Main Cave (now called the Westropp Chamber). From a note by T. J. Westropp (1900) it appears the party went down as far as the Main Junction and up the Branch Passage. This is the earliest record of a visit to the cave.[2]

In 1912 E. A. Baker and H. Kentish partly examined the Pollnagollum Cave (Baker, 1925) and later Baker returned with E. C. Barton, Dr. F. Oedl and Miss P. Führich in 1925. They explored the Main Cave to the final bedding-cave and also the Branch Passage to the waterfall. They appear to have overlooked the big Upper System above Pollnagollum. Oedl and Miss Führich surveyed the cave from the pot-hole to the Main Junction and also the Branch Passage.[3]

At Easter, 1935, a party of English speleologists made a general examination of the Slieve Elva region (Pick and Bartlett, 1936). The dry section near the final bedding-cave was discovered and the Upper System partly explored. Pollelva pot-hole was descended and a feeder of it northwards to Poll-Lismaurahaun noted. Later visits by the same party in 1936 and 1937 were concentrated on the western side of Slieve Elva, where some big cave-systems were examined (Bartlett, 1937). No surveys were made during any of the three vists to the area.

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[1] The survey was first plotted on a scale of 55 feet to one inch and then reduced to 110 feet to one inch. The entire plan on this latter scale measured nearly 8 feet in length, so this had to be further reduced for reproduction in the present report. Thus in its present form the plan naturally does not show all the many short "limbs" of the passages (some measurements especially in the Upper System being as short as 6–8 feet.)

[2] E. A. Martel makes no mention of the Slieve Elva cave district in his book "Irlande et Cavernes Anglaises" and whilst he discussed other underground water systems in Co. Clare he seems not to have been aware of the Slieve Elva caverns (Martel, 1897, chap. vii).

[3] The extent of the 1925 survey is that part marked C.D.E. on the plan of cave (Pl. XV). We re-surveyed this portion during our 1942 explorations.

Explorations resulting in the present paper.

In 1940, one of the authors (N. J. D.) made a general examination of the Burren district for cave sites and explored the Pollnagollum cave from the pot-hole to some distance beyond the first waterfall. It was not considered advisible to proceed further alone. In 1941 J. C. C. also made a general survey of the Slieve Elva region and later the same year the authors joined forces, accompanied by Mr. D. Dunne, chiefly for photographic purposes. The cave was examined to the Main Junction and up the Branch Passage; also the Upper System to Pollbinn. In 1942 the party returned with Mr. J. Cotter and commenced a survey of the cave from the Upper System southwards. This survey was carried well below the Main Junction. In 1943 a week was spent in the area to complete the Pollnagollum survey to the final point, exploring the Long Gallery, carrying out water-tracing tests, etc.

In the description of the cave it is dealt with starting at the most northerly point and working downstream; not therefore in the chronological order in which the system was explored.

TOPOGRAPHY AND GEOLOGY OF THE SLIEVE ELVA AREA.

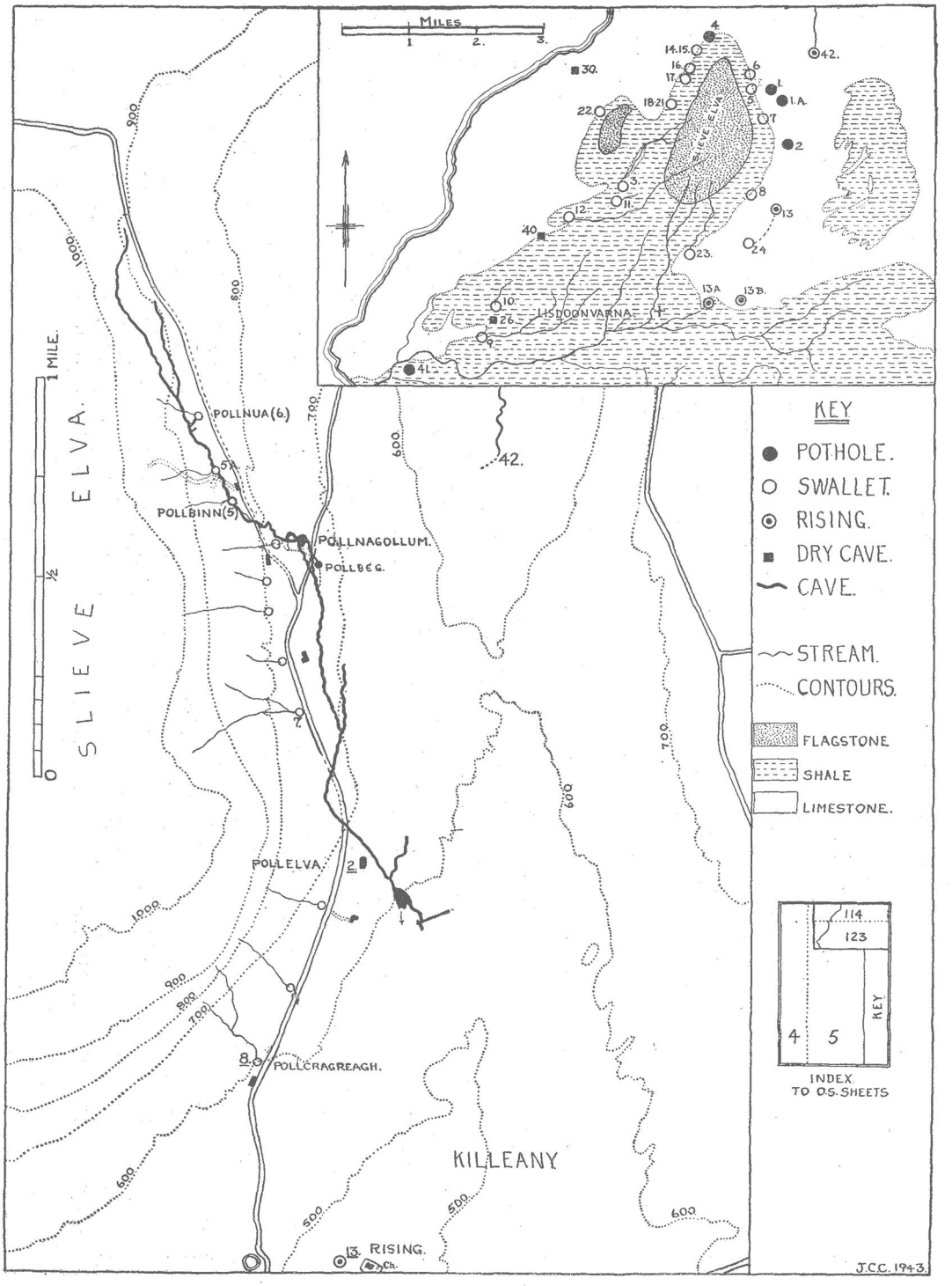
The geological structure of the area (Fig. 1) is very simple. It embraces the Carboniferous rocks from the Upper Limestone to the Flagstone series, all of which are readily recognisable in the field.

The northern portion of the district is a broadly dissected upland of limestone rising to heights of 1,000 feet and over. Surface drainage on the limestone is very rare and only one stream, the Caher River, reaches the sea.

Karrenfeld structure, typical of the Burren district of North Clare, is well developed in this northern portion, especially in the Black Head region. Southwards the limestone dips under a covering of shales and flags of the Coal-Measures. A tongue of this formation caps Knocksmountain (976 ft.) and Slieve Elva (1154 ft.). To the east, near Corkscrew Hill, there is a small drift-covered outlier of shale. The general dip of all beds is to the south and south-west and rarely exceeds 5 degrees. Indeed in the limestone uplands there is horizontal bedding over large areas.

The Coal-Measure uplands, forming Slieve Elva and the lower land to the south, carry a deeply incised consequent drainage system. In many places streams are lengthening their courses by headward erosion and others have cut down their beds through the shales exposing the limestone. In some places (*e.g.*, No. 3, Fig. 1) these exposed inliers have developed swallet phenomena with engulfment of the surface stream.[4]

[4] The swallets pot-holes and caves, etc., of the area have been listed and numbered to prevent confusion. A number were noted and named by the English exploration parties in 1935–7 and others by the authors. In the list given for Fig. 1 those starred enter into the present report.



Based on the Ordnance Survey by permission of the Minister for Finance of Ireland.

LIST OF SITES ON FIG. 1.

Those starred enter into the present report.

*1. Pollnagollum.
*2. Pollelva.
*1a. Pollbeg.
3. Polldonough (Coolagh river swallet).
4. Pollapouka, Ballyelly.
*5. Pollbinn.
*6. Pollnua.
*7. Poll-Lismaurahaun.
*8. Pollcragreagh.
9. Doolin road swallet.
10. St. Catherine's swallet.
11. South Polldonough swallet.
12. Schoolhouse sink.
*13. Killeany rising.
*13a. St. Brendan's Well rising.
*13b. Upper Black Bridge rising.
14–15. Faunarooska swallet.
16. Pollballiny.
17. Begob. pot-hole.
18–21. Polldubh series.
22. Pollnagree, Knocksmountain.
23. Kilmoon river sink (Polltaloon).
*24. Owentoberlea sink.
26. St. Catherine's Cave.
30. Crumlin fort (souterrain).
40. Ballynalacken castle (dry caves).
41. Pollnagollum, Doolin.
42. Rising of Caher river.

The drainage of the east and west sides of Slieve Elva and the west side of Knocksmountain is swallowed by the limestone on leaving the shales. Although points of engulfment are numerous the resurgences are comparatively few and in this respect the area is like the Craven district of Yorkshire (Simpson, 1935).

The contrast between the Coal-Measure country and the limestone country is most marked. The change in soil conditions is shown by increased human activity, evidenced by farms, castles, etc., along this geological line (Foot, 1863). Above Lisdoonvarna the shale escarpment is well seen. It is weathered into rounded bluffs and is deeply incised by gorge-like valleys in marked contrast to the almost level limestone. Glacial retreat phenomena include stepwise moraine forms in some of the broad northern limestone valleys (Charlesworth, 1928). Whilst chemical weathering and sub-aerial erosion have contributed in some measure to the rounded forms of the limestone hills (Kinahan, 1875), one may assume that glacial action also was responsible for the smoothed-off appearance of these hills.

EXPLORATION OF POLLNAGOLLUM CAVE.

Location.

Pollnagollum pot-hole is situated on the eastern slope of Slieve Elva in the townland of Caherbullog, and as it is the principal point of entry into the cave-system 100 feet below, the name is used to describe the entire cavern. The pot-hole is easily reached from Lisdoonvarna by following the Ballyvaughan road for about two miles and then turning left into the road leading over into the Caher valley and Fanore.

From the junction on the main road to Caherbullog, the shale-limestone boundary is followed and examination can be made of the swallets which in most cases lie directly inside the wall on the west side of the road. At Cosgrave's farm in Caherbullog, an old "famine road" follows the boundary further north and near the farmhouse are Pollbinn (5) and Pollnua (6). These sites and others are located on the area plan (Fig. 1).

The Upper System.

Pollnua (6).

This is the most northerly point of entry into the cave. It is an open pot-hole 18 feet deep. A surface stream from the shales enters it at the northern end in a series of cascades. The bottom of the pot is easily reached by a grass slope on the south. The stream runs off from the bottom in a narrow fissure and there is a low passage to the left which in a short distance receives the stream again. From here it is a narrow, low twisting passage. After travelling 163 feet the Upper Junction is

reached.[5] To the right is a large passage with a considerable stream flowing from the north to join the Pollnua water. The passage is wide and from 6–8 feet in height and has numerous windings inherited from a joint-directed course. The water is no more than 1 foot deep and generally only ankle deep. The passage became narrower as it was followed upstream, but did not decrease in height. Beyond a huge flake of fallen rock it is dry-floored for a short distance and then the stream is met again, but it is now considerably less in volume. There are several feeder inlets on the *east* side of the passage and ultimately the gallery is dry-floored and ends in a block of clay and stones.

The Long Gallery (2,395 *feet*).

Returning to the dry passage where the decrease in water flow was noticed a further passage was discovered on the right (west). This is hidden from view when moving upstream, but is at once seen on the return journey. In 1942 this inlet passage (now called the Long Gallery) was followed for a third of a mile. In 1943 we surveyed it for a distance of 2,395 feet, its farthest point being the most northerly point in the cave-system. This gallery is throughout on an average 6–8 feet in height and the width varies from 12–20 inches. Most parts are so narrow that one must proceed sideways with a crab-like motion. The stream on the floor is shallow with some small chert-ledge falls in parts.

Upper Junction to Pollbinn.

Emerging from the Long Gallery and continuing downstream to the Upper Junction the passage to Pollbinn can next be traversed. A few feet below the junction there is a low wide bedding-cave on the left. It extends for 100 feet and becomes too low for further exploration. It appears to be an old deserted watercourse, and it runs under some choked swallets, south of Pollnua. Further downstream the main passage becomes a wide channel with the stream flowing in a narrow trench in the rock-floor, which gradually gives place to a series of rapids, leaving a shelf on either side. It then plunges over a lip of chert as a seven-foot waterfall into a narrow canyon-like passage. The shelf, studded with knobs of chert, continues at the level of the waterfall lip above the "gorge." Near the waterfall there is a fine stalagmite formation (see Dripstone deposits, p. 124). Below the Tufa Fall the passage winds a great deal and the water is deeper. Soon an aven is reached with water cascading from the roof.[6] This presumably is the inlet marked 5*a* (Fig. 1).

[5] We had to devise names for almost all parts of the cave-system, for with the exception of Pollnagollum pot-hole it was without descriptive titles to its various parts.

[6] The term "aven" has been applied throughout to high almost circular cavities rising above the floor level, down which a stream cascades or has previously done so. They are akin to those forms called domes. Collapse of an aven roof gives rise to open pot-holes.

In addition to the aven cascade there are several small inlets along the east side of the passage below Tufa Fall, but all are too small to enter. Beyond the aven the passage enlarges again and the water becomes thigh deep. After a few yards of deep water, daylight is seen ahead and turning around a flake of rock the bottom of Pollbinn is reached.

Pollbinn (5).

This is an eighteen-foot pot-hole which engulfs a surface stream at its west side. There is a further hole in the roof immediately over the centre of the pot, but for a descent the waterfall pitch must be used. There is an insecure-looking but nevertheless safe belay for a ladder on the right-hand side above the fall. In exploring the Upper System it is advisible to hang a ladder here, for in exploring from Pollnua to Pollbinn, the open air can be regained at the latter point without wading upstream again.

Pollbinn to Pollnagollum (1,385 *feet*).

From the bottom of Pollbinn the cave stream now carries the waters from five streams and a number of smaller inlets.[7] The combined waters enter a wide high passage, but the roof soon descends until it is necessary to stoop. The stream now runs in a deep gully and a washed-out shale bed forms a wide lateral extension near the roof. At 265 feet from Pollbinn there is a dry upper passage a "fossil stream fragment" called the Roof Traverse. It curved around at a higher level and met the main present stream passage lower down and 20 feet above present stream level. Returning to the commencement of the Roof Traverse the stream passage was further explored. Shortly several water-slides were encountered and one waterfall 6 feet in height. The passage form was now a narrow and high rift varying from 20–30 feet in height. The shale bed mentioned as near roof-level at the commencement of the passage was now 10 feet above water-level. The water is only ankle-deep in this section of the cave. We found a small chamber a few feet above stream-level, but no passages led off from here. Beyond the chamber a large flake of rock comes down to within a few inches of the stream, but this obstacle is easily circumvented.

At a point 1,100 feet from the bottom of Pollbinn, the stream slides quietly away to the *right* into an impenetrable bedding-cave at floor level. Beyond the vanishing point the gallery continues as a narrow twisting passage with a flooring of heavy gravel and cobbles. At the end is a low bedding-cave, and on the left before entering same a large chamber can be explored. Here we found some big tufaceous cave pearls

[7] The streams are those flowing from Long Gallery, the Upper Junction passage, Pollnua, aven cascade 5*a* and the surface stream engulfed by Pollbinn.

amongst the floor debris of the chamber. The bedding-cave next to be traversed is on an average 14 inches in height. Its floor is composed of knobs and slabs of chert and it is a most painful place to crawl over. Fortunately it is only for a distance of 20 feet and the edge of a dry waterfall, 8 feet high, is reached and a descent can be made into a larger and more comfortable gallery. The sound of running water can be heard in some distant part of the bedding-cave just traversed and it would appear that the course down the dry waterfall only carries the surplus waters of flood conditions.

From the dry water fall pitch (B on fig. 2) the passage carries no running water and except for occasional pools, is rock-floored. The floor of the passage now drops steeply in a series of slides and in form becomes a high and narrow rift. *En route* an opening on the left proved to be the upper entrance to Baker's Rift to be later described. Soon daylight is seen and descending steeply a shelf is reached overlooking the Main Shaft in Pollnagollum pot-hole.

Baker's Rift (268 *feet*).

To regain the open air from the shelf at the end of the Pollbinn passage a climb must be made upwards to the right between some big rock flakes and then up slippery grass to the western lip of Pollnagollum pot. If a rope be fixed above this slope previously, the ascent can be made with greater ease. Baker in his account of Pollnagollum (Baker, 1932, p. 179) stated that access could be gained to a deep rift in the hillside behind the Main Shaft. We found this hole and descended into the rift by a 20-foot ladder. Below was a shelf a few feet higher than the terminal shelf of the Pollbinn passage. A trickle of water ran along the floor of the rift and there were pools with flowstone inclines separating them. These certainly were not deep enough to require ladders or swimming to negotiate them (Baker, p. 180). Floor and walls were thickly plastered with soft uncrystallised stalagmite. Exploring upwards the rift became a low tunnel with water trickling over and through a perforated chert floor. Further progress was a flat-out crawl in mud and soft stalagmite and then the tunnel, enlarging slightly, brought us out near the dry waterfall in the Pollbinn passage as previously noted. Baker did not explore this rift, but we have named it after him as he first noted its existence.

Notes on the Upper System.

The total surveyed length of the Upper System is 7,349 feet. It was thought that the water which disappears through the low bedding-cave in the Pollbinn section was probably the water which fed the First Waterfall in the lower or Main Cave below Pollnagollum. This was found to be the case by tests carried out in 1943. Details of these will be given in the description of the Main Cave.

The Main Cave.

Pollnagollum (1).

This, the name-giving pot-hole of the cave-system, was generally considered the beginning of the cave in the absence of knowledge of the extensive Upper System we have already described. The pot-hole is a roughly circular funnel-shaped hollow some 120 feet in diameter and approximately 100 feet deep. The upper edges are steep grassy slopes giving place to vertical rock walls on the north and east sides. The west and north-west corner are cut by the rift at the end of the Pollbinn passage and by Baker's Rift. Immediately below these is a cylindrical rock-cut hole, 20 feet deep which we call the Main Shaft, into which the trickle of water from Baker's Rift falls. The southern side of the pot-hole has a steep 20-foot grass slope at the top giving place to an almost vertical 18-foot rock wall and below this is a 40-degree slope of vegetation and grass-covered boulders and slippery clay. This runs down to the lip of the Main Shaft and in the north-east corner flattens out into a small platform, slightly overhung by the rock-walls above. On the east side of the platform at the base of the wall is a small opening giving access to Gunman's Cave (so named from the finding of trouble "relics" in the passage (Baker, 1932, p. 196)). Seven chert beds averaging three inches in thickness are interbedded with the limestone on the north and east rock-walls of the pot-hole.[8]

Pollnagollum to First Waterfall.

Both Gunman's Cave and the Main Shaft lead down to the Main Cave below and the use of the former point of entry obviates the necessity for fixing a rope ladder in the Main Shaft descent. From the low entrance to Gunman's Cave a boulder-filled chamber is entered which soon becomes a very high and narrow rift-gallery. A small inlet near the entrance (which we followed for 48 feet until it became too tight), sends a trickle of water down the rift passage. The floor is covered with soft flowstone which along with fallen boulders has dammed the water in several places into pools. The passage winds considerably, with parallel water-eroded walls rising up in a great underground canyon 50–60 feet in height. At 445 feet from the entrance, the trickle of water falls over a stalagmited edge into a passage some 10 feet below.[9] To the right of the point of

[8] The descent into Pollnagollum is best made at the southern side, a fixed rope belayed to a block in the wall being all that is necessary to reach the boulder and clay slope below. However, a rope ladder on the eighteen-foot wall is helpful, especially if much equipment has to be carried up and down to the Main Cave.

[9] There is a good belay for a rope or ladder to the right at this point. The descent into the lower passage could easily be accomplished on a rope, but a rope ladder is much more convenient, especially if a number of visits are being paid to the Main Cave, as was the case during our explorations.

descent a narrow winding passage leads out to the bottom of the Main Shaft. It has deep pools in places and is floored with heavy gravel and water-worn limestone slabs. The level of the high rift of Gunman's Cave continues downstream winding and crossing over the smaller lower passage, which, although at this point it carries no appreciable flow of water (except the trickle from Gunman's Cave) we will refer to as the stream passage. It is narrow and tortuous and the water is extremely cold (49 degrees F.). Proceeding downstream the boom of a waterfall is heard, but though it appears to be "around the next corner" the passage has to be traversed for a considerable distance before the waterfall is reached.

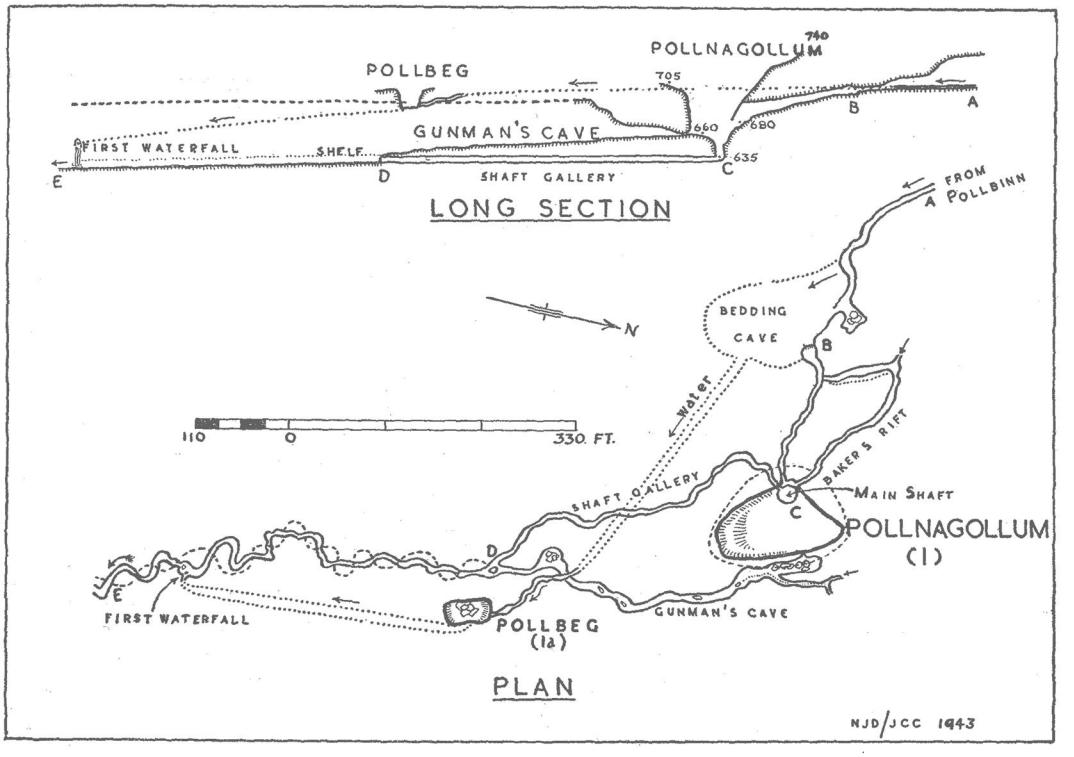


FIG. 2.

This, the First Waterfall, cascades down some 25 feet from a narrow fissure on the east side of the passage which here has widened out into an aven. The fall of water is not considerable, but in the confined space the noise is deafening. In 1942 we thought that this fall was fed by the water which disappeared in the bedding-cave in the Pollbinn section of the Upper System. In 1943, after some heavy rain, one pound of methyl violet was introduced into the stream at Pollbinn (5). One of us had previously stationed himself at the foot of the First Waterfall and after a lapse of 40 minutes from the introduction of the dye, the First Waterfall

cascaded down a beautiful violet colour, thus proving the connection of the fall with the Pollbinn water.[10]

Pollbeg (1*a*).

One further link was provided by the dye test, in that when Pollbeg pot-hole was examined, traces of purple violet froth were found upon the stones at the bottom of the pot. This proved that the Pollbinn water flows through here on its way to the First Waterfall. Pollbeg is a small dry pot-hole to the south of Pollnagollum (Fig. 2). It is a narrow rectangular hole 18 feet deep with a mass of collapsed rock at the bottom. There is a small stream-passage entering the pot at the base of the north side. This upstream passage was explored for 100 feet. It was a narrow low gallery with a swift flow of water. It ended in an impenetrable bedding-cave above a 4-foot-high waterfall. The bedding-cave was observed to be chert-floored. From the bottom of Pollbeg this stream loses itself down through the collapsed rock-mass and could not be followed. It will be seen from the plotted course of the upstream passage (Fig. 2) that it crosses over the high rift of Gunman's Cave and beyond this the assumed course is indicated by dotted lines. The downstream course, impossible to explore from Pollbeg, is similarly indicated.

It must be noted that on several occasions we have visited Pollbeg and saw no water flowing along the bottom, even though an appreciable flow of water was falling at the First Waterfall. It would appear therefore that some other feeder from a swallet joins the Pollbinn water before it plunges as the First Waterfall. Exploration of this high-level passage will no doubt throw some light on this point.[11]

First Waterfall to Main Junction.

Beyond the First Waterfall we may say we are in the Main Stream cave. The walls of the passage close to the waterfall are fluted and scored by an earlier position of the falling water and an immense fluted block with razor-sharp edges lies at the commencement of the stream-passage. The passage is a narrow winding "canyon" with the stream flowing swiftly on the floor. There is a shelf some 10 feet above, and over it winds the high Upper Rift which appears to start from Gunman's Cave (typical cross-sections C, E, F (C–D), Plate XV). Proceeding

[10] In addition to the dye a considerable number of used matches were put into the Pollbinn water (as a flotation test). Even after a lapse of three days (a dam being provided in the passage below the fall) *no matches* were observed. It would appear that the Pollbinn water (which of course includes the waters of the Pollnua section) when it spreads out in the low bedding-cave must meet some obstruction which prevents the flotation test succeeding. In any case the dye test was conclusive.

[11] With proper equipment it should be possible to ascend the First Waterfall and examine this upper passage running to Pollbeg. During our visits with the limited personnel at our disposal we were unable to carry out this project.

downstream the shelf gradually lowers and the stream-passage loses its narrow canyon form and becomes wider with extensive meander curves and slip-off slopes cutting and undercutting the rock below the shelf. Soon a relatively large chamber is reached. On the left is a huge mass of fallen limestone upon which are chalked the names of some former visitors. As the earliest were those of the Westropp party of 1880 we named the place the Westropp Chamber.[12] The distance from the entrance to this point is 1,600 feet. Beyond the chamber the passage is rather wider, the high upper rift usually winding in directions opposite to the present stream-course. The water is held up in several places by gravel and mud banks forming deep pools, sometimes thigh-deep, but these can usually be avoided by scrambling up on rock-shelves left by former meanders of the stream. From here to the Main Junction the description is similar, the only point to note being that the shelf below the upper rift gradually approaches nearer to water-level until at the junction it is no more than 2 feet above the water. (At Gunman's Cave the shelf was 10 feet above the floor of the stream-passage.)

In the section of the Main Cave below the Westropp Chamber, two beautiful dripstone formations are observed in cavities on the east side of the passage. One is a "petrified waterfall" running down the wall and enveloping a horizontal rock-ledge in a fine stalagmite cascade (Pl. XVI, 3). The other is a complex stalactite group overhanging a stalagmite boss. From the Westropp Chamber to the Main Junction several rock-falls are encountered in the stream-course, but nowhere do they present any difficulties in passing them. Near the Main Junction the water slides quietly over gravel through a low wide arch. Crawling through on all fours an expanded pool is reached with a tributary stream joining it accordantly on the left. This is the Main Junction and the tributary water flows from the Branch Passage.

The Branch Passage.

The volume of water running from this passage is much less in volume than that of the Main Cave stream and therefore we think the name of Branch Passage is justifiable, even though in form its rift and great height is on a grander scale than that of the main cave. It is a huge vertical walled "canyon" 60–70 feet at least in height throughout its entire course and in comparison to the main cave above the Main Junction, in the Branch Passage there is very little lateral erosion at stream-level. It is rock-floored in most places and near the junction the water flows in a gully 8 inches wide.

[12] The earliest inscription reads "W. R. Joyce, W. S. Westropp, J. H. Christy, 7/10/80." Lower down is chalked "John Christy, age 12, October 8th, 1880." H. E. Kentish and E. A. Baker have recorded their 1912 visit (Baker, 1925) and there is a record of a party of four in August, 1936.

There are several avens along the course of the winding passage. In one a trickle of water falls from a narrow vertical fissure on the eastern side. At several points the passage is blocked with big limestone rock flakes. In most cases these obstacles must be passed by crawling underneath on all fours in the shallow water. The noise of the falling water is soon heard and then, beyond a final aven, the passage becomes narrow (approximately 18 inches at shoulder height) and winds to the right and brings one to the foot of a strong waterfall. The water issues from a narrow ascending fissure about 15 feet up the east wall and, as in the case of the First Waterfall, the confined space magnifies the sound of the water to an intensity which makes it necessary to shout in order to make oneself heard.

The survey was carried to this point in 1942. In 1943 an attempt was made to ascend this Branch Waterfall by means of a ladder (of screwed piping and T-joints). Unfortunately this collapsed when one of us (N.J.D.) was half-way up and precipitated him into the plunge pool at the foot of the fall. Here again additional equipment and personnel will be necessary (as in the case of the First Waterfall) before the probable upper supply passage can be explored.

We had not gone beyond the waterfall in our visits of 1941/42, but in 1943 progress was made for a further 242 feet. From the fall pool the passage (still an immense vertical rift) ascends slightly and is stalagmite-floored. Then follows a climb up a block of boulders covered in mud and soft stalagmite. The far side is a vertical drop of 20 feet to be descended by a rope ladder. Below, the floor of the passage is covered with deep, sticky mud over which is still water in which the explorer is immersed waist-deep. To attempt to lift one foot causes the other to sink deeper down in the mire. After 200 feet of this hard going we were obliged to give up at another block in the passage. There is no doubt further progress could be made, but a larger party is essential, equipped with life-lines, etc.

There is one important point to be discussed in connection with the Branch Passage. Baker has stated that from the foot of the waterfall in this passage daylight could be seen streaming down the shaft and this point marked the bottom of Pollelva, another big pot-hole in the area (Baker, 1932, p. 194). Reference to our plans will show that this is impossible, Pollelva being a long way to the south. Also we could see *no* daylight from the foot of the fall, a fact substantiated by other explorers (Pick and Bartlett, 1936), and the daylight seen by Baker must therefore have been an error. Having reduced the survey of Dr. Oedl (given by Baker, 1925 and 1932) to the six-inch scale and plotted it on the O.S. sheets of the area, we found it closely corresponded with our survey and therefore that the Branch Passage waterfall could not possibly lie under Pollelva.

Main Junction to Main Bedding Cave.

During the 1942 expedition the survey had been carried for some distance beyond the Main Junction, but had to be abandoned for several reasons. On the 1943 visit we took more precautions and established a supply depôt (food, spare clothes, etc.) at the Main Junction. There is a small chamber here to the right of the junction pool, which we called the Waiting Room.

Below the Main Junction the cave is wide with the characteristic high upper rift. The stream is not deep and meanders in a broadened lower portion of the passage (see sections A, B, etc., D–G, Plate XV). The visibility in this portion of the cave was very bad, due in part to the mist created by our warm bodies. Near the Main Junction it would appear, however, that the difference in temperature between the main stream and the Branch Passage water causes a slight mist (see Appendix II). Following the stream-passage southwards, several obstacles are encountered in the shape of piles of fallen rock flakes and blocks of limestone. At "Coleman's Bath" (where we had given up in 1942) the stream passes to the left, with a deep pool under the fallen material and southwards from here there are several more deep pools apparently caused by the diversion and consequent scouring of the stream after falls of rock. The Upper Rift now decreases in height until it is no more than 25 feet high. Continuing, the passage becomes almost square in cross-section and the stream flows under massive blocks fallen from the roof. Some of these roof-falls are 50 feet in length and the upper surface of many of the blocks shows a profusion of fossils (crinoids and *Productus*). Beyond the fossil-bearing blocks the stream-passage widens out into a knee-deep pool with a broad flat roof no more than 5 feet above water level. The distance from the Main Junction to here is 2,533 feet. On the left is an inlet passage called Cotter's Gallery.

Cotter's Gallery (674 *feet*).

This passage enters the main cave as a fairly broad gallery with a goured floor over which flows a slight trickle of water. Where dripstone is absent the floor is of sticky mud. Proceeding up Cotter's Gallery at a corner with a pretty stalagmite cascade, entrance was effected to a small chamber (behind the cascade) containing two dripstone-coated avens each about 20 feet high. In spite of the dripstone the vertical scouring of previous water-action can be observed on the aven walls. From the cascade the gallery continues with a roughly rectangular cross-section, the floor becomes drier and there is a quantity of broken rock, sometimes almost filling the passage. Near the final point a streamlet is observed under the broken rock-floor. The final point was reached by climbing through a mass of boulders into a terminal chamber. There is an impenetrable terraced inlet at the far end.

The Main Bedding Cave.

Returning to the pool in the main stream-passage the final section of the Pollnagollum cave can now be explored. Downstream, the roof becomes progressively lower and the passage widens out considerably (Sections S, T, D–G, Plate XV). At 119 feet from Cotter's Gallery we were crawling on all fours in the water. The stream spreads over a gravel and cobble bed and is not deep. After a further 100 feet, the roof and floor being no more than 14 inches apart, further progress is impossible. The water appears to flow away to the right, in a very wide bedding-cave, and so far no one has succeeded in following its course beyond this point (Baker, 1932, p. 192, and Pick and Bartlett, 1936).

Dry Section.

To the left of the final bedding-cave the stream has deposited extensive gravel banks and crawling over these an old stream-channel can be followed which gradually give place to a passage. This passage is only a sort of channel between shattered limestone blocks of an extensive bedding-cave and numerous short fissures run between the broken material. The rocks and side fissures are plastered in silt and the channel passage is floored with coarse gravel. At a point where the East Tunnel comes in on the left the roof of the passage shows a remarkable rock-formation. In appearance it is similar to surface "clints" of the limestone, but is deeper and smaller in form. The roof has prow-shaped and bulbous pendents of rock, generally 6–8 inches in length and all closely packed together. In parts the ledges of the side walls are vertically scoured with a similar form. This is the only place they occurred in the Pollnagollum Cave.[13] Beyond the pendent chamber progress can be made for a short distance: a turn to the right and then to the left and the final point is reached. Here a mass of fallen blocks fills the passage. There are small bored tunnels at lower levels, but it is doubtful if these would lead any distance.

The East Tunnel (477 feet).

Returning from this final point we next inspected the East Tunnel. It runs in a straight line E.N.E. for the whole distance of 477 feet and ends in a collapsed bedding-cave. The cross-section is that of an arch with the highest point from 3–4 feet above floor-level. A thick calcite vein is traceable along the apex. It has all the appearance of a "bored" tunnel formed by water under pressure. No stream now uses the tunnel

[13] They are like those pendent rock forms seen in Ferguson's Cave, Indiana, U.S.A. (illustrated by Davis, 1930, Plate 7). Unfortunately we had not a camera with us at this stage of the 1943 exploration to record these features. We have not seen them so far in any other Irish caves. They are totally different from concave interconnected pockets of current action.

and the floor is of soft mud and occasional tufaceous gours holding pools of water fed by drip from the roof. Along the south side of the gallery are several stalagmite columns formed on a raised portion of the mud floor.

In concluding this description we may state that exploration difficulties in this lower section of the Pollnagollum cave are considerable. The return journey to Pollnagollum pot (the only exit) is an upstream trip of 1¼ miles. In our 1943 explorations we spent nine continuous hours underground to this point, much of the time of course being taken up with the tedious work of surveying. It must be remembered that a sudden change in weather conditions, which would cause a rise in level of the stream, might easily cut off one's exit from the Dry Section, as the entry from the main bedding-cave of the stream is no more than 14 inches in height.[14]

Other Pot-holes, etc., in the Area.

So far we have described the cave-system from its main northerly point southwards until it is no longer explorable. In addition to Pollnagollum, Pollbinn, Pollnua, etc., there are a number of smaller swallets along the shale-limestone boundary which are too small to permit exploration, but of which in general it can be said that the underground water from them takes an east or south-east direction. Presumably these do join the master cave of Pollnagollum somewhere along its course.

Pollelva (2).

This is another large dry pot-hole like Pollnagollum situated to the south of the latter and as will be seen from Fig. 1 very close to the lower Main Cave system. It is rectangular in plan and approximately 100 feet in depth and necessitates an 80-foot direct descent by ladder on the south side to gain the bottom. With our limited personnel during our visits to the area we were unable to descend Pollelva and the following notes on the pot are those of a previous party (Pick and Bartlett, 1936, p. 67):— There is a big accumulation of fallen blocks at the bottom and a stream falling into the pot (from a fissure in the north-west corner) can be followed from the bottom for a short distance eastward. The block of boulders in which the eastward stream loses itself demands further exploration. The fissure in the north-west corner of the pot-hole from which the water issues was explored upstream to a swallet called Poll-Lismaurahaun (Bartlett, 1937). In 1943 we endeavoured to force a

[14] Our supply depôt in the Waiting Room at the Main Junction came in very useful during the survey of the lower reaches of the cave. Here we were able to rest and have a hot meal (primus stoves being provided) before proceeding up the Main Cave to the exit. Travelling light and with previous knowledge of this passage a return can be made to the surface in just over half-an-hour.

way into this swallet (No. 7, fig. 1), but it was a mass of collapsed rock where the combined waters of two streams sink into the limestone.[15]

Pollcragreagh (8).

This is an 18-foot pot-hole into which a stream from the shales plunges underground. Unlike many other boundary swallets this pot is open and it is possible to climb down to the bottom. Unfortunately in a very short distance the stream runs into a low horizontal fissure under a mass of collapsed clay and stones.

RESURGENCE OF THE POLLNAGOLLUM CAVE WATERS.

From an examination of the area map (Fig. 1) with the cave system plotted in, it will be seen that the most southerly point in the cave is situated approximately ¾ mile north of the rising at Killeany (No. 13) at the southern end of the valley. The rising is a wide impenetrable bedding-cave and in dry periods no water issues from the opening, but more generally a slight stream issues which is increased to a torrent in prolonged periods of rain. The Killeany rising is 450 feet above sea-level and the explored end of the Pollnagollum cave system (where the waters run off in the bedding-cave) is approximately 500 feet, and whilst a chemical test would verify the fact there appears to be no doubt that the Killeany rising represents the point where the underground waters rise to the surface under flood conditions. From the rising the stream is known as the Owentoberlea and after a course of ¾ mile it sinks again through a mass of boulders (No. 24, Fig. 1). From the swallet no. 24 there are indications of a former surface stream course as one traverses the limestone south-westwards to the Black Bridge one mile east of Lisdoonvarna. At 13b (Fig. 1) there is a rising which functions only in flood conditions. From it a channel normally dry and floored with limestone, runs through a gorge cut in the shales. Immediately above the Black Bridge is a permanent rising of water, St. Brendan's Well (13a), where the water bubbles up through gravel in the stream-bed.

In the absence of an extensive chemical tracing-test the foregoing suggestion regarding the ultimate disposal of the Pollnagollum cave-water (representing the collection of the eastern drainage of Slieve Elva) is an assumption based chiefly on surface indications. It is not suggested that all the cave-water ultimately comes to the surface at St. Brendan's Well, or when the water-table rises, at Killeany resurgence. Much must be lost as ground-water in the well-jointed limestone.

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[15] As a result of our survey it would appear most probable that the stream flowing east from the bottom of Pollelva, joins the Pollnagollum cave-water (see location of Pollelva, Plate XV). The bottom of Pollelva is approximately 550 feet above O.S. datum and an aneroid reading of the commencement of the main bedding-cave gave an elevation of 500 feet.

Note.

This note regarding the change in the level of the water-table after heavy rain in the Slieve Elva district may be some indication that the route traced for the Pollnagollum waters is correct. The record was made one day during the last week in July, 1942.

1. In the morning (slight rain) a visit to 13a showed a normal rise of water at St. Brendan's Well with the river-bed dry up to 13b. At Killeany rising a small flow of water came from the resurgence, which vanished in a short distance amongst boulders in the bed of the Owentoberlea (before reaching the swallet at its end no. 24).

2. After 12 hours continuous rain the river-bed above 13a was still dry, but small "gushers" were appearing through joints in the limestone pavement of the bed, showing that water was piling up in the joint network beneath the actual river-bed. Time 7.15 p.m.

3. One hour later the river was a raging torrent from 13b, filling the entire previously dry river-course, and obliterating the normal resurgence of St. Brendan's Well (13a). From Killeany rising (13) to swallet (24) the Owentoberlea was also a swiftly flowing, deep and very wide torrent.

4. Next morning (11 a.m.) conditions were normal again, with a string of pools down the Owentoberlea and the river-bed above 13a again dry.

Notes on the Cave.

Rock-falls.

When one considers the vast extent of the Pollnagollum Cave, the rock-falls encountered are comparatively rare and in most cases do not offer any great obstacles to exploration. They can in general be divided into main divisions:—1. Roof falls. 2. Flake or wall falls.

1. Large roughly rectangular limestone blocks fallen from the passage roofs occur at many points. In contrast to the wall falls, they generally lie horizontally on the passage floors. Below the Main Junction they occur as masses of rock often 50 feet or more in length, showing an upper surface fracture along the bedding, studded with a profusion of fossils. Some large roof falls also occur in the Pollnua section of the Upper System. From their position as flat horizontal masses they are easily passed over.

2. Flake or wall falls are well shown by examples in the Branch Passage and Main Stream passage below the Main Junction. Generally they consist of large, thin rock-fragments or plates, standing almost vertically in the passage section. From their position it is usually impossible to climb over them and a route must be found underneath. Some show marks of previous water erosion on one side and a fractured surface on the other and they appear then to have spalled off the passage walls, the eroded surface representing the old wall-face before the fall.

Flake falls seem to be caused in a great measure by solution along a subsidiary joint more or less parallel to the opened stream-passage, especially when this minor joint runs across a curve in the wall above present stream-level. Near the Westropp Chamber minor joints filled with calcite were seen running-parallel to the stream-course and cutting across rock-curves of old meanders. The calcite in some of these joints was being removed in solution by wall water, thus loosening the rock-flake.

Chert Beds and Stream Erosion.

The type of passage developed along a bedding-plane in the limestone is usually very wide and low in cross-section. It is sometimes caused by the washing-out of shale beds in the rock, but in the Pollnagollum area no shale beds of any great thickness were observed and where they occurred did not appear to have been much eroded when the stream was working in their horizon.[16]

On the other hand it is seen that many bedding-caves (where the floor is free from loose material) are floored with knobs and slabs of chert. It appears that these hard and less easily corraded layers, while checking vertical, give rise to lateral erosion, thus forming bedding-caves. A fine example is that above the dry waterfall at the end of the Pollbinn section of the Upper System.

Whilst a number of waterfalls in the cave are the result of "hanging tributary valleys" (*e.g.*, First and Branch Waterfalls) many smaller ones occur where a chert bed forms the floor of the stream-passage. The examples to be described are only seen in the less mature Upper System.

At Tufa Waterfall in the Pollnua Section the stream plunges over a chert lip into a narrow gorge-like passage below the fall. Chert knobs and slabs are seen on the rock-shelf on each side of the gorge at the level of the waterfall lip, showing a plunge-pool retreat of the fall upstream. The chert-studded rock-shelf on each side of the gorge-passage represents the old passage-floor of lateral erosion before the fall stage (Section 1, A–C, Plate XV). Sometimes old chert floors are left as bridges across and above present water-level (Pl. XVII, 1) and in other places they are indicated by knobs and projections along the passage walls. Perforated chert and small falls also occur in the Long Gallery. It may here be remarked that these remnants of chert in the form of knobs and "jug handles" along the passage walls often offer inviting hand- or foot-holds in crossing pools, etc., but generally they break off at the slightest touch and are best avoided.

[16] Many Yorkshire caves, *e.g.*, Lost John's, show shale beds 7 feet in thickness (Simpson, 1935, p. 230), with bedding-cave passages developed in their horizon. In Pollnagollum, shale beds, where seen, were no more than a few inches in thickness.

Dripstone.

Under this heading it is proposed to discuss briefly the features of stalactites, stalagmites and other chemical deposits in the cave. In spite of the large size of the cavern, dripstone is not abundant, but this is in a great measure due to the fact that the major portion of the cavern is still in a cycle of active erosion and fuller deposition of chemical forms would occur at a later stage in the history of the cave (Davis, 1930, p. 475).

In an active cave, in contrast to a stream-deserted cavern, the moisture-content of the ground air retards to some extent dripstone deposition. Also in an active cavern area most of the surface water is led underground as vadose streams through pipes and swallets and therefore very little finds its way to the opened galleries by solutional percolation which gives rise to depositional replenishment.

Almost all the dripstone forms seen in the Pollnagollum cave are saturated, owing to low evaporation conditions and the characteristic dry crystallised form of stalactites and stalagmites is rare. Wall dripstone forms are most numerous in the cave of the "petrified waterfall" type (Pl. XVI, 3). Many of these types occur in stream-deserted avens as in Cotter's Gallery and parts of the Branch Passage. Much of the wall-deposit is soft and clay-like ("mondmilch") in texture as for example in Baker's Rift. Stalagmite on passage floors where it occurs is usually soft and in most cases is a flowstone deposited by trickling inlets of water (Baker's Rift, Gunman's Cave, Cotter's Gallery) and holding small pools in terraced gours. A remarkable stalagmite buttress occurs in the Pollnua section, on the right above the Upper Junction. Here a bulbous mass of stalagmite attached to the wall has been almost cut in two by a renewal of water activity from an inlet pipe behind the mass. Near the entrance to the Long Gallery in the same passage, beautiful clusters of calcite crystals thickly encrust small rock-hollows in ledges above the passage floor. At Tufa Fall is a stalactite-stalagmite column which had wrapped around it a mass of vegetable matter, brought in by flood-water. The continued drip has replaced the original organic structure of the grass and matter with an exact replica in calcite of a tufaceous character.

Fringes of small stalactites are seen along many parts of the cave, especially in the Main Cave below Pollnagollum. They usually occur where the wall drip seeps over the ledges and lips of rock left by the undercutting of the stream at higher levels.

Effects of stream action.

Throughout all parts of the cave, the walls (except where obscured by dripstone, or showing fresh fractured surfaces) are sharply cut with a strongly developed pattern of concave inter-connected hollows (Pl. XVII, 3).

A preliminary study of these forms has been made with a view to a more detailed report at a later date and it is not proposed to discuss the matter fully in this paper. In brief, this patterning of the wall, also occurs under present stream-level and appears to be directional in respect of the water-flow. Similiar wall forms are seen in many caves of activity and in stream-deserted caverns (*e.g.*, Ovens Cave, Co. Cork, Coleman, 1940).

DEVELOPMENT OF THE CAVE.

The Pollnagollum cave is interesting for the manner in which it demonstrates its previous history and that of the eastern Slieve Elva drainage area. The deductions arrived at may demand revision in the light of further cave research in the North Clare region, but in any event the Pollnagollum cave and its tributaries are of sufficient extent to make this attempt at its geomorphological history a reasonable one.

The general course of the consequent drainage on the non-limestone upland region is south and south-west, which is also the case with the explorable course of the underground drainage system. The drainage-system developed on a Coal Measure covering and cut down to the Upper Limestone and then with the tendency of all water flowing over well-jointed limestone, finally sank down into subterranean channels.[17]

One must agree with Davis (1930) that ground-water in dense limestones prepares a joint network of solutional channels. This network later engulfs surface drainage and erosional development of a cave-pattern begins. It is evident that no drainage can be induced underground into normal jointed rocks, unless some previously prepared cavernous structure has been initiated. Apart from the preparation of this network by ground-water solution, tectonic movements, resulting in the opening-out of joints and fissures might provide such underground channels. But in the area under review no evidence of faulting, etc., is forthcoming (Foot, 1863; Westropp, 1870) as is the case in the Craven district of Yorkshire where faulting is responsible for many of the pot-holes and underground drainage systems (Simpson, 1935).[18]

In the first cycle of the North Clare area there must have been a covering of the Coal-Measures over the entire limestone and this upland carried a consequent drainage system (Fig. 3A). The removal of this covering was brought about by the cutting-down of streams to the

[17] An earlier stage in this development can be seen at the present time within the area in the case of the Coolagh river (No. 3, Fig. 1). Here an incised stream on the shales has deepened its bed to expose an inlier of limestone and the stream is engulfed at the S.W. end of this inlier at Pooldonough swallet. *Above the swallet, the river* occasionally uses other swallow-holes in its bed, showing that a system of sub-river channels exists and is in course of enlargement beneath the present river-course.

[18] The existence of deep-seated cavernous structures beneath surface rivers has been proved by borings and excavations in the Tennessee Valley, U.S.A. (Moneymaker, 1941, p. 74).

limestone, exposing it as inliers in an early stage. Subsequent erosion and weathering has now removed nearly all the Coal-Measure cap from the elevated limestone region.

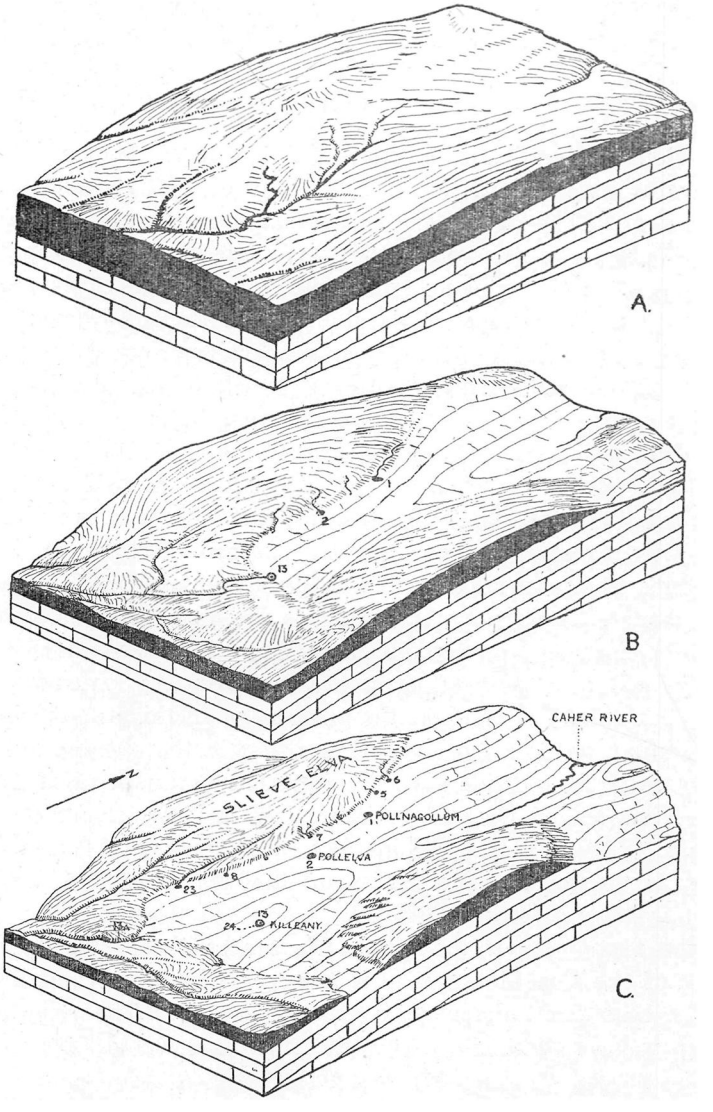

FIG. 3.

A large stream must have initiated the Killeany valley on the east side of Slieve Elva (now carrying only underground drainage) and it is suggested that sub-river solution at the inlier stage finally engulfed the Killeany stream and active erosion of a cave pattern commenced. The now dry pot-holes of Pollnagollum, Pollelva, Pollbeg (and possibly

others now obscured) represent a former position of the Slieve Elva Coal-Measure escarpment. Segmentation of the surface-drainage of the valley occurred at these points (Fig. 3B). Recession of the shale escarpment westward and exposure of the underlying limestone by the feeder streams would tend to form new swallets further back and the stream beds between the old and newer swallets became blind as the streams worked underground. To this movement we could attribute the desertion of Pollnagollum and other dry pots and the initiation of the underground tributaries of the Upper System, etc. The tributaries are young in contrast to the more mature main cave of Pollnagollum. Waterfalls occur in the stream courses and there is a general freedom from meanders and lateral erosion which seems to suggest they were formed at a later stage than the main cave. That part of the drainage system from Killeany rising to the Black Bridge at Lisdoonvarna appears to be only in the early stages of developing underground drainage channels, as a rise in the water-table causes flooding of dry stream beds, under which in normal conditions the waters flow (Fig 3C). Earlier, at the stage when segmentation of the surface-drainage occurred, the waters now only indicated by 13, 24, 13b, and 13a could have flowed as a surface river, probably from the Killeany rising (Fig. 3B).

We may note that the divide between the Killeany and Caher river-valleys is on a line running due east of Poll-Lismaurhaun (7) and the drainage from the shales north of the divide instead of feeding into the Caher valley is carried by the Upper System through the divide and into the Killeany valley. This might be due to structural control, the general dip of the limestone to the south directing the underground drainage or, it may be that the underground drainage was firmly established before the Caher river-valley developed. A southward creep or migration of the divide, if such be the case, could only have occurred after the establishment of the underground drainage.

In conclusion we must consider some aspects of the present form of the cave and endeavour to reconstruct the probable development. To-day Pollnagollum is a wide open pot-hole, but earlier in its history it must have been an active swallet receiving surface water. The present enlarged form of the pot appears to be the result of rock-collapse along intersecting joint-planes, due to the removal of support by underground water-action. This mass of fallen material forms the great boulder and clay slope within the actual pot-hole.[19]

From Pollnagollum the remarkable Upper Rift commences. It can be traced down the whole length of the Main Cave to well below the Main

[19] Throughout the Burren district the occurrence has been noted of vertical-sided joint-bound depressions due to underground solution (Westropp, 1870) and the enlargement of Pollnagollum was no doubt brought about in the same way, as appears also to be the case with Pollelva.

Junction and cannot be less than 50–60 feet in height. It was formed by a powerful vadose stream working along a joint network which was dominated by the roughly north and south master-jointing. Its freedom from lateral erosion and its great overhanging walls make it a gigantic subterranean canyon winding in great curves over and across the present stream-course.[20]

Immediately below the Upper Rift is a well-marked shelf of lateral erosion. It is 10 feet above present-floor level at the end of Gunman's Cave and this height decreases all the way to the Main Junction as already noted. On parts of the shelf are accumulations of clay, gravel and cobbles. Below the shelf and running from the bottom of the Main Shaft is the present stream-passage, joint-initiated and incised as a "canyon" on the shelf. Winding as it does in directions opposite to the Upper Rift it suggests rejuvenation of a stream meandering on the shelf with consequent renewal of down-cutting activity.[21] To a short distance below the First Waterfall this lower canyon of the present stream-course is well marked, but from the Westropp Chamber downstream, grading of the stream has resulted in considerable lateral erosion with undercutting of the shelf and the feature is not so pronounced.

The involved topography of the Pollbinn-Pollnagollum-First Waterfall section of the cave (Fig. 2) demands some attention. It has been already noted that the youthful condition of the Upper System contrasts strongly with the more mature Main Cave. The Pollbinn passage leads directly into the Main Shaft by a steep "step fall" passage and no doubt once carried the Upper System waters directly into Pollnagollum. This does not occur at present, except possibly in exceptional flood conditions, for the Upper System waters are diverted in the Pollbinn passage into a wide bedding-cave. The diversion was in part due to lateral widening of the stream working on a chert layer assisted by aggradation of the old stream-bed below the point of diversion. From this point the Pollbinn water crosses over the Upper Rift of Gunman's Cave, appears at the bottom of Pollbeg pot and feeds into the Main Cave as the First Waterfall, a hanging

[20] During the survey it was found impracticable to survey this Upper Rift as distinct from the present stream-passage. The map of the cave was surveyed at the level of the stream. The numerous cross-sections show the relation of the Upper Rift to the present course at many points, and on Fig. 2 an attempt has been made to indicate the Upper Rift from the end of Gunman's Cave to below the First Waterfall by a dotted line, winding over and across the double line marking the present stream-course.

[21] The rejuvenation of the system causing a renewal of activity by vadose streams after the formation of the Upper Rift and shelf demands some explanation. A detailed examination of the whole area and its caves might prove this to be due to uplift. On the other hand it might be the result of the cave system acquiring an increased water supply (Post-glacial melt waters?). As a basis for further work it may be mentioned that the valley near Black Bridge, Lisdoonvarna, shows evidence of rejuvenation in its form, a typical "valley in valley" cross-section.

tributary. The possible explanation of this course is that the diverted Upper System waters in the bedding cave took possession of a stream passage formed by a minor swallet during the cutting down of the Upper Rift.

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APPENDIX I.

Preliminary Report on Water Samples.

No.	Location	Un. Indicator	Phenol Red	Total Hardness
1	Lismaurahaun surface water ...	8·5	8·4	5 degrees
2	Pollcrageagh surface water ...	8·5	8·4	5 ,,
3	Swallet near Pollcragreagh ...	8·5	8·4	5 ,,
4	Swallet	8·5	8·4	5·5 ,,
5	St. Brendan's Well	8·5	8·4	10·5 ,,
6	First Waterfall	8·5	8·4	6·5 ,,
7	Long Gallery	8·5	8·4	6·0 ,,
8	Gunman's Cave	8·5	8·4	12·0 ,,

Nos. 1–5 are representative surface water samples, and Nos. 6–8 are cave water samples.

The water in Gunman's Cave deposits a flowstone on the passage floor. It is interesting to note that the water at the St. Brendan's rising is much harder than swallet water along Slieve Elva and also higher than normal cave-stream water (samples 6 and 7), showing that some lime is dissolved out during its underground movement.

N. J. D.

Appendix II.

During the explorations in 1942 and 1943 water-temperatures were taken at various points in the cave as listed below. Very little difference was noted between the two years' readings, even though in the 1942 (last week in July) visit the weather was inclined to be cold and with many days of heavy rain in contrast to the 1943 (same period) visit when we had almost continuous dry and sunny weather. In wading through the water the difference in temperature was most marked when wading upstream from the passage fed by the First Waterfall into the passage fed by the inlet from Gunman's Cave. Here the drop in temperature of 2 degrees F. was painfully felt! In 1942 the meeting of the Main Cave water with the Branch Passage stream produced a foggy atmosphere, but this was not so noticeable during the 1943 explorations.

Water Temperature Records (F).

Location	1942	1943
Surface Stream at Pollnua (6)	56·5	57·5
Surface Stream at Pollbinn (5)	57·0	58·0
Cave Stream between 5 and 6	53·0	54·0
Gunman's Cave	50·0	50·5
Between Gunman's Cave and First Waterfall (still pools)	49·5	49·0
Main Stream, near Westropp Chamber	53·0	53·0
Branch Passage Stream	51·0	52·0
Main Stream below Junction	50·5	51·0

Average temp. of underground water, 51·107 F.

,, ,, ,, surface streams 57·25 F.

J. C. C.

Appendix III.

Table of Distances in Pollnagollum Cave.

Pollnua to Upper Junction	163 feet
Upper Junction northwards	1,662
Long Gallery	2,395
Bedding-cave near Pollnua	100
Upper Junction to Pollbinn	1,201
Pollbinn to Pollnagollum	1,385
Roof Traverse in Pollbinn section	175
Baker's Rift	268
Total length of Upper System ...	7,349 feet

Pollnagollum to end of Gunman's Cave (*i.e.* from bottom of Main Shaft	458 feet	
Gunman's Cave	445	
Inlet in Gunman's Cave	48	
End of Gunman's Cave to First Waterfall	547	1,155
First Waterfall to Westropp Chamber	608	
Westropp Chamber to Main Junction	2,048	
Total ...	4,154 feet	

NOTE.—Distance from entrance down Gunman's Cave and by stream-passage to Main Junction is 3,648 feet.

Branch Passage to waterfall	899 feet
Surveyed beyond waterfall	242
Total ...	1,141 feet
Main Junction to pool at entrance to Cotter's Gallery ...	2,533 feet
Cotter's Gallery	674
Pool to main bedding-cave	220
Dry Section from main bedding-cave to final point ...	743
The East Tunnel	477
Total length of lower Main Cave ...	4,647 feet
Upstream passage surveyed from the bottom of Pollbeg ...	100 feet
Total length of Pollnagollum Cave ...	17,391 feet

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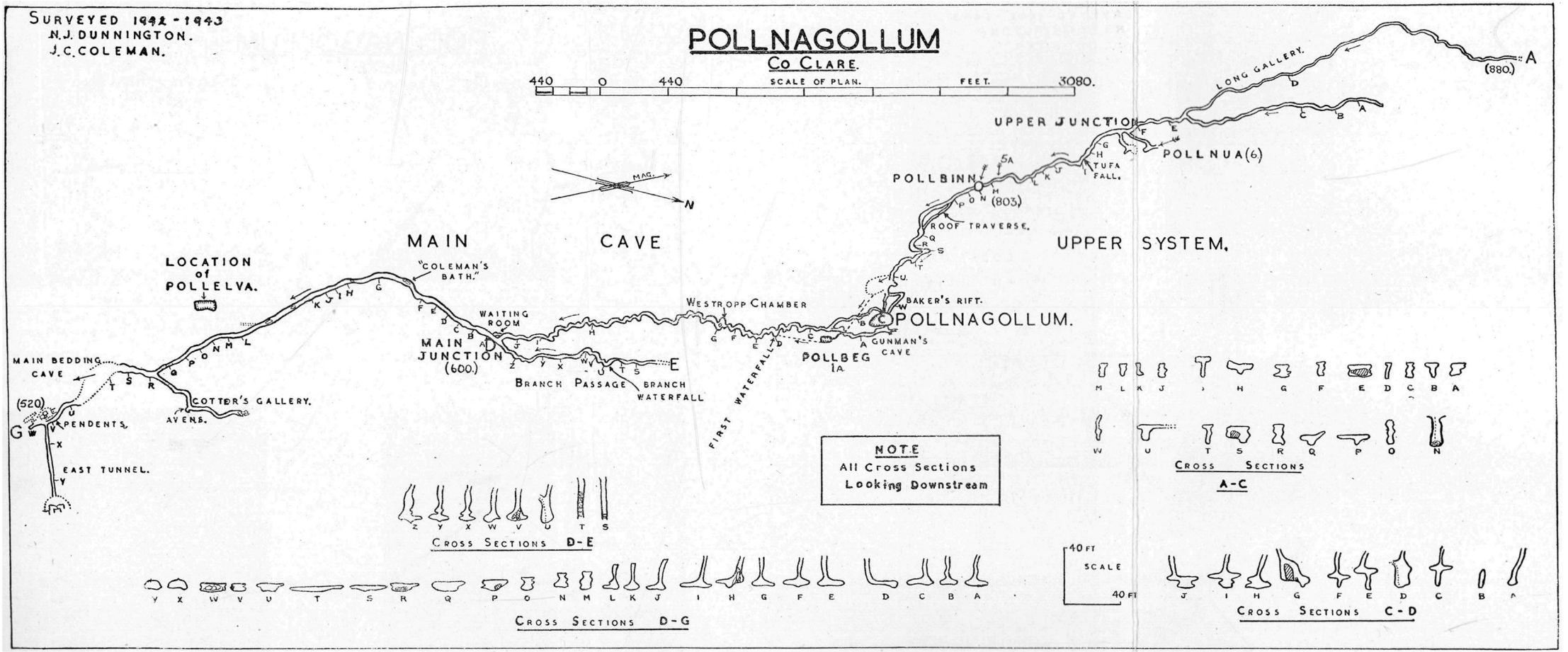

Coleman and Dunnington—Pollnagollum Cave.

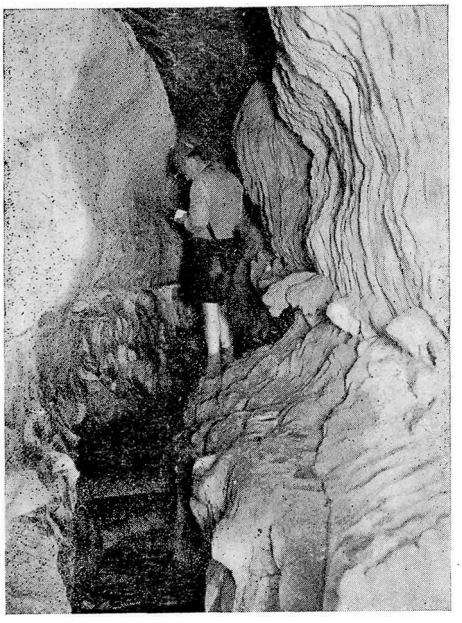

FIG. 1.—THE ROOF TRAVERSE NEAR POLLBIN, A STREAM-DESERTED UPPER PASSAGE.
Note stalagmite covered Chert ledges on right.

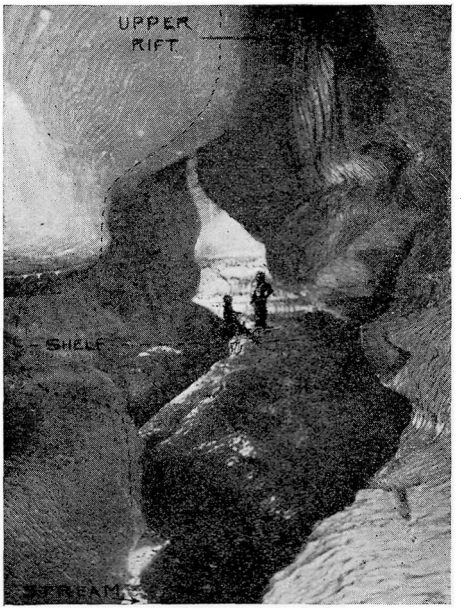

FIG. 2.—THE MAIN CAVE PASSAGE BELOW THE WESTROPP CHAMBER.

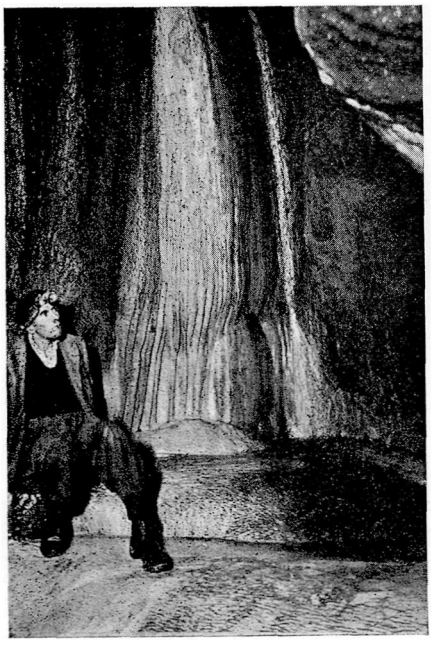

FIG. 3.—DRIPSTONE CASCADE.
Main Cave.

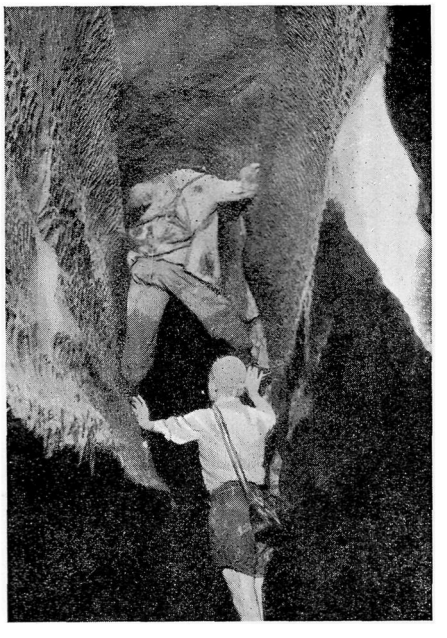

FIG. 4.—THE STREAM PASSAGE NEAR GUNMAN'S CAVE SHOWING POCKETING OF WALLS.

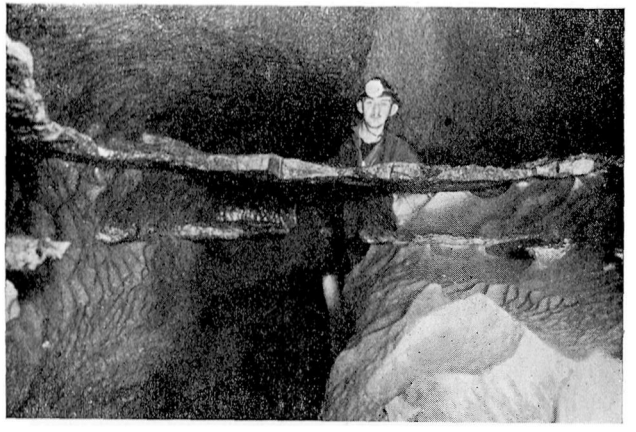

FIG. 1.—CHERT BRIDGE AND LEDGES NEAR POLLBINN.

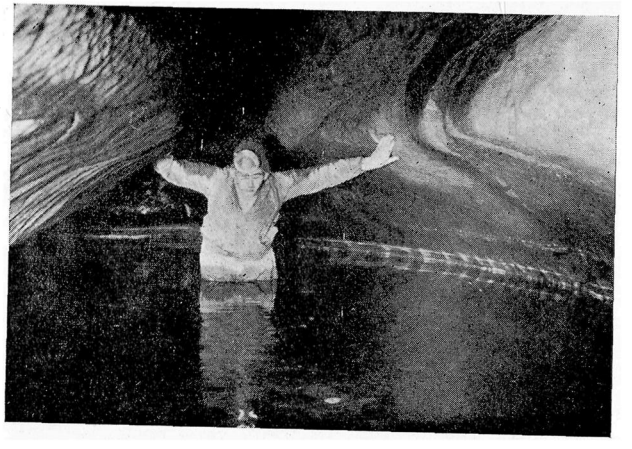

FIG. 2.—A POOL IN THE MAIN CAVE NEAR WESTROPP CHAMBER.

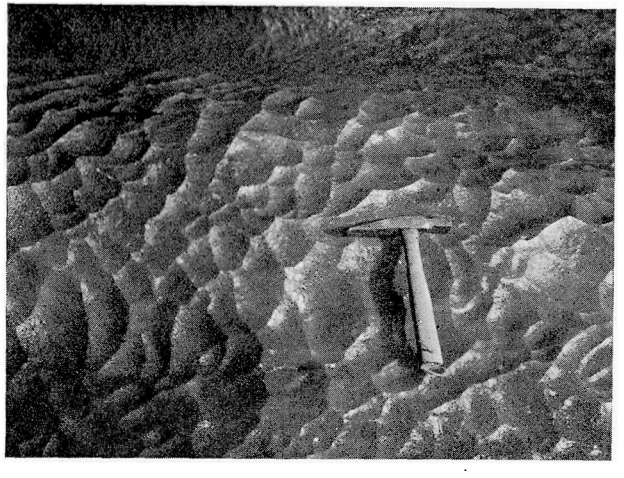

FIG. 3.—CURRENT-ERODED ROCK SHOWING POCKETING.
ARROW—DIRECTION OF WATERFLOW.

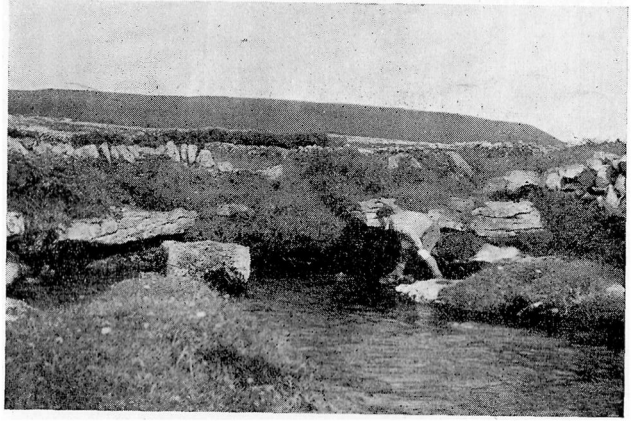

FIG. 4.—KILLEANY RISING.
(Slieve Elva in background.)