

Poulnagollum — Poulelva Caves

Slieve Elva, Co. Clare, Eire

(I.O.S. 6 in. to 1 mile, Clare, Sheets 4 and 5)

By

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[Editorial note. This paper has been constructed from a number of separate reports by various authors on individual sections of the cave. These reports have been collated by E. K. Tratman, B. B. Perratt and B. R. Collingridge, principally the latter, who is solely responsible for the sections on "Relationship to Surface Features" and "Geomorphology". The following have contributed reports: G. D. Witts, E. K. Tratman, Patricia Tangye, T. R. Shaw, B. B. Perratt, O. C. Lloyd, T. J. Hill, E. V. Gilbert, W. A. Dowden, B. R. Collingridge, G. M. Bond and P. R. Blatchford. Many others have been concerned with the field work.]

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INTRODUCTION

The first detailed accounts of Poulnagollum and Upper Poulelva are given in papers by J. C. Coleman and N. J. Dunnington in 1944 and 1949. Many of the cave passages were named in those accounts and as far as possible the same names have been used in this paper. The explanation for the names is usually self evident and so not all the explanations are given here. Further, for the sake of brevity, the papers of Coleman and Dunnington are hereafter cited as "C. & D. 1944 and 1949" respectively. Since these accounts appeared a good many new discoveries have been made greatly extending the system

and proving various connexions. In the course of surveying these new passages still more were found and it became necessary to do a check survey, originally without passage detail, of the parts surveyed by C. & D. so as to be able to tie in the new passages to their survey. In the course of this work various discrepancies between our survey results and the earlier accounts were found. Some of the discrepancies were of a major nature and seem likely to have been due to errors of computation, e.g., adding lengths together twice. Because of these errors it was decided to make a completely new survey. This has given a most interesting plan of the layout of the passages in relation to each other. These passages, with two exceptions, are all described from their explorable beginning in a downstream direction so that all lefts and rights are used in the same sense. For Branch Passage and the Craven Canyon this arrangement is not practicable and these two are described moving away from the point of entry, that is upstream in Branch Passage. The method followed in this account is to describe the main route from the head of the Short Gallery of Upper Poulmagollum through the cave to the Flooded Bedding Plane Passage and the Maze. Although the streamway in Lower Poulelva is a continuation of that in Poulmagollum, it was found convenient to describe the whole of the Poulelva series separately. The tributaries are described in groups at the end of each account of a major section of the system.

In the Bibliography a selection has been made of the principal references. Thus references in caving club journals about visits to the cave are omitted as they do not provide any additional information. The spelling of names is taken from the earliest sources. Some are taken from the Ordnance Survey maps and most of the rest from the papers of C. & D. (1944 and 1949).

SUMMARY

Poulmagollum (Slieve Elva) with which is included Poulelva is one of the longest cave systems known in the British Isles. It is often called locally Cahir Bullog from the name of the townland in which the open pothole is situated. The system comprises nearly 7 miles of passages of which nearly 6 miles are active streamways. The general direction of the passages is between south-east and south-south-east. The most northerly passages originate well north and west of the col which separates the heads of the Cahir River valley to the north and the Killeany valley to the south. They run in a platform that slopes down south. All the major streams in the cave and several of the smaller streams are derived from swallets that lie along the edge of the shale on the east side of Slieve Elva.

The most northerly of the swallets apparently feeds Branch Passage Gallery West. The next ones to the south feed into the set of passages known collectively as Upper Poulmagollum. The first group of these swallets feed

in sequence the streams of the Long Gallery and Short Gallery. These two passages unite and are joined by the stream from the pothole known as Pollnua. All now run together to be joined by other streams at the two parts of Pollbinn, one of the parts being another open pothole. Some minor tributaries come in and the passage enters the Poulmagollum pothole in the north-west. Under low water conditions no water reaches the pot, as before this the stream goes off to the right down a low bedding plane passage, passes through Pollbeg, now filled in, and crosses above the roof of Shaft Gallery and Gunman's Cave to enter the Main Streamway at the First Waterfall.

From the pothole two routes continue downstream, Gunman's Cave which is more or less dry but has a small stream in wet weather, and Shaft Gallery which takes the surplus water from Upper Poulmagollum. The union of these two forms the Main Streamway, a large high meandering passage continuing down to Main Junction, where it is joined by Branch Passage and the water issuing therefrom. The Main Streamway continues southerly till it is joined by the combined High and Low Road Passage at roof level and at floor level but not at intermediate levels just here. The present active streamway now follows for some distance what is strictly the continuation of the High and Low Road Passage, while the original Main Streamway is blocked by stream-borne filling.

Beyond, the active streamway continues but the height of the passage is gradually reduced to where it is necessary to crawl in the water at the Flooded Bedding Plane Passage. Just before this on the left, Cotter's Gallery enters. A crawl round the upper end of the flooded Bedding Plane in the water takes one up a mud bank and thence into the terminal series of passages known collectively as The Maze. This in turn connects in at least one place with Poulelva.

The tributaries are several. The west arm of Branch Passage Gallery derives its water almost certainly from the most northerly of the swallets along the shale edge near the northern end of Slieve Elva. The passage runs southerly to a point quite close to Poulmagollum where there is a short roof level connexion, the Muddy Link, with Gunman's Cave. A little further down is a second roof level connexion between the two which is known as The Sewer. Thereafter Branch Passage Gallery swings more to the east and away from the Main Streamway. It rejoins this, after turning back south and then slightly west of south, at the waterfall in Branch Passage. This itself is a more or less dead passage, with deep pools and mud between stalagmite barriers, down as far as the waterfall from Branch Passage Gallery. From this point down to Main Junction the Branch Passage is an ordinary active streamway. A now dry extension, south of the waterfall, continues the original line of Branch Passage Gallery and this can be followed over fill, to within 200 ft. of the upstream end of High Road Passage. This starts

in a low but very wide bedding plane passage where there is a roof connexion to Branch Passage. It continues southerly to be joined, 100 ft. from where it meets the present streamway, by the Low Road Passage.

The passable part of Sump Canyon starts about 350 ft. west of the upper end of High Road and 400 ft. south-east of the dry extension of Branch Passage Gallery. It runs more or less south to enter Cotter's Gallery, which joins the Main Streamway just before the Flooded Bedding Plane Passage. From this place the water runs through to Poulelva while there is at least one connexion from the Maze, beyond the Flooded Bedding Plane Passage, with the east end of the Craven Canyon of Poulelva. Parties in the two caves can get to about 12 ft. from each other, but the passage is too low to crawl through. There are other sump connexions between the two parts.

Upper Poulelva derives its waters from the twin swallets of Pollismorahaun and another a few yards south, all at the shale edge. This water and that from some minor swallets forms the main stream of Upper Poulelva, which is a winding canyon passage right down to the end where the roof is open and the stream plunges down into the pothole of Poulelva. At the bottom the water disappears amongst boulders to reappear on the right of the active streamway a little way downstream from the pothole. From the bottom of Poulelva a crawl soon leads into an active streamway. This water is directly from the Flooded Bedding Plane Passage between 200 ft. and 300 ft. to the north. On the east, Craven Canyon, with its connexions to the Maze at its eastern end, comes in. Downstream the Poulmagollum waters join that of Upper Poulelva and the streamway can be followed for about 600 yards till the passage is too low. This point is a little over 50 ft. above, and less than three-quarters of a mile from Killeany rising, where the waters all reappear.

HISTORY

The earliest exploration which can be fully authenticated took place in 1880. A chalked inscription in the Westropp Chamber reads: "W. R. Joyce, W. S. Westropp, J. H. Christy, 7/10/80" (C. & D., 1944, p. 116). Unless William H. Stacpoole Westropp made more than one visit, this is the occasion recorded as follows by T. J. Westropp (1901, p. 306): "Near the bluff of Slieve Elva we find a remarkable pit in the limestone which leads to an underground river. . . . The late Dr. William Stacpoole Westropp and several friends once explored these extensive caverns with no little risk and difficulty. The stream falls over a high shelf of rock into a pearly natural dome, whence runs a long, low passage, which eventually communicates with a lateral gallery, up which exists a still finer but similar dome, a waterfall bursting through a cranny high up its flank. The caverns down stream lead towards Killeany church." Thus they appear to have gone downstream to Main

Junction and then up Branch Passage to the waterfall, a distance of about three-quarters of a mile. It was most unlikely that the descent was made by way of Gunman's Cave rather than the more obvious main shaft which could have been easily negotiated with a rigid farm ladder. Another inscription chalked in the Westropp Chamber records the visit of "John Christy, age 12, October 8th, 1880."—the following day—presumably with some or all of the previous explorers, and he would have found the Gunman's Cave route very difficult.

There had probably also been visits to the cave before 1880. When W. H. S. Westropp (1870, p. 77) refers to the caves at Slieve Elva, almost certainly he means Poulmagollum, as the most prominent and accessible of them. He writes: "[The caves] at Sliab Elva and at Kilcorney are very extensive; they have never been thoroughly explored. Some foolhardy individuals attempted to explore them, after having fortified their nerves with liberal allowances of whiskey; under the influence of the potent spirit they beheld, while in the caves, divers strange sights and visions, the description of which has quite deterred the natives from following their example."

It is interesting to speculate whether one of these very early visits may not have been made by the geologist Frederick J. Foot. In the *Memoirs of the Geological Survey* (Foot, 1863a, p. 18) he recorded "numerous conical hollows or 'swallow-holes'" along the escarpment "between Ballyvaughan and Lisdoonvarna". He also stated, in a lecture read in April 1862 (Foot, 1863, p. 104), ". . . after searching almost every known cave, I had come to the conclusion that the wild Burren district was unfrequented by these animals [bats]". He goes on, "I must observe, however, that almost all the caves there are the mouths of subterranean water courses . . ."; so his visits were not restricted to the dry caves. The fact that he does not mention the cave in the Geological Survey Memoir does not in itself argue against such a visit, for nor does he mention the Glencrawne Cave and others he is known to have explored. If Foot did in fact explore Poulmagollum, his visit may well be the one mentioned by W. H. S. Westropp (1870); in the intervening eight or more years the story of the geologist's visit could well have developed at that period to one about "Some foolhardy individuals".

As far as is known the next explorers were E. A. Baker and H. E. Kentish in 1912. They were told by the landlord of the Queen's Hotel at Lisdoonvarna (Mr. Curtin) that "in his youth [he] had been in the party, or at least in one party, that had been down Poulmagollum and explored the subterranean river. He corroborated the report that they had gone two and a half miles underground. At that distance, he said, they had been stopped by a sink." (Baker, 1932, p. 183.) The report referred to was one that the cave "was said to have been explored to a distance of two and a half miles. But the person who first told us of it was such a mine of misinformation that we paid little

attention to such a story" at first (Baker, 1932, p. 175). To which party Mr. Curtin belonged there is now no means of telling. It is unlikely he was with the 1880 Westropp party as his name is not among the others in the Westropp Chamber, but he might have been only a helper at the entrance who learned the details of the exploration from the others; this would explain Baker's remark that "it is very hard to make his account tally with our own observations" (Baker, 1926, p. 42).

In 1912 Baker and Kentish went downstream to a point they measured as 267 yards past Main Junction. They turned up Branch Passage but only for "a short distance". In August 1925 Baker returned to the cave with C. G. Barton, Miss P. Fühlich and Dr. F. Oedl, who made the survey reproduced in Baker's book (1932, pp. 190-1). Downstream they reached the bedding cave and they went along Branch Passage as far as the waterfall. Here Baker (1932, p. 194) reported they could see daylight above and they were convinced therefore that they had reached the bottom of Poulelva! The passages upstream of the main entrance were not explored at all. Gunman's Cave was discovered on this visit, with the relics which prompted its name.

At Easter 1935 a party of the Yorkshire Ramblers' Club, including S. J. Pick and F. G. Balcombe, visited the cave but did not pass Baker's furthest point. They also made the first descent of Poulelva (Bartlett, 1936). A year later almost the same party returned to Poulmagollum (Bartlett, 1938) and explored further downstream "well beyond the initials E.A.B." They also entered Cotter's Gallery (so named in 1943) for the first time but "no attempt to explore fully was made" (Balcombe, 1936, p. 8). In Branch Passage the rift beyond the waterfall was penetrated for "a few hundred feet". In 1936 also, the upstream part of the main cave was first entered and the passage explored as far as Pollbinn. On Aug. 13th, 1939, J. H. D. Hooper (1940, pp. 75-6) explored more of Cotter's Gallery, reaching the boulder chambers.

N. J. Dunnington and J. C. Coleman started independent work on the cave in 1940 and 1941 respectively. From later in 1941 to 1943 they collaborated in making the survey which appeared with their classic paper (C. & D., 1944). In the course of this work they found extensive additions to the upstream part of the cave beyond Pollbinn. In 1948, together with Dr. C. Barker, they discovered the High and Low Roads and also reached the end of the Branch Passage Canal. In Poulelva they entered the stream passage leading towards Poulmagollum but were halted by a very low bedding plane (C. & D. 1949).

The next discovery in the Poulmagollum system was made at Easter 1952 by the R.A.F. College Potholing Group. Deepening of a shakehole for use as a camp kitchen developed into a more thorough excavation and on April 12th natural passages were entered in what was then called Pollardua.

The connexion with Gunman's Cave and part of the Sewer were discovered in the next few days. Exploration continued in August 1952 when Branch Passage Gallery was entered from the Sewer and explored for only a few hundred feet (Shaw, 1956). At the following Easter the same Group followed it downstream as far as the head of Branch Passage Waterfall but this was not recognized as such at the time; upstream, progress was stopped by deep water at the first traverse (Anon., 1953). An inscription in the passage shows that it was further explored by the same Group in 1956; no published reference can be traced and the Group is unable to find its MS. log books for this period.

The Craven Pothole Club (Holgate *et al.*, 1952, pp. 185-6) entered a new section in Lower Poulelva at Whitsun 1952. Their sketch plan shows a downstream passage running south for some 1,600 ft. and a dry passage going east for about 1,100 ft. (Craven Canyon). Also in August 1952 the First Waterfall was scaled by the R.A.F. Group and the passages above it explored (Shaw, 1956).

It was in 1957 that the University of Bristol Spelæological Society finished the exploration of what is now known as Branch Passage Gallery West. They got 100 ft. further along Branch Passage in 1958 than the point reached by Barker (C. & D., 1949). In 1959 the same society found the Muddy Link connecting Branch Passage Gallery to Gunman's Cave. The existence of this link had been postulated from the survey of the known passages. Also in 1959 they discovered Sump Canyon and proved the connexions between the Flooded Bedding Plane Passage at the bottom of Poulmagollum and the active streamway of Lower Poulelva and between the eastern end of the Craven Canyon (C.P.C., 1952, above) and The Maze in Poulmagollum.

UPPER POULNAGOLLUM

Upper Poulmagollum is that part of the cave which lies upstream of the main pothole. At its head are two stream passages, the Long and Short Galleries, which join to form the rest of the passage down to the pothole. The part below the junction receives two major tributaries, from Pollnua and at Pollbinn. The most northerly entry point and the one usually used is Pollnua, which comes in as a branch passage 250 ft. downstream from the junction. No tackle is required for any part of this route, nevertheless there are places where a rope or even a ladder can be used to make awkward climbs easy. It is convenient to leave a rope hanging down into the exit passage into Poulmagollum pothole so that one can climb back to the surface there without difficulty instead of going back upstream to either Pollbinn or Pollnua.

The water enters by a series of sink holes (*Fig. 52*), which lie along the shale-limestone boundary of Slieve Elva north of the Caher Bullog farmhouse. At least two of these, 9 and 18, have been proved by colour tests

to feed the system, one of them, 9, being certainly a feeder of Long Gallery. (See Appendix 1 for details of colour tests.) The surveyed end of both galleries lies underneath the shale. As both passages run generally south-east, all the tributaries, save those close to the head of each, must come in on the left.

Short Gallery is obviously the major passage. Its upper end is choked by a mud and gravel fill through which issues the stream. 60 ft. downstream from the choke the passage is 5.5 ft. high and 3 ft. wide in the water channel at floor level. The passage at roof level is wider and the roof is flat. The only tributary to enter from the right comes in at 40 ft. Just beyond a large unstable slab of limestone, which straddles the passage at 200 ft., the surveyed route follows a dry oxbow on the left for 135 ft. This rejoins the main passage at 350 ft. which from here becomes narrower and higher so that 70 ft. further on, where a tributary enters on the left, it is 7 ft. high and only 1.4 ft. wide at floor level. Beyond this point, 450 ft. downstream, is a mud-filled oxbow. The passage widens to 4 ft. and a T-shaped cross section becomes apparent. This form is retained, with minor variations, for 550 ft. until the height of 7 ft. begins to diminish. This is due to the slope of the floor becoming less than the dip slope of the single bed of limestone which has so far formed the roof. At 1,050 ft. the height is down to 5 ft. and the width has increased to 5 ft. (Sect. 57). In the next 200 ft. discontinuous chert bands become apparent in the walls and floor and there is a 30-ft. oxbow on the left. Then 1,250 ft. from the choked end of Short Gallery, Long Gallery comes in on the right. Here the passage widens out and the stream passes through a low gap in the right wall to join with the stream of Long Gallery. The line of the Short Gallery is continued along a passage floored with mud and boulders for just over 50 ft., when there is a slope down into the combined waters of the two galleries. If one is walking upstream from Pollnua along the main stream passage, the junction of these two galleries is rather hard to spot, as the stream lies out of sight beneath a large, fallen slab. Coleman and Dunnington (1944, p. 110) describe how they noticed it by observing the sudden diminution in the volume of stream water as they entered Short Gallery. In times of moderate rainfall the streams in the two galleries are about equal. On the return journey down Short Gallery the junction is obvious, as one is faced by an oval opening, now dry, 1.5 ft. above the floor.

The passage below the junction is a 6.5-ft. high canyon. It continues for 250 ft. to where the main Pollnua stream comes in on the left. The Pollnua Dry Series passage comes in 20 ft. beyond the main active one, again on the left. This is a low wide tunnel whereas the main Pollnua stream passage is low, narrow and partly obscured by a flake of rock. In the next 720 ft. the passage becomes larger and meanders repeatedly; three small tributaries enter from the left. About 2 ft. below the roof is a bedding plane in which have developed good examples of half tubes (Sect. 52). A specimen

was found lying on a ledge in the passage, having fallen out of its bed, and was brought home and placed in the Society's museum. *Plate 14A* is a detailed study of its under surface. Another feature of the cave is the chert ledges. There is a small rapid wherever the stream cuts through a chert band. In its erosion of the limestone the stream has spared some of those parts protected by chert, so that large "mushrooms" have been formed (*Plate 15A*), the cap being made of chert, the stem of limestone. At the end of this section a large stream comes in on the left from a passage which cannot be followed. This is almost certainly from swallet 28 (*Fig. 52*) known as Pollbinn North. The floor level drops 4 ft. here and the passage is now 16 ft. high. It is running close to the shale edge and its direction is more easterly than before.

At 1,000 ft. downstream from the junction a roof passage goes off to the left and rejoins the stream route after 50 ft. This is really an upper level meander which is completely offset from the main passage, which is thus reduced in height to only 4.5 ft. while still 5 ft. wide. The height goes up to 15 ft. where the roof passage rejoins. An upper level of meanders is characteristic of this passage from here onwards. A further 100 ft. leads to rapids descending 7 ft. through boulders on the floor. The passage becomes over 20 ft. high. Almost immediately daylight is seen and for two short stretches, separated by a narrow bridge, the canyon is unroofed. These are the two openings known as Pollbinn (*Fig. 52*, Nos. 29, 30). The streamway beneath the two entrances widens out considerably into an oval chamber with fluted walls. At the downstream end, on the left, is a wide aven reaching almost to the surface. The first of the openings takes a stream from the shales of Slieve Elva; after a drop of 18 ft. the stream enters the main stream passage from the right. To enter it from the surface a 20-ft. ladder may be hung by a short tether to a chert bollard on the right. Unless it is very wet the ladder will hang away from the waterfall. The pitch can be climbed by an active individual without tackle if the waterfall is not too large. Pollbinn's second opening gives access to the roof of the main passage and is surrounded by a low stone wall; too low, in fact, for in 1959 there was found here the decaying body of a horse. By 1960 the bones had become clean and were scattered down the streamway, many having been carried by flood waters on to ledges 6 ft. above the floor of the streamway.

Downstream from Pollbinn are several cascades cutting down through four discontinuous layers of chert. There are three passable oxbows near the roof and two are over 150 ft. in length. Entry into the first of these can be made at its upper end by walking along the chert ledges which eventually form its floor. This oxbow lies to the left of the streamway and is the one described by Coleman and Dunnington (1944). Its floor is partly gouged and partly covered by thick mud. There are some formations in its 173 ft. and the average height is 9 ft., whereas the streamway is reduced in height to 5.5 ft.

The second oxbow lies 200 ft. from the end of this and to the right of the streamway. It is 165 ft. long and richly decorated. It was discovered by an R.A.F. party in 1960. Where this oxbow rejoins the stream from the right the third oxbow commences on the left side of the streamway and 8 ft. above it. This is 75 ft. long, low, and contains little decoration.

The gradient of the floor steepens below Pollbinn and the passage becomes much higher for a while and the meanders more acute. After 750 ft. the water under low conditions goes off to the right down a low, wide bedding plane passage. The passage is only 18 in. high at the beginning and cannot be followed. Under ordinary and high water conditions this route does not take all the water and some continues down the main route to Poulmagollum to fall into the Main Shaft. The water which goes off to the right crosses above the roofs of Shaft Gallery and Gunman's Cave, passes through Pollbeg and reappears as the First Waterfall in Poulmagollum Main Streamway (C. & D., 1944, p. 115). At a little over 200 ft. from this bedding plane the route followed divides. To the left is a small chamber leading to two other chambers floored with stalagmited boulders and moonmilk. There is ample evidence of phreatic solution. To the right the roof of the main passage comes down to within 18 in. of the floor to form a 30-ft. wide bedding plane passage (Sect. 48). The floor is of chert, very much pock-marked which makes progress painful. After 27 ft. there is a drop of 10 ft. into a 15-ft. wide chamber decorated with flowstone. Baker's Rift has its northern opening a few yards beyond this chamber to the left. To the right of the chamber the floor of the main passage drops rapidly in water slides of increasing depth until the passage is a tightly meandering rift, which is 50 ft. high just before it is unroofed at Poulmagollum Pot. At 2,690 ft. from the Long and Short Gallery junction the head of the waterfalls down to Main Shaft and Shaft Gallery is reached. This point is about 10 ft. back from the top of the western lip of the Main Shaft.

The high rift opens into the north-west corner of Poulmagollum Pot. One can climb out of the top of this rift a few yards before its termination. The route to the surface lies behind a clump of hazels inside the walled enclosure of the main pothole, but the grassy slope above it is steep and rather dangerous. From the lower end of the terminal rift one looks down into Shaft Gallery, which is not readily accessible, but a fairly easy climb up to the left leads into the lower, south end of Baker's Rift.

TRIBUTARIES

Long Gallery

This is fed from swallet 9 (*Fig. 52*). Like the Short Gallery its entire length lies under the shale. It lies to the west of Short Gallery and runs more or less parallel to it. Its position thus precludes it receiving any tributaries

unless they come down through the shale. The upper end of the passage is blocked by mud and boulders. The passage is at first low and narrow and tightly meandering but becomes fractionally wider after 70 ft. when, for a stretch, the line of the passage follows the north-south jointing, but the direction soon changes to south-east. At 260 ft. the roof is very flat and for the next 50 ft. there are many dripstone formations including curtains. There are pools in the floor and the passage has become 5 ft. high after 370 ft. It maintains this height for about 300 ft. to where there is a small, dry tributary passage on the right. The floor gradient gets less and so, therefore, does the height. At 850 ft. the upper part of the passage takes on an inverted V form while the lower part becomes wider. Chert ledges appear along the walls at 1,000 ft. and in an equivalent position in Short Gallery. The passage continues as a canyon, 6 ft. high and 2.5 ft. wide at the roof, which is again flat. After a further 500 ft. the stream is lost to the right in a low passage and a short tunnel turns left to join the Short Gallery. Long Gallery is in general a meandering canyon passage with scalloped walls. It is narrower, cleaner and more difficult to pass than Short Gallery.

Pollnua Stream Passage

This swallet has a wall built around it and it is elongated from north to south. The stream comes down about 18 ft. in a series of cascades off the shales and turns in west under the shale. The stream normally goes along a narrow channel and entry is through a low, wide opening leading immediately into a canyon passage about 5 ft. high where the stream is soon met. There are some boulders in the entrance. The whole length is only 170 ft. and meanders throughout. The stream is a major tributary to the upper series. Its point of entry can easily be missed from the cave.

Pollnua Dry Passages

This is a subsidiary opening now blocked by roof collapse about 70 ft. south of the south end of the wall around Pollnua. It takes a small stream from locally collected water in wet weather but is normally dry. It starts as a low bedding plane in the floor of which a meandering trench has been incised. It takes a more direct course than the stream passage to the main streamway and enters it from the left and is 170 ft. long.

Baker's Rift

This rift was called after Baker by Coleman and Dunnington (1944, p. 112) because he was the first to enter it (Baker, 1932, p. 179). He did it in 1912 by descending through a small hole in the grassy slope to the north-east of the main pothole of Poulmagollum. This hole lies inside the walled enclosure and gives access to the roof of Baker's Rift above its lower end. A 20-ft. climb leads down to the floor. From the bottom end of the rift, where one can look out into the pothole, the route up the rift is a series of twenty or more unevenly spaced steps. Each has a pool at its foot, varying in depth



(Photograph: O. C. Lloyd)

PLATE 14A

Example of Roof Anastomosis Channels from Upper Poulmagollum.



(Photograph: D. M. M. Thomson)

PLATE 14B

Poulmagollum Main Streamway. The photograph is taken from the entrance to Cotter's Gallery. Roof pendants in various stages of solution are seen.



PLATE 15A

(Photograph: O. C. Lloyd)

Upper Poulmagollum. Chert "Mushrooms", pendants and flat roof.



PLATE 15B

(Photograph: O. C. Lloyd)

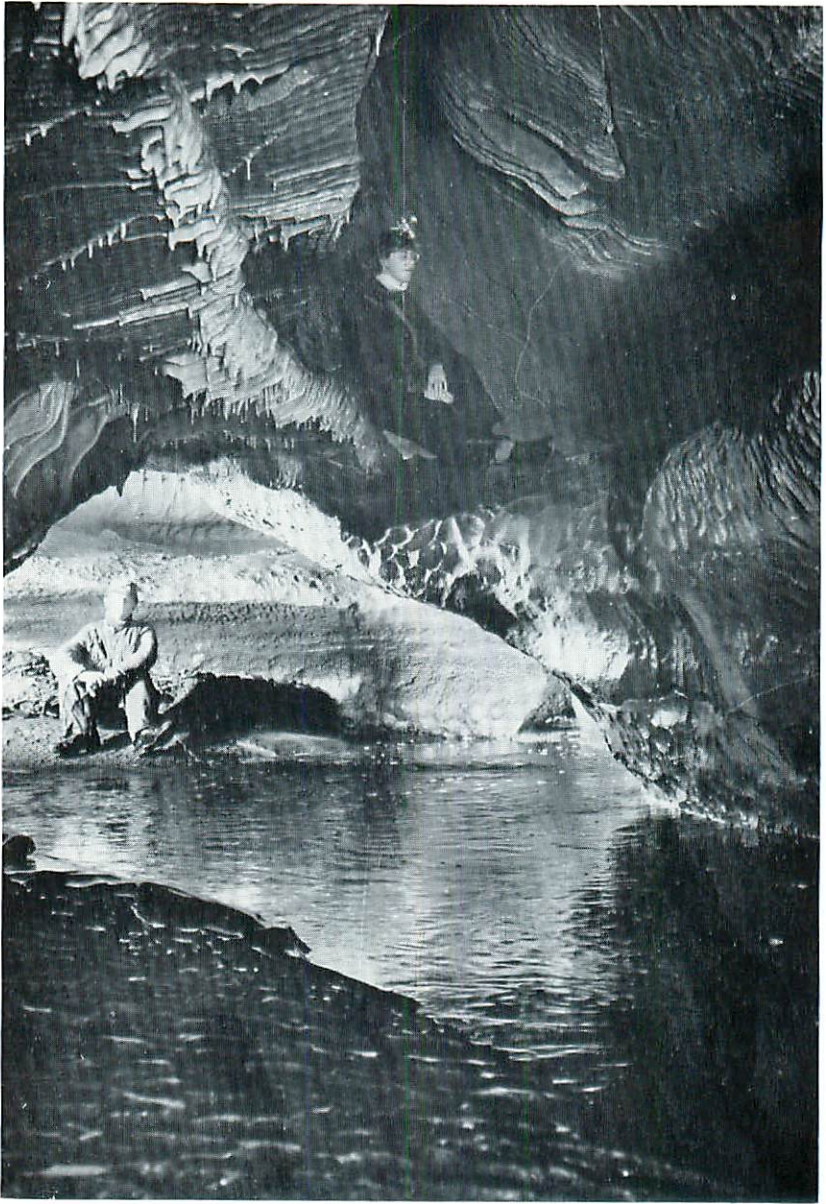
Poulmagollum Main Streamway between First Waterfall and Main Junction. Note: (1) Upper Level Meanders, (2) Widening of passage at 7-10 ft. above floor, (3) Scalloping and undercutting of the present streamway.



(Photograph: D. M. M. Thomson)

PLATE 16

Poulnagollum Main Streamway between First Waterfall and Main Junction. Present streamway offset from widened section and Upper Level Meanders, which are to the left.



(Photograph: D. M. M. Thomson)

PLATE 17

Poulnagollum Main Junction. The upper figure is seated in the alternative higher level route (Coleman's "Waiting Room"), but even this was flooded to a depth of over 2 ft. in July 1961.



(Photograph: J. K. Pitts)

PLATE 18

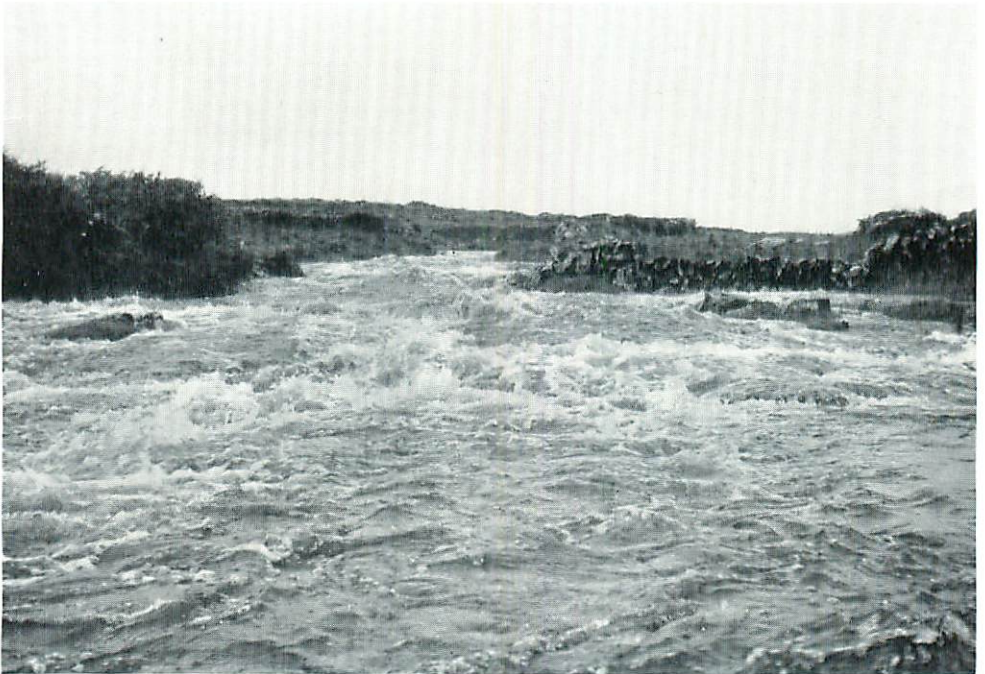
Pouelva Pothole. Looking up the waterfall descending from Upper Pouelva.



(Photograph: D. M. M. Thomson)

PLATE 19A

Killeany Rising. Low water conditions. To the left of the figure is the water from Poulmagollum-Poulelva. To the right the water from Cullaun I and II.



(Photograph: D. Savage)

PLATE 19B

Killeany Rising. Flood conditions July 1961. The maximum has passed. The rock just visible on left in middle distance is seen in *Plate 19A* in the extreme right foreground. The roof of the rising in *Plate 19A* is covered to the level of the rock sill above the figure.

from 3 in. to 2 ft. The rift ascends steeply and meanders. There is much moonmilk and creamy flowstone on the walls and floor which makes the passage quite beautiful. At its northern end the floor ascends to within 6 ft. of the roof and a rather insignificant passage, over mud and boulders, leads to a 5-ft. slope down to the main streamway.

POULNAGOLLUM POTHOLE

The main entrance to the system is through the pothole of Poulmagollum in the townland of Cahir Bullog. The survey (*Plate 20*) and map (*Fig. 52*) show its actual position in the system and its relation to the topography. The pothole measures 50 ft. from north to south and 40 ft. from east to west at floor level. In the northern end of the west face are the openings of the lower ends of Upper Poulmagollum and Baker's Rift. Below them is the Main Shaft (C. & D., 1944, p. 113). On the east side is the entrance to Gunman's Cave, so called from the evidence of the use of this part of the cave as a hideout in the time of the "troubles" by a gunman. On the east side, part of the pothole wall is vertical and here is the greatest depth from the surface of 60 ft. The normal approach is from the south, down over a steeply sloping mud and grass bank which comes immediately inside the wall surrounding the pothole. The bank ends in a drop of 15 ft. over deeply weathered limestone on to a boulder-strewn floor. The slope and drop can be climbed without a rope by using a crevice against the east wall for footholds. A rope tethered at the top of the bank is a convenience which makes the descent easy. There is no shale round the pothole nor is any shale debris visible in it, but the amount of mud and limestone fragments especially in the southern part of the pothole is considerable. At the northern end of the pot the last 15 ft. is roofed over. The height of the roof, which is flat, is here almost 20 ft.

The underside of this overhang shows evidence of phreatic solution in the form of anastomosis channels, rock pendants and half tubes. South, beyond the overhang, these features can be traced for 8-10 ft. up the east wall of the pothole, above the level of the undersurface of the overhang. Similar phreatic features can be seen on both the east and west sides of the pot under the overhang commencing at about 4 ft. from the flattish floor of the northern end.

On the west side of the pothole immediately south of the overhang is Main Shaft. This consists of a minor pothole within the main one. It is some 12 ft. deep by 20 ft. long by 12 ft. wide. Into this shaft the surplus waters, which do not take the route to the head of the First Waterfall, from Upper Poulmagollum descend as a waterfall in several steps totalling about 25 ft. in height. They then flow away along Shaft Gallery. The foot of the shaft can be reached from the pothole by a wriggle down through boulders against the north wall.

GUNMAN'S CAVE

On the east side of the main pothole and some 12 ft. under the overhang is the entrance to Gunman's Cave. The width of the entrance is restricted to a few feet by boulders. This gives access to the roof of a bedding plane passage and the route goes down over boulders into a low chamber of irregular form some 40 ft. long and 15 ft. wide. About 30 ft. from the entrance a stream from the Muddy Link series flows out of a canyon passage on the left. The bed which forms the roof of Gunman's Cave is the same one as that forming the roof of Shaft Gallery, the entering canyon passage and that of the Muddy Link and its associated passages. The whole length of Gunman's Cave is notable for the large quantities of moonmilk which cover its floor and many parts of its walls. This deposit is over 3 ft. thick over the floor and rock is nowhere seen in the floor.

The roof of Gunman's Cave at the entrance shows a number of meandering water channels. They are quite shallow half tubes and are the relics of the bedding-plane anastomosis stage of cave development. These channels soon unite into a single major one which takes a sinuous course from which the curves of the canyon passage are inherited. The entrance passage has now become a canyon. The floor falls steeply and there are several cascades. The roof soon becomes difficult to see even in the wider parts but it remains in the same bed throughout the length of the cave. The stream which comes in from the Muddy Link Series at the entrance is now producing minor rejuvenation features in the form of shallow narrow gullies cut into the moonmilk. In this deposit are a number of pools with soft mud and moonmilk in their bottoms. One can sink into this for over 2 ft. Mostly the pools can be by-passed by going round their edges. There are occasional short oxbows. The passage has several abrupt bends although in general the meanders are much more gentle than those further down the cave.

The width of the passage varies and generally it is widest near the floor level where it is from 4 to 6 ft. wide and even more at some of the bends. At 180 ft. from the entrance a chock stone can be seen wedged about 16 ft. above the floor in the upper, narrower part of the canyon passage. Here is the ascent to the Gunman's Cave end of the Sewer connexion at roof level to Branch Passage Gallery.

The cave is deemed to end where there is a vertical descent of 12 ft. over a stalagmite flow down to the floor of the Main Streamway. The usual route down is along a ledge on the left and thence by a bold step across the lower part of the canyon passage on to a ledge on the right where an easy way down can be found. There are various alternative routes off to the right. Some can be chimneyed quite easily but one of them needs a rope or a short tether and 10 ft. of ladder. Where Gunman's Cave is deemed to end is also the junction with Shaft Gallery. The union of the two passages forms the

Main Streamway. The junction at levels above that of the floor of Gunman's Cave is not a simple one. Above is a series of interconnected passages. Some of the connexions are the full height of the passage. Others are loops at varying levels. At the same level as the floor of Gunman's Cave there is the undercut bottom of the Upper Meander Passage (Main Streamway below).

Below this the Lower Meander Passage is reached in a vertical descent. Near the junction it is possible to get up into the roof. The roof passage going downstream is a 20-ft. wide or wider passage with a flat roof with walls about 2 ft. high. The floor slopes down from each side towards the incised meander trench, which is the top of the Upper Meander Passage of the Main Streamway. The trench wanders from side to side of the floor and the slopes of the floor steepen towards the edge of the trench. There is a little mud along the edges when the trench is on the opposite side of the floor. The form of this roof-level portion of the Main Streamway passage is similar in every way to that of the roof portion of Branch Passage Gallery both above and below the Muddy Link where the roof route has been followed for a very long way. At the roof level of the Main Streamway the passage has been followed downstream for about 100 ft. to a point where the risk of sliding down into the canyon passage to the rock floor some 40 ft. or more below became too great. The passage can be seen to continue in the same form to the limit of vision provided by a powerful electric head lamp. Upstream from the junction the Shaft Gallery roof passage is a 2-ft. wide, tightly meandering, minor canyon passage with *Productus giganteus* in the top 1 ft. This little passage is 3 ft. high. A second roof level is then formed below it, flat and 4 ft. wide. Below this the Shaft Gallery passage meanders.

THE MUDDY LINK AND ASSOCIATED PASSAGES

The canyon passage entering on the left 30 ft. inside the entrance to Gunman's Cave is some 7 ft. high and 3 ft. wide. It can be followed upstream but the floor slope is steeper than the roof slope and the height soon decreases to 5 ft. at 35 ft. from the start of the passage. Here there is a westerly turn (left going upstream). At this turn another passage enters down a filthy muddy slope from the north-east. This is the lower end of the Muddy Link. Beyond the bend the canyon passage runs for 30 ft. into a small chamber about 12 ft. in diameter and 4 ft. high. The stream so far followed rises amongst boulders in the floor and is also fed from a small tributary from the left wall of the chamber. This comes from an impassable bedding plane passage trending back towards the main pothole. Through the right-hand wall of the chamber the lower of the two passage branches running into the Muddy Link can be seen but not entered. Across the chamber from the entrance is a passage 2 ft. high and 4 ft. wide, which, after 8 ft., forks. The

right-hand branch is only 9 in. high but leads into the upper of the two tributaries to the Muddy Link. The left-hand fork is choked.

The Muddy Link itself is 150 ft. long and connects Branch Passage Gallery and Gunman's Cave. The roof of the Muddy Link and its associated passages is formed by the same bed of rock as the roof of Branch Passage Gallery and in turn this is the same which forms the roof of the canyon passage just described, Gunman's Cave and Shaft Gallery.

It starts from the right side of Branch Passage Gallery just downstream from Section 36. There is a climb up out of the stream bed and then up over mud and boulders to a height of 15 ft. The floor is now of mud and continues to rise gently till the height of the passage is only 2 ft. 6 in. and it is 4 ft. wide. The passage continues in this form for about 60 ft. down a gentle slope to emerge down a final mud slope of 2 ft. into the canyon passage and Gunman's Cave. At 60 ft. from the start from Branch Passage Gallery a tributary comes in on the right. It is a low passage 18 in. high and it can be followed in an upstream direction for 16 ft. where it enters a chamber, U shaped in plan, 11 ft. high and 3 ft. wide. From here the passage climbs 8 ft. following a northerly joint into a chamber 14 ft. by 18 ft. and 10 ft. high. Above the entrance to this chamber a small gap leads into a greatly shattered aven. The chamber has no solid walls and appears to be in a shatter belt.

The first of the two lower tributaries to the Muddy Link comes in at 110 ft. from Branch Passage Gallery again on the right or west. It can be followed upstream in a low crawl for about 100 ft. on a bearing of about 300° average direction. It then gradually closes down till it is only 12 in. high and 30 in. wide. It has two impassable connexions (mentioned above) with the other passages at the head of the canyon passage.

There is thus a considerable network of passages with their roofs in the same bed forming connexions between Branch Passage Gallery and Gunman's Cave in the area adjacent to the pothole. Only one of these, the Muddy Link, provides a passable connexion. Further downstream The Sewer provides another connexion.

THE SEWER

This is the passage first explored by the R.A.F. Potholing Club (Cranwell) in 1952. They entered it from Poll Ardua (Shaw, 1956), a shake hole, south-east of the main pothole but west of the road. From Poll Ardua, a passage led to Pagoda Pot and thence to The Sewer. This latter passage forms a roof-level connexion between Gunman's Cave and Branch Passage Gallery. It is a thoroughly awkward and unpleasant passage and need not be used as there is an alternative, shorter and easier route through The Muddy Link (p. 225). The general direction of The Sewer is south-east from Gunman's Cave. The access point, which is 180 ft. downstream from Gunman's

entrance, is marked by an unstable looking chockstone, 16 ft. above the floor. The passage at this point is 6 ft. wide at floor level, and 3 ft. wide at the level of the roof. A handline, slung over the chockstone, is a help for the first part of the climb up to the ledge, near roof level. The ledge is followed downstream for 10 ft. to an opening, which leads into a low, sandy passage on the left. This is a dry gravel with no appreciable slope. It varies in height between 1 ft. and 3 ft. and in width between 2 ft. and 3 ft. After 80 ft. it leads into the bottom of Pagoda Pot, which is an aven 50 ft. high and roughly oval in plan, being 24 ft. long by 9 ft. wide. A high level passage, now blocked, enters The Pot in its northern side, about 25 ft. above the floor. This is the passage from Poll Ardua. The walls of The Pot are covered with flowstone, kept moist by several substantial drips from the roof. These give rise to shallow, muddy pools in the floor; these pools continue along the rest of the passage. This goes off from the south-east side of the aven bottom and is at first 4 ft. high and 3-5 ft. wide, but gradually narrows and increases in height as the Waiting Chamber is reached, 180 ft. further on. This chamber is a temporary and welcome widening before the last, horrible 110 ft. of muddy and tortuous canyon passage. At its best the passage is extremely narrow and only passable at one level, along any one stretch. At one point this involves squirming through 1-ft. deep, white mud and water mixture which forms the floor. At another point there is an awkward, full-length traverse, 2 ft. above the floor level. Each sharp bend has to be negotiated in its own way and with a view to tackling the succeeding one. There is a very slight down-slope from Pagoda Pot to Branch Passage Gallery. There is no belay point where the passage enters Branch Passage Gallery and an iron bar, 2.5 ft. long, is required. It can be wedged across the passage mouth to form a somewhat insecure anchor for a ladder or rope for the 12-ft. pitch to the floor level of Branch Passage Gallery streamway, here 10 ft. wide with boulders on the floor.

SHAFT GALLERY

This passage can be entered most easily by a low crawl through boulders from the floor level of the west side of Poulmagollum pothole. This way comes out at the northern end of the open Main Shaft after 20 ft. The Main Shaft here is 25 ft. long from north to south. Shaft Gallery begins at the south end. It is a typical Clare canyon passage but the meanders are fairly simple at first, though well developed. The passage starts off south-westerly but soon there are repeated changes of direction, though the general trend is approximately south. The roof bed is the same all the way down the passage into Gunman's Cave, and continues beyond (*see below*). The slope of the floor gradually decreases from about 15° at the entrance to an almost negligible one. Pools appear in the floor after about a third of the length of

the passage, and these are sometimes deep. When the stream is not flowing, these pools are noticeably colder than when the stream is flowing.

The passage starts as a rift and is 20 ft. high soon after the entrance, which is 10 ft. high. A substantial tributary enters from the right, just after the entrance. The passage is about 3 ft. wide at floor level. An upper level of meanders appears after 100 ft., which at their base are some 4 ft. wider than the lower part of the passage. The height of the passage soon increases to an estimated 50 ft. and at 157 ft. the width at head level is 15 ft. From here downstream, the upper level of meanders becomes more complex. Oxbows occur at all levels in the walls; in some cases being completely offset from the present streamway and so, much reducing it in height, as in Upper Poulmagollum. The stream channel is generally 3 ft. wide and meanders more noticeably than the upper levels of the passage.

A chert band appears 20 ft. above the floor at 240 ft. with a contorted, very thin, shaly band (approx. $\frac{1}{4}$ in. thick), at about 6 ft. above the floor. At 300 ft. the passage height is still 50 ft. and one can, for convenience, leave the stream and pass along a normally dry series of meanders. A drop of about 5 ft. takes one back to stream level again. The shaly band is seen again 400 ft. from the entrance, 10 ft. above the floor. Here the passage has been climbed. The T-junction roof is 45 ft. above the stream. The fossil, *Productus giganteus*, was seen in the roof and 1 ft. below. The meander just below roof level is barely 1 ft. wide. Dried mud, with shale fragments, was noted on all ledges above 20 ft. Shortly after this the passage divides. The upper level meanders go off to the left of the 8-ft. high, lower streamway, but quickly rejoin. A little way downstream, recent flood debris, in the form of tree branches, was noted approximately 25 ft. above the floor (1961). At this point the passage is 6 ft. wide at 6 ft. above the floor, but 3 to 4 ft. wide at floor level. The roof after 500 ft. ceases to be visible, but is known to be 50 ft. high. From here onwards, the character of the passage remains the same until the junction with Gunman's Cave. The base of the upper level meanders widens to 10 ft. The lower streamway is 4 ft. wide as it approaches the junction.

MAIN STREAMWAY

Immediately after the confluence of Gunman's Cave and Shaft Gallery the resultant passage is called the Main Streamway. The roofs of both Shaft Gallery and Gunman's Cave are formed by the same bed and the floor of the former, which is 10 ft. below that of the latter, is the same as the floor of the Main Streamway (Sect. 19).

After the trickle of water from Gunman's Cave has dropped over a flowstone fall to join the main stream, Gunman's Cave appears to continue as a high meandering canyon passage 10 ft. above the floor of the main streamway; these meanders are not only out of phase with those of the Main

Streamway but also occur in a wider meander belt. However, in reality, the upper level passage was produced when Gunman's Cave and Shaft Gallery were both active streamways, for Shaft Gallery also has an upper level of meanders which start 100 ft. downstream from its upstream entrance. It is quite easy to travel along this Upper Meander Passage as far as the First Waterfall and so keep out of the stream, because lateral corrasion by the old stream has left wide ledges at the level of the floor of Gunman's Cave (Sect. 18). Thus it seems that for a considerable period there was little downcutting by the stream in the Main Streamway, just lateral shift of the meanders, but when downcutting re-started, the flow of water through Gunman's Cave was practically negligible and has been so ever since. It is interesting to note that the present stream is not a misfit in its trench below the widened section, but fills the floor and is quite capable of producing such a passage. The soft moonmilk deposit seen throughout Gunman's Cave is not seen in either the Upper or Lower Meander Passages, although the ordinary form of calcite deposit is seen occasionally and mud deposits can be found on the ledges and in the bottom part of the Upper Meander Passage.

The Main Streamway is a tall, narrow, tightly meandering passage as far as the First Waterfall Chamber. The width of the passage is first 2.5 ft. gradually increasing to 3 ft. (Sects. 17 and 16). Although the roof is not often seen, where the Upper and Lower Meander Passages coincide it is estimated to be about 60 ft. above the floor, and appears to be flat with a T-form development. The walls of the Lower Meander Passage are strongly scalloped and the floor is for the most part covered by a limestone-with-shale-and-flagstone gravel. While the depth of the water is normally between 6 and 12 in. in summer, there are occasional pools as much as 3 ft. deep. There are no known tributaries in this section, but there is an aven with a strong drip in the Upper Meander Passage about 400 ft. below Gunman's Cave. The level of the wide section (e.g. *Fig. 53, D, (1)*) between Upper Meander Passage and the Streamway drops at a steeper rate than the floor of the Streamway.

The First Waterfall Chamber is encountered 575 ft. downstream from Gunman's Cave. It consists of a 25 ft. long aven stretching across the Main Streamway into the left-hand wall, so that the right wall of the chamber is still that of the main passage. The floor is hidden beneath a pile of large boulders, some wider than the incoming stream passage, that have fallen from the higher parts of the walls and roof. The aven is about 15 ft. wide at its right-hand end but only 5 ft. at its left. At this narrow end is a 25-ft. high waterfall. A dye test by Coleman and Dunnington has shown that this is the water from Upper Poulmagollum, which leaves by an impassable bedding plane and flows through Pollbeg (now filled in). The waterfall has been climbed and the passage from which it issues followed as far as possible.

This was first explored by a party led by T. R. Shaw (1956). A scaling ladder was used to climb the 25-ft. high pitch. Above the lip is "a succession of small falls, each up to 6 ft. high, separated by deep, eroded pools". The height of the passage is about 2 ft. to a "small junction chamber which is 13 ft. high". The stream enters at floor level on the far side of the chamber. After two more waterfalls totalling 8 ft. in height "the passage remains for 96 ft. with a flat roof 7 ft. above the floor". At the far end the passage opens into the side of a small chamber and "the water appears through an egg-shaped hole 2 ft. by 1 ft." in the roof. The point where the water enters is about 190 ft. from the First Waterfall in a direct line. The general direction of the passage going upstream is approximately north. The water is known to pass through Pollbeg (C. & D., 1944, p. 115) which lies about 700 ft. almost due north from First Waterfall. When Pollbeg was open, the water, when high, could be seen to enter from the middle of the west side of the pot and to flow over and through the boulders on the floor steeply down to the south-east corner.

Behind the waterfall and immediately to the upstream side are some excellent vertical flutes, which cut the scallop markings, but on the downstream side these flutes are seen on the walls as far down to where the Main Stream Passage leaves the chamber. The waterfall is undoubtedly the cause of the formation of the aven and thus the chamber. The manner in which the vertical flutes cut the scalloping show that the waterfall is of more recent development than the upper portions of the scalloping. The chamber itself has obviously been formed by waterfall retreat.

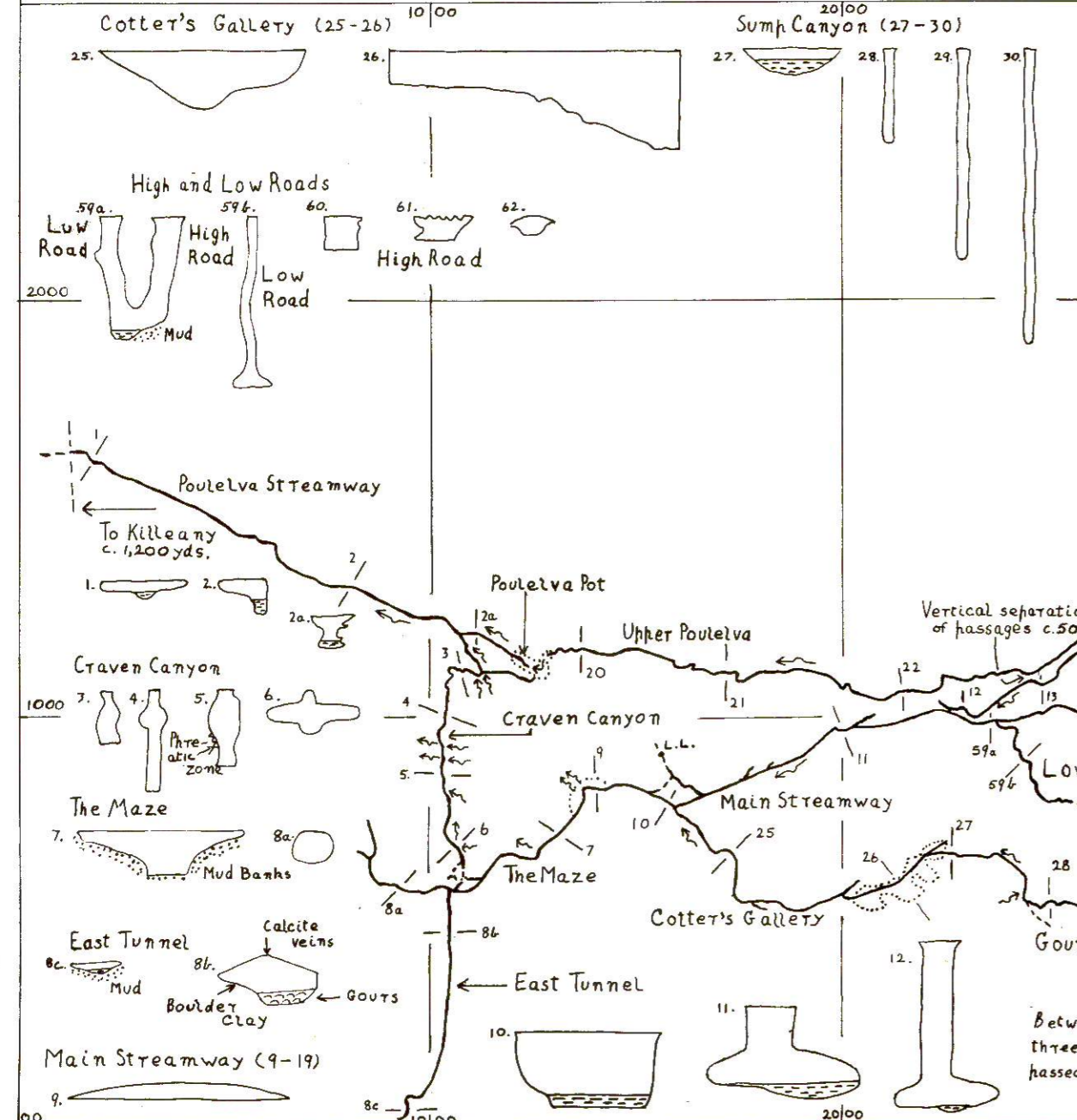
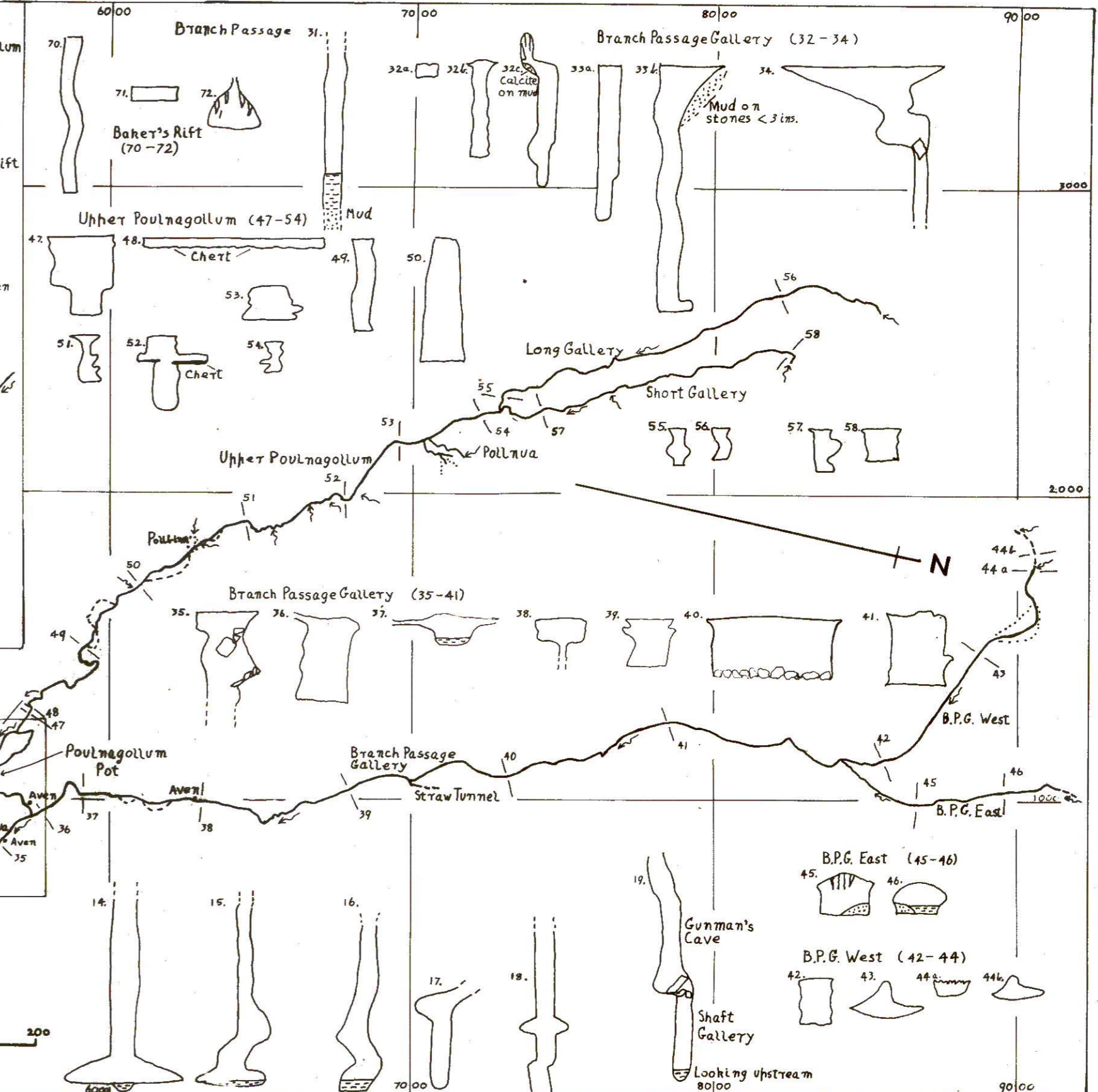
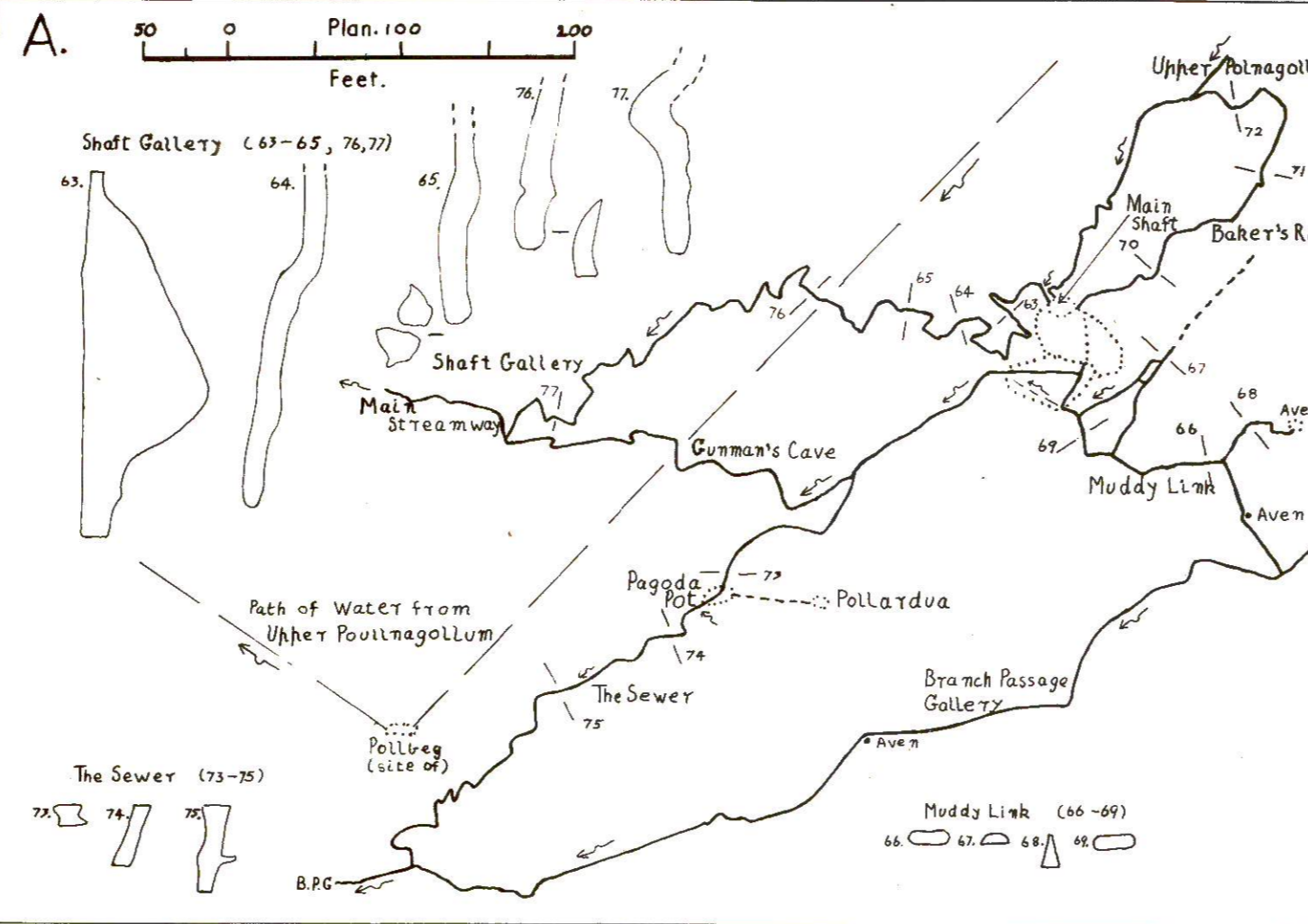
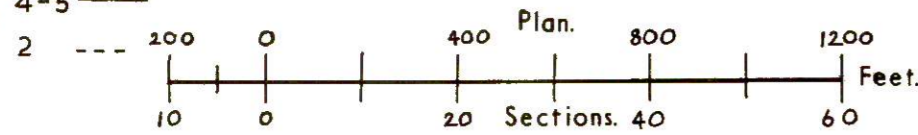
After leaving this chamber, the Main Streamway continues as a tall, meandering canyon passage for 2,600 ft. to where it is joined by Branch Passage at the Main Junction. Along this stretch is a slight widening of the passage associated with an enormous boulder, which partially blocks the passage. This is the so-called Westropp Chamber (C. & D., p. 116). For the first part of this section the character of the passage is the same as that before the First Waterfall, except that the width is now 4 ft. as opposed to 3 ft. (Sect. 15). The passage as a whole still has an upper and a lower portion but the Upper Meanders are much tighter than before. About 200 ft. below the first Waterfall Chamber there is a large aven in the Upper Meander Passage containing a small waterfall; the water from this runs straight into the Main Streamway. The source of the water is unknown. Apart from this aven, which has some iron-stained flowstone on the floor and walls, the Upper Meander Passage continues to be dry with mud and occasionally boulders and gravel on the ledge. Continuing from the First Waterfall the height above the stream of the wide section, which is the floor of the Upper Meander Passage, continues to decrease until it is only 2.5 ft. above the Main Streamway floor at the Main Junction and disappears entirely below that

POULNAGOLLUM - POULELVA CAVES.

Slieve Elva, Co. Clare, Eire.

U.B.S.S. Survey 1962.

C.R.G. Grade 4-5



Between sections 12 and 13 are three obstructions which can be passed at stream level.

point. The meanders of the Main Streamway also become more open. The wide section, as shown in *Plate 15B*, is a form of meander belt within the limits of which the Upper Meander Passage winds sinuously. The present stream passage is wider than the upper meander and generally meanders less acutely. However, at times, it swings beyond the limits of the wide section (*Plate 16*). Slip-off slopes are very common and current marking prominent. The largest scalloping is found generally on the outside of meanders.

Though the roof is not often seen it is probable that it remains in the same bed all the way down from Gunman's Cave to Main Junction and that the floor slopes less than the roof dip, thus making the roof height less, lower down the cave. Consequently, 600 ft. upstream from Main Junction, the roof can be seen less than 50 ft. above. At Main Junction it is a little over 30 ft. In this last stretch, the passage is partially blocked in two places owing to boulder falls. The stream itself flows faster after the First Waterfall, but, while the depth is normally about 12 in., constrictions cause a few pools to be formed where the water is 3 ft. deep. Flood markings show that in this part of the cave the water can rise by nearly 6 ft.

At the Main Junction the stream passes under an arch a little over 2 ft. high and 7 ft. wide (*Plate 17*) where it is joined by the Branch Passage stream. The Upper Meander Passage which moves away to the right before the arch, and rejoins the Main Streamway after 20 ft., is blocked in the middle by boulders and mud though it is possible to get through at roof level. A very clear section through this infilling is to be found at the downstream end of this blocked passage. The bottom 3 ft. is ill-sorted, Namurian shale and gravel, with boulders up to 1 ft. in diameter. This is abruptly overlaid with a layer of finely laminated or varved, ochre-coloured clay, which is sticky and very fine. This can only be boulder clay. The thickness of this varved clay bed is 2 ft. at the sides, where protected, but only 5 in. in the centre where it has been eroded and has slumped a little. The whole is overlaid with half an inch of dark brown silt obviously recently deposited by flood waters. Similar triple deposits are found in several places between Main Junction and the Maze, a little above the present stream level.

Just before the blockage on the upstream side, there is another passage, by-passing the low arch to the left and running at a higher level. This is the Waiting Room (C. & D., 1944, p. 118), but even this takes plenty of water under flood conditions, as debris shows. Thus the Upper Meander Passage and Branch Passage, which have their roofs in the same bed, run parallel for 20 ft. before joining, but relatively recently the stream has undercut at two successive levels into the Branch Passage, where they begin to run together. After the Main Junction, the Main Streamway is in a canyon passage about 30 ft. high and 3 ft. wide, but the lowest 5 ft. have been undercut on both sides so that it is nearly 20 ft. wide at floor level (Sect. 14). The floor is covered

with mud and shingle and the stream has, in some places, cut a channel into this. In the continuation downstream, the upper narrow part of the passages moves repeatedly from left to right and back again in relation to the widened lower portion. The undercutting has been so great in some places that the higher part seems almost to leave the lower part completely. Still the meanderings of the upper part and lower part are far more often in phase along this section than they were upstream from Main Junction. Where the two parts do get out of phase, it is often easier to travel along the dry, but muddy and boulder-strewn, floor of the Upper Meander Passage. The roof gets steadily lower owing to the gradient of the floor being less than the dip slope of the roof, so that at the junction with High and Low Road (C. & D., 1949) the passage is only 20 ft. high and the lower, undercut part is only 2.5 ft. high. In the dry summer of 1959, water was seen to bubble up through the stream bed about 200 ft. below Main Junction. Scalloping is still seen to cover the walls and calcite formations are very rare. Rock falls have occurred at several places causing pools of deep water to form, but it is only necessary to cross four of these. The first is about 3 ft. deep in normal water conditions and is about 300 ft. below Main Junction. The second is "Coleman's Bath" which comes after a further 400 ft., but here it is not more than 2 ft. deep if a narrow ledge on the extreme left is used to cross it. Two other pools, each 3 ft. deep in normal conditions, occur in the next 200 ft.

After 1,430 ft. from Main Junction the present streamway joins High and Low Roads. At this junction, the narrow, meandering part of the passage above 3 ft. from the floor continues straight on to form a rift blocked to the roof with laminated boulder clay. There is a steep mud slope leading up to the blockage and above this slope the passage can be followed at roof level, with difficulty, for a further 120 ft. Just before the mud slope starts, the lower, undercutting meander has cut its way through 12 ft. of rock in the left-hand wall and entered the combined High and Low Roads Passage and it is through this opening, which is 2.5 ft. high, that the present stream flows. About 60 ft. before the rift passage becomes completely impassable, there is a small connexion with the High and Low Road Passage, 15 ft. above the floor and nearly at roof level, and it can be seen here that the roofs of the two passages are in the same bed. The blocked rift has a roof with eroded pendants and a small channel in the top of the boulder clay fill. 300 ft. downstream from the High-Low Road Junction, a narrow canyon passage enters the streamway from the right. It extends to the full height of the stream passage and is choked, after 40 ft., by a varved, boulder-clay deposit which fills the passage to the roof with its eroded pendants. The clay has a small channel cut in the top of it. This is almost certainly the continuation of the Main Streamway Passage, lost at High-Low Road Junction. The two passages have therefore repeated the pattern of Main Junction, but in a more lengthy form.

A few feet after the entrance to the original, but now mud-blocked passage it is entered from the right by a small stream of unknown origin. From the Junction onwards, the main stream still flows in the low, undercutting meander, which has now added itself to the bottom of the continuation of the High and Low Road Passage and thus this continuation has now become the Main Streamway. After 200 ft. of streamway below the Junction, the roof is flat with no sign of a T formation. The upper part of the passage is almost square in section, being about 6 ft. wide, but the undercutting meander part, which is about 20 ft. wide, gives the passage a total height of 10 ft. The water here flows in a channel which it has cut on the right-hand side (Sect. 11). The general character of the cave remains unchanged for the next 700 ft. until Cotter's Gallery (C. & D., 1944, p. 118) is reached, except that by this place the height has decreased to 8 ft. as the dip slope of the roof is greater than the floor gradient. There are frequent rock falls along this part of the cave, mostly in the form of large slabs, up to 50 ft. long, from the roof. Where these falls occur, it is seen that the bed immediately above that forming the roof is the same as that in which both Branch Passage Gallery and the Poulelva Main Streamway are formed. It is a bed with a very distinctive fossil assemblage and in particular contains an abundance of *Productus giganteus*. Two passages enter the stream from the right before Cotter's Gallery. The first, 180 ft. above the Cotter's Gallery junction, is a low canyon passage similar to the previous passage on the right and blocked by varved boulder clay, after 50 ft. The second is a stream passage 80 ft. upstream from Cotter's Gallery. This is a 6-ft. high canyon which leads, after 90 ft., into a beautiful little chamber, richly decorated with formations and with an abundance of *productids* in the walls. The stream enters this chamber down a 10-ft. pitch from another small, decorated chamber. The stream also enters this second chamber down a 10-ft. drop and the pattern seems to continue above. The whole passage was called Leprechaun's Leap. 20 ft. before this tributary passage joins the Main Streamway, a low crawl goes off to the south down a flat-roofed passage, nearly filled with laminated boulder clay. This can be followed for 90 ft. until it rejoins the streamway below Cotter's Gallery, having cut off the corner at that junction. The lower entrance can be seen to the right of the figure in *Plate 14B*.

At the junction with Cotter's Gallery, which comes in on the left, there is a chamber with a pool filling the floor. This pool is about 2 ft. deep under ordinary summer conditions but the whole area can be filled to a height of at least 8 ft. above this under flood conditions (e.g., July 1961) and the water backs up into Cotter's Gallery. From this junction the main stream, plus the small one issuing from Cotter's Gallery, takes the only way out of the chamber along a wide, silt-floored bedding plane passage 2 ft. high and not less than 20 ft. wide (Sect. 9), where the roof is covered with partially dissolved

pendants, and where the walls are covered by scallops with solution-blunted cusps. This solution of the cusps probably takes place when flooding occurs.

The stream can be followed along this bedding plane for 280 ft. to another chamber. Although the roof gets steadily lower from Cotter's Gallery it suddenly rises in this chamber to 4.5 ft. at the centre. The stream flows off to the right in a south-west direction across the gravelled floor, into a 1-ft. high bedding plane with pendants from roof to floor. This has been followed in dry weather for 50 ft. but it is difficult and the stream is known to sump before Poulelva, where it reappears as the stream at the head of the Poulelva Streamway Passage. There is another exit from this chamber to the left, going first in a south-east direction, and this is the entrance to the Maze.

THE MAZE AND EAST TUNNEL

This is the name given to the complex series of passages, tunnels and collapse chambers that exist at the bottom of Poulmagollum (C. & D., 1944, p. 119). The description here given and the survey are those of the obvious route. Entry is gained from the chamber just described by wriggling up and over a levee of gravel, deposited on the outside bend of the stream as it turns south-west into its final bedding plane passage. The straight passage thus entered is 20 ft. wide, and its height becomes 6.5 ft. after 450 ft. (Sect. 7). For the first part of the passage the floor is covered with gravel, with a channel cut into the middle. The relative positions of the stones making up the gravel show (1959) that the last active stream flowed north-west. It is likely, though, that this last active stream was in fact the product of present-day flooding (e.g., July 1961); when the whole of this part of the cave becomes filled with water and when the flow decreases back to normal, the flood waters retreat the way they have come. After 500 ft. the roof comes down a bed. The new roof is remarkable for the number of its pendants. East Tunnel lies to the left under the pendant roof. To the right, the way on is through a tunnel 4 ft. high and 5 ft. wide, which runs for just over 100 ft. to a collapsed boulder chamber. A little way along this tunnel is an oxbow on the right. It rejoins the tunnel after 20 ft. It has a mud floor. Its right-hand wall is formed of fallen limestone blocks. In places it can be seen that these have partially filled up a bedding plane passage in thinly bedded limestone about 9 in. high, which leaves the oxbow at the present floor level and stretches to the right of it. This bedding plane passage is 15 ft. long and leads directly into the east end of the Craven Canyon of Poulelva. So far no part of the bedding plane has been found high enough for a person to get through from one cave to the other but a way may yet be found. The connexion was verified by parties descending each cave and meeting one on each side of the gap.

After the collapsed boulder chamber, there are many ways on, all of which involve climbing over or round boulders, most of which soon close

down due to the thick mud and silt deposits or to boulder falls. In the right-hand wall of this chamber is a way through the boulder ruckle. This leads to a passage 4 ft. high containing gour pools and this in turn leads to a narrow passage 7 ft. high that ends in a muddy-silt choke. Both these passages have their walls and roofs covered with mud. A small orifice in the muddy-silt choke at roof level in the last passage leads into another similar one, which ends in a muddy-silt choke also. It seems that the whole of this part of the cave is a maze of passages up to 7 ft. high, often mud-filled or interconnected through boulder ruckles and boulder chambers. The plan shows one route through the first part.

The route to the beginning of East Tunnel starts at the point described above, and after a 30-ft. crawl under the roof pendants emerges into a 20-ft. wide chamber which is about 10 ft. high. East Tunnel leads out of this, eastwards in a straight line for 470 ft., following a very marked, calcite vein in the roof. The cross section of the Tunnel is an inverted V, with the sides sloping down from the calcite vein in the centre of the roof. The Tunnel is 20 ft. wide and 7 ft. high at the beginning; it decreases to 6 ft. wide and 3 ft. high at the far end. A short way along the passage, the boulder and mud floor gives way to gour pools on the left and mud banks on the right. Laminated boulder clay is found along this passage. At one point, an 18-in. stalagmite has formed on this deposit. At the far end of the Tunnel, there is much shattering and roof collapse. A way on through this exists which has been followed for 180 ft. through mud and pools. The average height of this last section is 1.5 ft. It appears to continue indefinitely out under the centre of the valley. The survey makes it clear that the East Tunnel is a continuation of the Craven Canyon in Lower Poulelva (p. 250). Much of the gap between the two passages is impassable largely, if not entirely, because of roof falls and mud in-filling.

BRANCH PASSAGE

This passage is described moving upstream because of the nature of its upstream end.

Branch Passage joins the Poulmagollum Main Streamway at Main Junction. This has been fully described in the Main Streamway account. Just above the junction the passage is floored with small rapids. For the 700 ft. from Main Junction up to the ladder pitch from Branch Passage Gallery this passage is a typical vertical sided canyon, 36 ft. high, and generally about 6 ft. wide, although the width is double this around Main Junction. There are several large boulders on the passage floor. The top of the ladder pitch from Branch Passage Gallery is 22 ft. above the stream on the right, east, side of a small chamber formed by the canyon passage widening to 10 ft. This pitch carries surplus waters from Branch Passage Gallery under flood conditions. A further 80 ft. upstream from this, another hole, 20 ft. up the right

wall, discharges the Branch Passage Gallery stream as a powerful waterfall, which falls into a similar but smaller chamber. Here, the roof of the passage is about 50 ft. above the stream, the maximum for Branch Passage. There is a slow increase in roof height from Main Junction to this waterfall and this is probably due to the one bed which forms the roof dipping at a steeper angle than the floor of this section of Branch Passage.

Upstream from the waterfall the passage reverts to a canyon form, although only about 3 ft. wide and with a little water flowing over the boulders and stalagmite on the floor. After 40 ft. the floor slopes more steeply upwards for 20 ft. to the foot of the first barrier. This barrier consists of boulders, apparently fallen from the roof, loosely cemented by mud and calcite. A 10-ft. climb leads to the top of this barrier which fills the passage to within 20 ft. of the roof. It is 9 ft. long at the top and about 18 ft. long at the base. A 20-ft. ladder belayed to a firm boulder on top of the barrier just reaches to the surface of the water on the far side; the lower 15 ft. is a vertical drop. This water appears to be static but is known to vary in depth from 5 ft. to 3.5 ft. with an unknown depth of soft mud on the bottom. Presumably it drains through the barrier to form the stream which is met on the downstream side. For 150 ft. upstream from the first barrier the water continues at about this depth in the 3 ft. wide canyon passage, with the roof at an unknown height, above. The water decreases in depth in the next 90 ft. until the floor emerges to become a dry calcite-covered rock floor with no stream flowing on it. The only obvious source of water for the canal is a small waterfall which enters from the right 210 ft. from the first barrier.

From the end of the water the dry canyon floor rises gently in the next 100 ft. to the foot of the second barrier. This was presumed to be formed of boulders and is covered with a thick layer of soft calcite. The barrier is very difficult to climb and rises for 18 ft. to within 5 ft. of the roof. At this level the passage is revealed as being typical of Clare as it has a T cross-section. The upper 2.5 ft. of the passage is a horizontal bedding plane, 8 ft. to 10 ft. wide, tapering to 4 in. in height at the outer limits. The second barrier fills the lower part of the passage and is 5 ft. long at the top. From this the route upstream is a traverse for 20 ft. at roof level above the canyon to the top of the third barrier. This is similar to the previous barrier. On the upstream side a 10-ft. rope gives an easy descent to the moonmilk and mud floor. This can be followed for a further 25 ft. to a pile of boulders. For 40 ft. beyond this the floor slopes gently upwards to the base of a mass of boulders covered with white calcite flow on boulders. This mass is 8 ft. high. The passage above this obstacle is rock floored, 4 ft. wide and at first 4 ft. high. It can be followed for 30 ft. The floor rises steadily towards the roof and the passage widens until it becomes a bedding plane 8 ft. wide with a maximum height of 6 in. This is the limit of exploration.

BRANCH PASSAGE GALLERY

The end of the survey is a mud bank 2.5 ft. high in a passage going west, passing under an aven which crosses the passage at right angles along a north-south joint. The aven is about 25 ft. high and is blocked at its northern end by loose boulders. Just beyond this, the passage turns towards the south-west and passes under two more avens, 10 ft. and 20 ft. high. A small stream enters from the third aven. Exploration beyond this point was not continued because of the very unstable nature of the roof. It is to be noted that immediately beyond the mud bank a stream is met, which is flowing towards the avens. The cover is then moving downstream towards these avens, whereas until the mudbank he had been moving upstream; thus a complete reversal of direction of waterflow has occurred.

This unusual drainage pattern cannot be fully explained but is possibly due to the saturated mass of mud and shale in the floor, giving rise to two separate streams. It is probable that the west-flowing stream, which is known to be turning south, joins the other stream in the very wide bedding plane passage some 300 ft. down Branch Passage Gallery West from the mud bank.

In this description, the mud bank is taken as being the end point of Branch Passage Gallery West, and from here onwards, one is proceeding downstream in a general southerly direction. 40 ft. below the mud bank, a stream emerges from the floor debris and this is followed down for the rest of the way.

At first this is in a passage 3 ft. to 4 ft. wide at roof level, with a wide bedding plane extension at floor level. The floor of the passage is scalloped and covered with sharp, shale fragments and long pools of water. 300 ft. from the mud bank, the cave develops into a bedding plane passage 18 in. high and up to 50 ft. wide, with the stream flowing over the whole width of the floor, here of soft moonmilk.

Over the next 200 ft. the passage narrows and the floor gradually falls, until the gallery is 5 ft. high and 10 ft. wide. The passage continues in this fashion for the next 500 ft. although it narrows to 6 ft. before the tributary passage from Branch Passage Gallery East enters. At this point the Gallery widens to 12 ft. A mud stalagmite about 4 in. high was seen at the entrance to Branch Passage Gallery East.

Below the junction of the tributary, the passage is large and the going fairly easy. In general the passage is between 8 ft. and 15 ft. high and between 10 ft. and 20 ft. wide. A T section persists at roof level. The floor is often covered with a mass of boulders and slabs of rock, fallen from the roof; a characteristic which is seen throughout the length of Branch Passage Gallery. The stream flows sometimes over the whole floor, sometimes beneath the walls, and sometimes beneath the fallen debris. There are several clusters of straws,

about 3 ft. long, in this section of the passage. In this part of the Gallery, layered mud deposits, about 2 ft. deep, occur. The only inlet noted is about 1,000 ft. south of the junction, where a small trickle flows into the stream from roof level, through a small hole about 2 ft. square on the left-hand side of the passage. This inlet was not investigated.

About 600 ft. downstream from this inlet, there is an aven about 40 ft. high, dipping 80° to the north-west, on the left-hand side of the passage. 100 ft. south of this aven, an old dry, stream passage, named Straw Tunnel, enters from the left. This is described later.

The walls of the passage between the junction of the two tributaries and Straw Tunnel exhibit large current markings, about 9 in. in diameter, over the whole surface, except for a few inches at stream level, where the scalloping is much smaller.

The character of the passage downstream from Straw Tunnel changes considerably, being generally much smaller in cross-section. Passage width varies from 5 ft. to 10 ft. and the height is between 6 ft. and 8 ft. The general direction for the next 500 ft. is slightly east of south and then trends south again. 500 ft. downstream from Straw Tunnel, the stream flows down a passage about 8 ft. wide, which appears to be too low to follow. The way on is an oxbow to the left about 3 ft. wide and 11 ft. from floor to roof and containing 6 ft. of standing water. The traverse over this water for 30 ft. is very difficult. Half-way along this piece there is a hairpin bend to the south-west. At the bend a passage enters from the left; it can be followed upstream for 15 ft. where a mud choke reaches to the roof. Beyond the traverse, the cave runs almost due south. 100 ft. downstream from the traverse, there is a second traverse, again above deep, standing water, but much easier than the first, and also about 30 ft. long. An impassable, mud-choked oxbow by-passes the second traverse.

The passage immediately south of the second traverse is aligned along a $\frac{1}{2}$ -in. wide calcite vein. In the roof, the vein projects where the rock has been dissolved on either side, but in the water, the vein is flush with the floor. This suggests that either the calcite is less soluble in the phreatic water than the limestone, and the lower part of the vein has been subsequently corraded by vadose action, or that when the water level is roof high, most of the suspended corrasive matter is in the lower part of the stream.

About 100 ft. beyond the second traverse is a small chamber about 15 ft. across, off the right-hand side of the stream. This chamber contains an aven, 50 ft. high, beautifully decorated with calcite, down which a heavy drip falls. The stream passage now proceeds for a further 80 ft. where a dry oxbow, 100 ft. long, by-passes the stream, on the left-hand side. 80 ft. on there is another dry oxbow about 30 ft. long, again to the left-hand side. Opposite the upper end of this oxbow, a narrow tributary stream enters from the

right-hand side of the gallery. This stream runs parallel to the main stream and is too low to follow after 60 ft.

Downstream, 100 ft. from the oxbow, a low crawl in water around a gentle left-hand meander brings the passage trend once more slightly east of south. The floor drops for the next 200 ft. over a series of small rapids, to a point where the passage is 25 ft. high, with a small vertical aven on the right. An upward slope beneath the aven leads into the Muddy Link Passage, which connects with the upper part of Gunman's Cave. The roof in this section of the gallery is in the same bed as the roof of Muddy Link and Gunman's Cave. The distance from the junction of Branch Passage Gallery West and East is 3,082 ft.

Gentle, almost continuous rapids proceed for the next 200 ft. until the passage is a high rift meandering within the limits of the wide T section at roof level, in a similar, but less exaggerated, manner to the Poulmagollum Main Streamway. A vertical aven, 7 ft. wide and 80 ft. high, appears here, and immediately downstream from here, the wide bedding plane cave at the top of the T section develops into a roomy passage, easily negotiable by walking, with the stream flowing at the bottom of the rift. Both the rift and the roof passage meander, the meanders of the canyon being slightly sharper than those of the roof passage. The total height of the passage is about 25 ft. In places, fallen boulders and mud deposits block the roof passage from the stream. There is a 30-ft. aven in the roof, with a heavy drip, 100 ft. from the beginning of the roof passage. Another 100 ft. beyond this, the rift can be descended to the stream, and a little way on a large chamber is reached. A small hole, 3 ft. high and 11 ft. from the floor, marks the exit from the Sewer, which leads via Pagoda Pot and the Crawl into the roof of Gunman's Cave and was the original entrance for cavers into Branch Passage Gallery. This hole is on the right-hand side of the passage. On the left side, opposite the Sewer, a climb up a slope for some 15 ft. gives access to the roof, where an excellent example of bedding plane anastomosis channels can be seen. The broad roof passage can be followed from here to a point at least 1,200 ft. downstream, where it can be seen to continue, but steep, muddy sides indicate that descent to the stream is an easier method of progress. This roof passage was searched for side passages, especially on the right-hand side for possible connexions with Branch Passage, but none was found. The roof passage continues to meander more or less in phase with the rift passage. Much roof fall has occurred and mud deposits cover the walls. These mud deposits were not systematically investigated. Some stalactite formations are to be seen.

The whole gallery can also be traversed at stream level downstream from the Sewer, to the head of the pitch, which drops into Branch Passage. This route is a lofty rift between 2 ft. and 6 ft. wide, with the stream varying

in depth from a few inches to at least 6 ft. in pools. This section of the gallery is not too easy to traverse as there are many submerged boulders. Large chockstones are jammed in the rift at frequent intervals. 500 ft. beyond the Sewer, a small aven, covered with white flowstone, enters the left-hand side of the passage. 1,000 ft. below the Sewer, a large number of boulders have fallen into the stream and become calcited together. It is necessary to climb about 10 ft. up over these boulders and, after a few feet, to drop down through a small hole to the floor and regain the stream 12 ft. below. Beyond this obstacle the walls are often covered with soft moonmilk. 400 ft. downstream from the climb, an aven, 25 ft. high, enters on the left-hand side, well decorated with flowstone. From here the passage trend is approximately south-west, although the rift passage meanders much more than before.

About 1,600 ft. from the Sewer the water is between 4 ft. and 6 ft. deep over a distance of 120 ft. The rift is 3 ft. wide here and traversing the deep water, on narrow ledges covered with soft moonmilk, makes progress difficult. A further 100 ft. on, the stream disappears through a circular hole, 18 in. in diameter, on the right-hand side of the passage. The stream descends a 10-ft. waterfall, which was not followed, and the stream reappears as the waterfall in Branch Passage. The gallery beyond this outlet contains standing water for a distance of about 20 ft. to a point where another small passage opens in the lower part of the wall of the passage and leads away on the right-hand side to the head of a ladder pitch. This pitch is normally dry, but takes the overflow from the Branch Passage Gallery stream when the latter is in flood. At the top of the pitch is a thigh-deep pool of standing water. The ladder is belayed to a boulder above this pool. The pitch is 22 ft. deep and descends into Branch Passage, entering on the left side of this passage in a small chamber about 80 ft. downstream from the waterfall.

Both the connexions to Branch Passage are late developments in the history of Branch Passage Gallery and that passage continues beyond the exit to the ladder pitch. The floor rises gently over gravel and then mud. Roof anastomosis channels are at first prominent but disappear further along. The passage is a canyon 12 ft. high with only a very slight T section at roof level. At 200 ft. the highest point of the continuation is reached. Here the passage is only 18 in. high with a gravel floor and mud-filled sides. Then comes a shallow pool fed by a very small trickle from the left and the water flows out south down over a calcite floor. It was followed for 100 ft. till the air gap was only 9 in. The passage continued to the limit of vision and there was a definite draught (1962) going down the passage contrary to the 1957 report of the air rapidly becoming foul. The general direction is south towards the upper end of High Road, 200 ft. away.

BRANCH PASSAGE GALLERY EAST

The large tributary passage which enters Branch Passage Gallery 1,000 ft. from the beginning of Branch Passage Gallery West is known as Branch Passage Gallery East. The length of this tributary is about 700 ft. and the average passage size is from 6 ft. to 8 ft. high, and the width varies from 3 ft. to 12 ft. The size of its stream is known to vary considerably and can be as large as that in Branch Passage Gallery West; however, most of the stream in the main Gallery normally comes from the west tributary. The general passage direction is south-east in the upper length and south-west in the lower part. The furthest point reached is a passage 6 ft. high and 3 ft. wide, blocked by a stalagmite barrier. A low crawl, continuing north beyond the barrier, is in glutinous mud and soon becomes too tight to pass. The downstream passage goes south-west for 50 ft. and then turns south-east past two small tributaries, which enter at roof level on the left-hand side. The floor here is soft moonmilk over mud. 300 ft. from the beginning there is an aven 15 ft. high, up which flows a draught of air. Downstream from this aven the floor rises gently over fallen boulders and there are many stalactites in the roof. 200 ft. from the aven a calcited rock barrier covers the floor and immediately beyond there are mud banks on the floor. The passage here is 8 ft. wide and 6 ft. high. Much breakdown of the walls has occurred throughout the whole passage and many boulders are strewn across the muddy floor. The passage type is a fairly wide canyon, with T section at roof level. There are corals and a few *productids* in the walls. The roof bed is a single one throughout and is the same one as the main gallery.

STRAW TUNNEL

This is an old, dry stream passage, which comes in on the left-hand side of the gallery 1,500 ft. downstream from the junction. This passage was surveyed for 180 ft. from the main stream and goes upstream in a north-east direction. The height is 2 ft. and the width 4 ft. and the cross-section is an inverted U type, with exaggerated width. A profusion of straws abound in the roof. The passage was seen to continue when the survey was stopped, but was too narrow to follow.

HIGH AND LOW ROADS

Though this passage is entered from its lower, downstream end, it is described from its upper end back to the access point where Low Road joins it. This passage is reached from Main Streamway by walking up the tributary canyon from High-Low Road Junction for 100 ft. to a point where Low Road enters from the right. High Road can be entered by climbing into the roof of the canyon passage over a slope of laminated boulder clay and continuing along at roof level. Most of this passage has been filled to a considerable

depth by boulder clay. At its entrance it is evident that this once extended right up to the roof.

The upstream end of the passage is blocked by a stalagmite flow which fills the passage to within 4 in. of the roof. Beyond this, the passage can be seen to continue to the limit of vision in the light provided by a carbide head lamp. The part beyond the barrier continues directly the line of the passage, which is pointing towards the nearly dry, southern end of Branch Passage Gallery about 200 ft. away. It is reasonable to assume, from the relative horizontal and vertical positions of the two, that High Road was once the continuation of Branch Passage Gallery but this has not been proved. Immediately south of the stalagmite barrier the passage has a typical T section. The top of the T is extremely wide but only 7 in. high against an estimated width of 200 ft. The leg of the T gives an overall height of 3 ft. About 15 ft. from the barrier there is a channel in the bedding plane passage about 12 in. deep on the right. By wriggling along this for 48 ft. a hole in the left-hand wall of Branch Passage is reached, 34 ft. above the floor. Here it is seen that the roof of Branch Passage is formed by the same bed as the roof of High Road. The roof of High Road is, in this part, flat, with no indications of phreatic solution at all, and the walls and floor are covered with thick mud deposits. There is no stream.

For the next 850 ft. the character of the passage remains the same. The height increases to about 12 ft. in about 50 ft. and then slowly decreases until it is only 2 ft. The sudden increase in height is due to the flowstone, which forms the barrier, sloping down from it. The later decrease in height is due to the mud fill and perhaps also to the floor beneath it sloping less than the roof, which remains in the same bed. At 550 ft. from the barrier pendants and some half tubes are seen in the roof (Sect. 61), but no phreatic features are seen on the walls. It is apparent that while the bedding plane part at the top is phreatic in origin, the lower part of the passage is vadose. About 850 ft. from the stalagmite barrier, the height of the passage begins to increase again due to the steepening of the slope of the mud floor. The roof becomes flat, and the bedding plane passage at the top gets very narrow quickly, so that a nearly rectangular section is formed (Sect. 60). No explanation is offered for this absence of phreatic features in this part of the roof of the passage.

At 100 ft. from the junction with the Main Streamway a steep slope on the mud fill of High Road leads down to the stream flowing out of Low Road, which comes in from the left. Low Road is a tall, narrow canyon passage, partly floored with mud and stones (Sect. 59b). It was surveyed for 300 ft. and followed for a further 120 ft. It is a tight, muddy canyon with a stream flowing in a wide plane at floor level. There are mud banks against the walls which the stream is eroding. Its roof is in the same bed as High

Road. After the junction of High and Low Roads (Sect. 59a), the stream passage is 20 ft. high and rapidly increases to 25 ft. as the stream flows steeply down between mud piles to where the passage joins the Main Streamway. Remnants of the varved boulder clay infilling are present on both sides of this last 100 ft. of passage.

COTTER'S GALLERY AND SUMP CANYON

This tributary to Poulmagollum joins the Main Streamway from the left as it takes a right-angled bend to enter the terminal maze. It has two names as it is divisible into two sections. The lower part, Cotter's Gallery, was so named by Coleman and Dunnington (1944, p. 118) and explored as far as the boulder chambers. The upper part, Sump Canyon, was discovered in the dry summer of 1959. A party surveying Cotter's Gallery found this further extension which added 1,250 ft. of quite dissimilar passage to the 880 ft. of Cotter's Gallery. It was believed in 1959 that the very small entrance to this new section would, in times of normal waterflow, be under water, so it was called Sump Canyon. Further exploration in the wet summer of 1961 revealed that the waterflow had barely altered.

SUMP CANYON

The furthest point reached in Sump Canyon is where the canyon passage becomes blocked to further progress by pink flowstone on the walls of the already narrow passage. For the first 25 ft. downstream from this constriction, the only route is 5 ft. above the floor because of the narrowness of the bottom of the passage. Thereafter, the route is on the passage floor. At this end of Sump Canyon, the passage is approximately 40 ft. high, 2 ft. wide and meandering gently. For the next 640 ft. the same general pattern is followed. In 1961 a slight draught was noticed blowing downstream at this far end.

There is a slight stream in the passage, at times barely visible, but becoming more obvious further down the cave when joined by tributaries. For the greater part of the first 650 ft., the floor is composed of mud, or mud covered by calcite and small gour pools. The mud is of unknown depths, and after being stirred up, gives off an unpleasant smell. Some small, mosquito-like, dead insects were noticed on the walls. Large pools are rare in this upper part of the cave. The walls are covered with crenellated mud, or white or yellow crenellated calcite, which is in parts thinly covering mud, particularly in the upstream part of this section. Occasionally, bare rock is visible, marked by vadose scalloping. The cross-section is straight and rarely wider than 4 ft.; in parts it narrows so much as to permit sideways movement only. At one point, 240 ft. down from the constriction, the canyon passage widens to form an oval chamber 8 ft. wide, with a pool 2.5 ft. deep.

This is where a tributary enters through a small and inaccessible opening from the left, down a 12-ft. waterfall. For much of this section, the roof is too high to be visible, but after 470 ft. the T-shaped roof section becomes discernible 25-30 ft. above the floor.

After 660 ft. the passage undergoes several changes. At four points in the next 300 ft., boulders, which presumably have come from the roof or higher parts of the walls, are wedged across the passage, forcing the caver either to crawl in the stream or clamber up out of it, as high as 6 ft. above water level. In this 300-ft. section, the walls are largely of bare rock, although parts are covered with mud. The canyon passage becomes no wider but considerably lower (e.g., Sect. 28), the height dropping from 25 ft. to 7 ft., but retaining a T-shaped cross-section throughout. Some half tubes are visible in the roof. As there is no obvious change in the roof bed, one must presume that the floor is dropping at a less steep angle than the bed in which the roof is formed.

In the last 220 ft. of Sump Canyon, the passage undergoes several changes. It loses its typical T shape and gently decreases in height from 7 ft. to 2 ft. (Sect. 27). At the beginning of this part the passage becomes 12 ft. wide at roof level where a tributary enters from the left.

This tributary, Gour Tunnel, was followed, but not surveyed, for about 220 ft. in a north-easterly direction. For the first 75 ft. the passage is about 3 ft. wide and the height drops from 7 ft. to 5 ft. At the end of this passage is a small chamber, on the far side of which is a very narrow slot about 3.5 ft. above the floor, through which only one member of the party was able to squeeze. This leads into a roughly circular passage about 2 ft. high, with a rock roof, mud walls and a floor of continuous, very fine gour pools, up to 9 in. deep and each floored with moonmilk. This tunnel was followed for 150 ft. and appeared to continue indefinitely, rising slightly.

After the temporary widening of Sump Canyon, where the Gour Tunnel tributary enters, the streamway narrows again to become a 6 ft. high, 3 ft. wide, flat-roofed passage with a 9 in. deep stream, flowing over a mud floor. This continues for 130 ft. The passage height then gradually lowers to 3 ft. and the water deepens. The passage widens to 12 ft. again and then rapidly narrows for the last 30 ft. to become a straight tunnel, 5 ft. wide and 3.5 ft. high. The water in this tunnel is ponded back by a boulder and stalagmite grill at the downstream end, so that the air gap is as little as 6 in. It was assumed in 1959 that this last section of Sump Canyon would become impassable in wet weather, but further exploration in 1961 found finger marks, made in 1959 only 2 in. above the stream at this lower end, still unblurred by water action. The slight volume of the stream in Sump Canyon may therefore be considered constant.

The tunnel at the end of Sump Canyon opens out at the foot of the only solid rock wall of a small triangular chamber which is floored, roofed, and walled on the other two sides by boulders. The stream flows across this chamber and sinks.

COTTER'S GALLERY

A 20-ft. climb up through the boulders forming the roof of the chamber at the end of Sump Canyon leads to the centre of the boulder floor of the first of four chambers at the end of Cotter's Gallery. This chamber is 50 ft. long, 40 ft. high and 20 ft. wide. The floor is composed of boulders, haphazardly piled. The roof is flat with the remnants of a chert band clinging to it. At the north end the walls come close together sharply and a possible passage continuation is choked with dry mud and gravel. At the south end the connexion to the second chamber is up a 30-ft. pitch, over unstable boulders loosely cemented with dry mud. This requires a 15-ft. ladder. From the top of this pitch the way on lies through three chambers. Each slopes steeply downstream with a dry floor composed of mud and gravel cementing boulders, with large blocks and flakes of rock forming a very uneven surface. Much of this material has very obviously come from the roofs.

The second chamber is triangular, about 50 ft. long and a maximum of 50 ft. wide. It is between 10 ft. and 30 ft. high. In the north-east corner the roof is highest where a massive rectangular block has dropped out of the flat roof. There is a great deal of apparently-recent shattering around this chamber at roof level, presumably the result of frost action. From the bottom of this chamber a gap, 3 ft. high and 8 ft. wide, connects with the upper end of the third chamber. This is also roughly triangular, but somewhat smaller, with a maximum width of 35 ft. and height of 12 ft. The roof is fairly flat (Sect. 26) but a great deal of rock debris is piled up to within 4 ft. of the roof on the west side. From the bottom south corner a drop of 5 ft. leads to the fourth chamber. This is floored with much gravel and dried mud and several large flakes from the roof. This chamber slopes steeply. It is 7 ft. high in the centre and about 25 ft. wide. The height rapidly decreases and the way out is through a scramble over large flakes of rock and down through a 14-in. high, 2-ft. wide squeeze down a mud slope. This leads into the left side of the upper end of Cotter's Gallery proper. In all four chambers the amount of debris is far more than can have come from a simple roof collapse. There is a vast amount of boulder clay and gravelly mud intermixed with limestone slabs and blocks. Collapse of this infilling has caused considerable holes to form in the floors. The whole section appears to have undergone very considerable infilling and shattering.

When coming upstream, Cotter's Gallery appears to terminate in a flat-roofed, 12-ft. wide and 8-ft. high section of passage, the continuation of which has been blocked by rock and mud; the route up through the squeeze

to the chambers is not obvious. The 600 ft. of Cotter's Gallery from this point to the junction with the Main Streamway slopes fairly steeply downstream with a flat but low roof, 4 ft. to 6 ft. high, marked in part with shallow anastomosis channels. In parts the roof bed has collapsed into the passage. On either side the walls are banked with mud and boulders and the floor is similarly composed. A small stream appears on the right, 36 ft. down from the squeeze, but sinks almost immediately into the boulder floor. After a further 100 ft. a collapse of the passage floor of clay and boulders has revealed a small tributary passage entering below the present level of the floor, from the left. This can be followed for 50 ft. until it becomes too tight. 60 ft. downstream from this, large gour pools appear, each floored with moonmilk and no more than 2 ft. deep. The passage at this point has widened to 10 ft. For 130 ft. the water in the gour pools is static, then a small stream enters on the right and flows for the remaining 190 ft. through gour pools to the Main Stream. This small stream is probably the one which appeared briefly 390 ft. upstream, and possibly is the stream which flows through Sump Canyon. The passage in the last 150 ft. gets steadily larger, becoming up to 8 ft. high and 20 ft. wide but still has a boulder floor with mud banks on either side. In the floods of July 1961, the whole of this junction area with the Main Streamway was filled to the roof and the waters backed a considerable way up Cotter's Gallery.

UPPER POULELVA

The stream passage of Upper Poulelva is accessible at three points: at the upper end from the swallet known as Pollismorahaun, at another opening close to this and a little south of it, and at the lower end from Poulelva itself. Pollismorahaun is a Y-shaped swallet (Clare 4, E. 36.1 in., N. 8.3 in.), alongside the west side of the road on the edge of the townland boundary. It is fed by two streams; the main stream sinks in the southern branch and a tributary in the northern. The entrance to the cave lies in the tributary branch, near the junction with the main stream branch, and about 10 ft. below the general ground level.

The first 35 ft. of the cave consists of a tight crawl down through boulders and shattered rock to a drop of 3 ft. into the streamway. At this point the passage is of the T-shaped canyon type, 12 ft. high and 2 ft. wide. This form is retained throughout the cave but the height varies partly because of variations on the floor slope in relation to the even slope of the roof, and partly because the roof bed changes downward in one place. The Geological Survey map shows a dip slope of 5° approximately south-south-west, near the head of the cave, changing to horizontal bedding towards the lower end. The passage continually meanders; in some places the meanders have cut down obliquely rather than vertically.

An impassable tributary enters the cave on the right, 60 ft. from the entrance. A roof passage on the left, 70 ft. further on, leads past fallen boulders back to the surface. A second tributary enters on the right at 220 ft. It is a canyon passage starting from a boulder choke where it is about 10 ft. high and 2 ft. wide, and runs to meet the main cave, after 150 ft., on the right. Its general direction is from between south-south-east to south-west. Its upper end cannot be far from the second entrance already mentioned. Downstream from this tributary the height gradually decreases as the floor slope lessens till at 390 ft. from the entrance the cave height is 6 ft. Here it is possible to climb into a wide bedding plane at roof level on the left-hand side. After about 10 ft. a small streamway is encountered, 2 ft. square in cross-section. The passage is impassable to the left but can be followed downstream to the right through several meanders until it rejoins the main passage after about 100 ft.

Just below the upper end of this roof passage, the roof of the main passage drops several beds and the floor is nearly horizontal till at the point where the roof passage rejoins, the height of the main passage is only 3 ft., the minimum for the cave. The width at roof level is 2 ft., and at floor level 5 ft. The low roof continues for about 200 ft. and then the height gradually increases to 10 ft. At about 800 ft. another low roof passage goes off back north for about 140 ft. from the right side. There is no recognized surface feature to correspond to this passage, which comes in just where the cave is emerging from under the shale edge.

At 880 ft. the floor of the main passage has been cut down into bands of chert. The slope of the floor increases, bringing the height up to 15 ft. This is followed by a sudden levelling of the floor and the height is reduced to 8 ft., after which the floor slopes down again and the height increases to 15 ft. At 1,000 ft. chert bands occur at several levels and in some places the chert is continuous from side to side thus forming bridges over the stream. Formations are present hanging from the roof and on the walls, and at 1,490 ft. partially block the passage. Two similar blockages occur at 1,850 ft. and 2,100 ft. One very narrow dry tributary, not followed, occurs in this part at 1,200 ft. entering on the left. At 2,300 ft. a strong draught is felt. (This might be the connexion to the now filled-in Bullock Pot (Clare 5, E. 0.5 in., N. 6.6 in.), so called because of the bullock that got stuck in it.)

In the last part of the cave chert bands are still present with many projecting nodules. In one place the chert forms a false floor for 38 ft. and one has to pass under it. Immediately beyond this the stream drops down a series of small cascades and at their lower end the height of the passage is 15 ft. The chert bands end just before the pothole and the canyon passage has a high roof tapering to a point. 20 ft. after the last of the cascades a climb of 24 ft. leads upwards to the surface near the lip of the pothole while the

stream drops in another series of cascades and a final pitch of about 60 ft. into Poulelva pot.

POULELVA STREAM PASSAGE

This commences where the entrance passage series from the pothole encounters an active streamway, which can be followed downstream for over 1,200 ft. in a southerly direction. A dye test has shown that the water encountered is from the flooded bedding plane at the bottom of Poulmagollum. The streamway is a typical Clare canyon type passage with a faint T section at roof level in places. The roof is formed by the same bed for the whole length of the passage. There is a thin bed containing the fossil *Productus giganteus* in large numbers at a level about 1 ft. above the water level.

The passage is at first 3.5 ft. high. At 150 ft. a tributary passage comes in on the right. Dye tests have shown that this is the water from Upper Poulelva which has flowed out of the northern end of the pot. This tributary has been explored upstream for 150 ft. to a low bedding plane passage and thus must start just underneath the pot itself. At 200 ft. the floor steps down over some small cascades and the height of the passage is increased. Just beyond the walls are covered with flowstone. At 400 ft. the route becomes a crawl over pebbles with the stream disappearing under the wall on the right. After a further 100 ft. there is an aven 20 ft. high in the roof. Its walls are covered with flowstone. Beyond 600 ft. pieces of grass wedged in the roof show that here and for the rest of its length the passage fills to the roof under flood conditions though this has not prevented the development of a profusion of stalactites and helictites, which hang from the roof in this part.

Thereafter the passage, which has become 3 ft. wide by 6 ft. high, gradually decreases in height and at the same time becomes wider. The passage was followed till the maximum height in the channel incised in the floor was only 2 ft. Just beyond the last survey point the width has increased to 20 ft. and the height has decreased to 1 ft. The passage can be seen to continue in this form. This end survey point is about 1,200 yards from Killeany Rising and not more than 50 ft. higher. No tributaries were seen to enter on the left side so presumably those streams which cross the floor of the Craven Canyon passage from north to south join the streamway beyond the end point reached.

POULELVA POTHOLE

This pothole is the last and most southerly of those connected with the Poulmagollum cave series. It is also the largest and deepest. The ladder pitch at the northern end is 97 ft. and the ladder can be anchored by using a 30-ft. tether attached to hazel bushes. From north to south at the top, the pot is 90 ft. long while the breadth varies from 25 to 30 ft. In a north-south

section, the pothole is somewhat funnel-shaped with steeply sloping upper parts to the funnel and with accumulations of mud on them, especially on the south. At a depth of 50 ft. the north-south length has shortened to 30 ft. and there is a considerable recess on the west where the stream from Upper Poulelva has cut back into the side (*Plate 18*).

The pothole lies at the junction of the two systems of Upper and Lower Poulelva and in this respect resembles Poulmagollum pothole itself. It is formed along the line of two large, parallel, calcite veins running north-south. These are very obvious in the south wall and more, similar veins are very apparent in the entrance rifts of the lower Poulelva series. The west side of the pot stands considerably higher than the east, being formed by a scarp in the limestone about 10 ft. high. This is nearly vertical north and south of the pot, but has a very steep slope round the west side of the pot. Here the Upper Poulelva passage, which has its roof throughout its length only a few feet below the surface of the limestone, comes out at the foot of the scarp and is unroofed. At the point where the stream from Upper Poulelva first made its descent, a large mass of tufaceous dripstone hangs from the rock wall. It has been deposited from water trickling down from seepages. The stream at present plunges down a series of waterfalls, the last being about 60 ft. high. There is a pool about 15 ft. wide from north to south close to the foot of this. The floor of the pot is covered by rocks and a few large boulders, amongst which the stream wends its way to flow out at the north end, where it cannot be followed. Unlike Poulmagollum, this pothole does not exhibit any phreatic features in its lower portions. These could have been eroded. There are large solution cusps in the west wall of the pot, near the top at about the level of the Upper Poulelva entrance.

Both the entrances to the lower cave lie under the east side of the pothole. Near the south end of the pot a flake of rock about 15 ft. high conceals a passage which runs a short zigzag course into a high rift, running north to south. This is not less than 50 ft. high and 4-5 ft. wide. It has beautiful, vertical fluting down its sides and several chert bands stand out prominently. To the south the rift ends blindly. North, after 60 ft. and passing through a squeeze, the route from the second entrance is met. The latter route starts from the north side of the pot in the undercut but soon turns east. Near the bend, a branch passage enters on the left, or north, but it becomes completely blocked after 9 ft. The route is a low crawl over shale debris and rapidly turns south to enter the high rift already mentioned. The floor of this rift is mainly mud, but none of it seems to be the product of recent floods. On the left or east side of the rift a passage opens at 30 ft. from the entrance and immediately bifurcates. The more northerly branch is a tight passage 12 ft. long, crossing a stream by a phreatic half tube in the roof. The stream is 6 ft. wide, flowing from north to south, entering and going

out by an impassable bedding plane passage. The more southerly branch can be followed for 36 ft. along a tight bedding plane passage, 10 ft. wide, crossed by a stream running south, possibly the one seen in the other branch, and this apparently sumps after 10 ft. These streams are from Poulngollum and not from Poulelva. Beyond this is a further junction. The passage followed is now a mud-floored canyon and continues east across two more streams, to become the Craven Canyon. At this junction it is possible to turn downstream in a passage at first only 3.5 ft. high, the present active stream route. The stream passage is heavily current marked, while the dry passage is not.

CRAVEN CANYON

At 15 ft. beyond the High Rift in Lower Poulelva, the passage drops down to the left into a tunnel and after 46 ft. reaches the Main Stream Passage. The dry passage one is following continues on the far side of the stream as the Craven Canyon, so called because members of the Craven Pothole Club were the first to find and explore it (H[olgate] *et al.*, 1952). The Craven Canyon is a typical canyon passage. It has an average height of 9 ft. from rock floor to roof decreasing towards the far end, a maximum width of 3 ft. and retains its canyon form for 560 ft. The general direction of the passage is from east to west, though there is some doubt about the original direction of water flow. The passage is here described from west to east. The walls are rather dry and dirty and the passage is partly filled with gravel and mud over most of its length. Several streams cross the floor at various points, entering on the north (left) and going out on the south. They have cut through the fill and removed it. They emerge at floor level from bedding planes a few inches high and disappear into similar ones. Where the floor has been washed clean the fossil *Productus giganteus* is visible. There is no change in the roof bed for the whole length of the passage.

At the far end of the Craven Canyon, the passage forks and there is much flood debris of obviously recent origin (1961). To the left, the passage form changes abruptly to a crawl, leading to a stream entering an impassable passage on the south (right) over the *Productus giganteus* bed. At 60 ft. upstream this water is seen emerging from another passage on the left. This has strongly developed phreatic features and sumps after a few feet. At this junction there is no way straight on, but to the right, about 2 ft. above the water level, a crawl leads to an aven, Escalator Aven, sloping upwards at 45°. It can be climbed for 20 ft. over cemented boulders until it becomes blocked. The roof and sides are phreatic.

To the left, at the foot of the aven, is the entrance to a wide bedding plane passage. Its floor is composed of thin, dry limestone slabs. It was forced for 20 ft. when it became impassable, but oral and visual

connexion at this point was made with a party in Poulmagollum, about 10 ft. away.

The right fork is the real continuation of the Craven Canyon. It is in direct line with the East Tunnel in Poulmagollum. It has some features in common with the main part of the passage. Initially it has the same height, is slightly wider and has similar dry, dirty walls. A short distance from the fork the floor becomes covered with large angular boulders, and at 10 ft. from the fork the passage is partially blocked with a stalagmited boulder. The passage continues for about 150 ft. beyond this obstacle. Initially it has a height of 4 ft. and the floor is hidden by large angular boulders, which were coated with fresh wet mud in 1961 and there were pools of stagnant water. After about 100 ft. the passage passes into a wide bedding plane in thinly bedded limestone and the rock floor reappears through the boulders having risen. Eventually this passage becomes too low to be forced, but it can be seen to continue for at least 20 ft. over a mud bank. The mud was fairly fresh and contained much organic debris including one bone, possibly of a sheep.

Along this right fork passage, about 70 ft. from the fork and coming in from the left, is a tributary passage. It can be followed for about 30 ft. and again finishes in a bedding plane identical with that at the foot of Escalator Aven. An oral connexion was made with this bedding plane.

Draughts were observed in the Craven Canyon and in the three bedding planes all blowing towards Poulelva pot. It is very difficult to assess the original direction of water flow in the Craven Canyon, as it is largely debris choked with only occasional appearances of the rock floor where it has been washed clear.

RELATIONSHIP TO SURFACE FEATURES

(*Fig. 52*)

Most, if not all, the streams which flow into this cave system originate on the plateau crest of Slieve Elva. This upland is a steep-sided mass of Namurian shale and sandstone resting unconformably on the Mid-Carboniferous peneplain which cuts across the top of the great thickness of Carboniferous Limestone in this area (Sweeting, 1955). Streams which originate in the natural reservoir of the peat, overlying the crest and slopes of Slieve Elva, flow rapidly down on all sides and sink immediately on reaching the shale-limestone junction. Thus, Slieve Elva is encircled by swallets, some large but the majority small. On the west side of Slieve Elva this has given rise to several, surveyable cave passages: Pollapooka, 90 ft. deep; Faunarooska, 1,176 ft. long; Pollballiny, 4,050 ft. long; Pollderreen South, blocked after 35 ft. but possibly over 1,000 ft. long; Polldubh, 1,800 ft.; the Coolagh River Cave, over 2 miles long and fed by two streams off the slopes of Slieve Elva, the Ownealiken and Coolagh rivers.

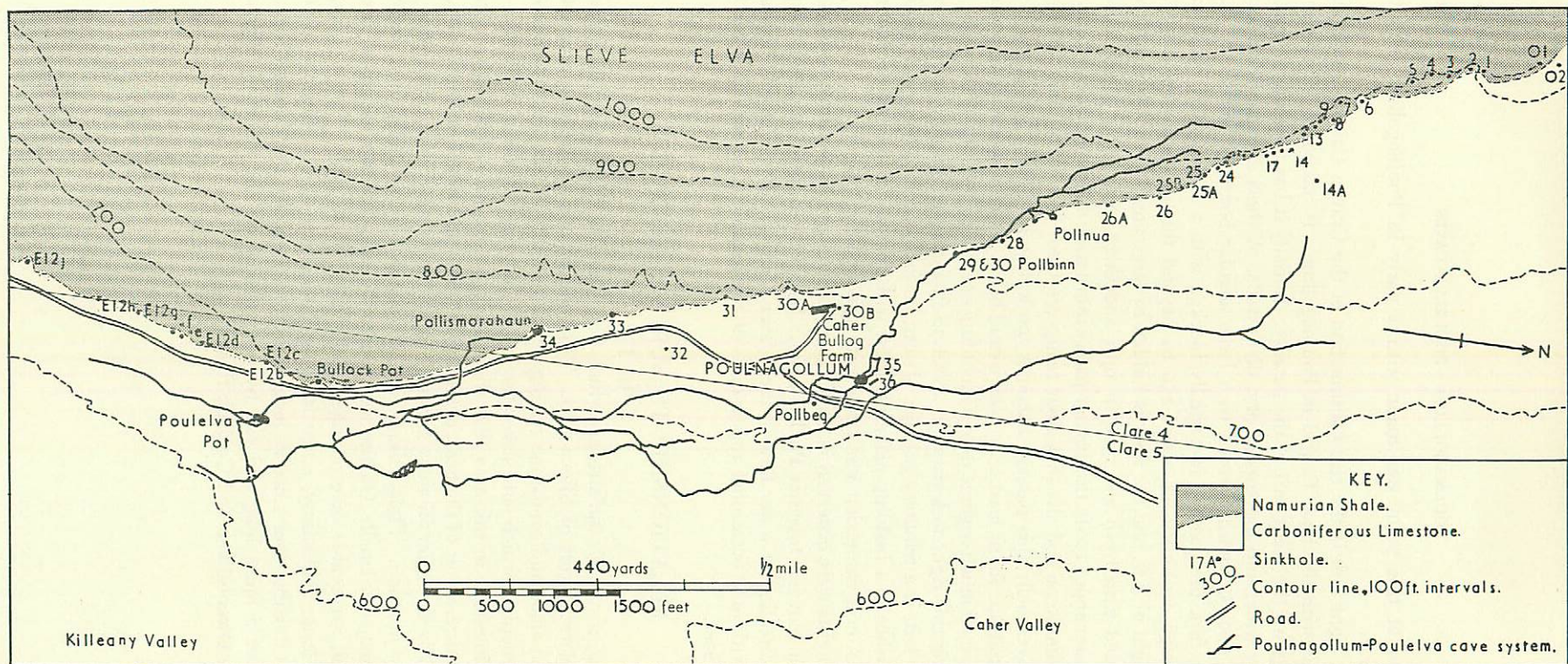


Fig. 52.—Reproduced from the Ordnance Survey with the permission of the Minister of Finance, Republic of Ireland. Cave and Geological data added by University of Bristol Spelæological Society.

On the east side of Slieve Elva, apart from Poll Cragreagh, 1,440 ft., Poll-Cahireloggaun West and West-1 estimated as being over 5,000 ft., and several minor lengths of cave passage to the south, the Poulmagollum-Pouleva cave system contains the only surveyed passages. This system, which extends north-south along the east side of Slieve Elva, takes streams from approximately three-quarters of that side and it is therefore understandable that a system of such size, with over 6 miles of active streamway, has resulted. The east side of Slieve Elva, beneath which lies the cave, slopes down into a valley which separates that upland from Poulacapple ridge, a mile to the east. In the floor of the northern part of this valley is the Caher River which flows quite steeply to the north and owes its continued existence on the surface of the limestone in part to boulder clay but in its upper reaches to the steepness of its gradient. The southerly part of the valley drains more gently, beneath the surface, into the basin area in which lies the Killeany rising. The watershed between these two catchment areas lies half a mile to the south-east of Poulmagollum Pot. Thus, from the contours, which are at 100-ft. intervals, of the Irish Ordnance Survey 6 in. map, all of Upper Poulmagollum, Branch Passage Gallery, and Poulmagollum main streamway down to Main Junction, lie under what one would expect to be the surface drainage area of the Caher River, although their waters drain south to Killeany and the Aille River.

A close inspection of the surface of the valley side above the cave reveals many minor complications of the drainage pattern. The surface slope on the shale runs quite steeply down to the shale-limestone junction, from which extends a bench feature on the limestone. This bench is found all along the east side of Slieve Elva and extends outwards for up to 40 yards at the level of the shale-limestone junction. It is not a structural bench, for it slopes south at a different angle from the dip of the limestone. It is probably an exhumed remnant of the Mid-Carboniferous peneplain. The shale-limestone boundary is also clearly marked by the line of swallets and collapse features at the foot or just inside the edge of the shale. The majority of these are impassable, but dye tests with a few of the more important have found the probable limit of the area draining into Poulmagollum and the extent of the drainage area of parts of the cave. In Appendix 2 (p. 270) the individual swallets are described in more detail.

Below the level of the shale the sides of the Caher-Killeany valley are scored by a great many limestone benches, all of which are structural with the important exception mentioned above. All dip to the south at not more than 5° depending upon the flexures in the limestone. The vegetation is poor grass and dense thickets of hazel bushes, with clints in all stages of development, amongst the vegetation. These benches are complicated by tangled, dry valley systems and hollows running athwart the structural lines.

No dry valleys cross the exhumed bench although several start at the foot of its scarp.

On the shale above the limestone there are a few benches but these are much less abrupt and wider. The surveyed ends of Long and Short Galleries are under a bench about 50 ft. above the limestone or, more precisely, beneath a short valley incised in this bench. This short valley contains the stream flowing down to Pollnua. Upper Poulmagollum only emerges from beneath the shale when it is about 100 yards above Pollbinn. However, a considerable number of swallets drain to it and this probably means that some drain back under the shale for as much as 250 ft.

On emerging from beneath the shale, Upper Poulmagollum runs at first parallel to the limestone-shale boundary picking up a number of streams before cutting obliquely across to the south-east, beneath the limestone bench, to Poulmagollum Pothole. This stands below the edge of the bench and about 200 yards from the shale. The outer edge of the bench above the pothole is marked by a dry valley which runs south, parallel to Upper Poulmagollum, from the opening 14A down to the pothole. Well out to the east of this and beneath the valley side, which here slopes down to the Caher River in a series of uniform structural steps, is Branch Passage Gallery. The surveyed beginning of Branch Passage Gallery East is horizontally a quarter of a mile from the nearest shale edge or swallet. There is no drainage feature on the surface above it. Branch Passage Gallery West starts beneath a large closed depression which has a marshy bottom and is fed by three dry valleys. The passage leads from the direction of the opening 14A and the shale edge. Of the two stream passages, Branch Passage Gallery East and West, the stream in the latter has a regular flow while the stream in the former is much more dependent upon the recent weather for its rate of flow, as would be expected of a passage with such a limited catchment area. There is no surface indication above any other part of Branch Passage Gallery to indicate its presence apart from two large depressions, which coincide with avens in the gallery, 680 ft. north of the pot.

Below Poulmagollum Pothole the cave stays entirely out under the limestone. The narrow dry valley which runs into the north side of the pothole does not continue to the south of it. It restarts below Pollbeg, which is now filled in, and continues for a further quarter mile until it is directly over the Branch Passage and Branch Passage Gallery junction. Here it loses itself in a maze of dry valleys. The main valley to the south-east of this drains gently towards Killeany. In contrast to the evenly spaced contours of the Caher valley sides, the steep slopes become largely limited to the shale and on the limestone the valley floor becomes wide and flat, although still marked by dry valleys descending from the limestone benches on the valley sides.

Sump Canyon and Cotter's Gallery lie well out towards the fairly flat valley floor. There is no obvious source on the surface for the small stream which flows through that passage, nor is there any evidence of collapse directly above the surveyed positions of the four chambers at the end of Cotter's Gallery. There is, however, a rectangular, vertically walled, collapse feature 18 ft. long, 12 ft. wide and 10 ft. deep, floored with boulders, 200 ft. to the north.

Upper Poulelva starts where two streams incised in the shale meet and sink at Pollismorahaun. The passage turns south under the shale for 500 ft. It then turns east and emerges from under the shale only to turn back south and run beneath the limestone bench and parallel to the shale-limestone junction, heading towards Poulelva pothole and picking up several tributaries *en route*. In following this course the cave twice passes over the Main Streamway* of Poulmagollum and 50 ft. above it. Poulelva pot stands right at the edge of the limestone bench, which is here marked by a 10 ft. scarp. This makes the west side of the pot considerably higher than the other sides, which are cut into a lower bench. Fifty feet down the valley from the pothole, a very faint, dry valley is observable, but this peters out after 100 yards. Two scarps of 10 ft. drop down to the valley floor to the east of the pothole. Limestone pavement in this area, which is directly over the Craven Canyon and East Tunnel, shows a marked east-west jointing. The ends of the system in The Maze lie out under the valley floor beneath areas of pavement and hazel bushes. There cannot be more than 30 ft. of rock between the surface and the cave roof. There is probably less than this as there is much evidence of collapse and frost shattering in the lower parts of the cave. Killeany Rising is not more than 50 ft. lower and three-quarters of a mile distant from the lower end of Poulelva streamway. The end of East Tunnel lies about 200 yards north of an area of bare limestone at the foot of a small scarp where standing water is often to be found.

GEOMORPHOLOGY

In this paper it is postulated that the Poulmagollum-Poulelva cave system was largely formed before the last glacial advance when the surface morphology of its catchment area was rather different from that of the present day. It is further suggested that since the last glacial retreat the whole system has undergone considerable modification as the present streams, being unlike the inter-glacial streams, have been engaged in altering the ground plan and cross-sections to suit their needs. The general conclusions reached by Ollier and Tratman (1956) based upon examination of the

* In *Fig. 52* and *Plate 20* the passages, in order to avoid confusion, are shown running parallel to each other.

juvenile, post-glacial caves of the area have been considered and found not to apply to much of this system and a sequence of formation for it is suggested.

A study of the accessible parts of the roofs of most of the passages in Poulmagollum makes it apparent that in some ways this cave is similar to many of the other caves of the area. Nearly all passages were evidently initiated by anastomosing channels developed within one bed. Eventually this phreatic stage came to an end and led to the formation of either a wide bedding plane passage or to the development, where one well-defined channel was present from an early stage, of a simple T-sectioned canyon passage. In nearly all passages the T section is present to a lesser or greater extent. In some passages, such as Branch Passage Gallery both above and below The Sewer and the Main Streamway below Gunman's Cave, the crosspiece of the T was developed to a considerable width and depth before the later downcutting represented by the canyon part began. In others, for example Upper Poulmagollum, Sump Canyon and Lower Poulelva, the crosspiece of the T is very slight. The usual roof of either canyon or bedding plane passage is a fairly flat surface because the pendants and half tubes have been greatly reduced by solution, the more complete pendants and half tubes being located to the sides of the crosspiece of the T. *Plate 15A* shows the flat roof of Upper Poulmagollum. *Plate 14B* shows the roof of the Main Streamway at the entrance to The Maze with pendants in varying stages of solution.

A more detailed study of the cave's relation to the surface and of the passage detail and tributary relationships reveals, however, that many of the general statements made by Ollier and Tratman (1956) are not applicable to this system. First, only Upper Poulelva and most of Upper Poulmagollum are obviously related to the pattern of the surface drainage of the area. Secondly, there is evidence of a stage of infilling in all parts of the cave below the open potholes of Poulelva and Poulmagollum except in the Poulelva Streamway and the Flooded Bedding Plane Passage of Poulmagollum. Thirdly, abandoned passages and oxbows are common features of Lower Poulmagollum and Poulelva. And fourthly those parts of the cave above the potholes have the juvenile feature of running very close to the surface, as is shown, for example, at Pollbinn and Poulelva pots. The only other parts of the system close to the surface are those which are inexplicable in terms of the present drainage pattern of the area because the passages start well away from the present shale edge and flow in under the limestone benches of the valley side.

These points are considered below in detail.

THE RELATIONSHIP OF THE CAVE TO THE TOPOGRAPHY OF THE AREA

The major streams flowing through this system enter it at the shale edge and the passages, which begin there, extend well beyond that feature

in the limestone. This is a normal feature of a juvenile cave system. Water, if it is to be capable of initiating a cave system of any size, has to collect into streams on an impervious rock, before it flows on to the limestone, for rain falling directly on to limestone produces only minor solution features and rarely, if ever, a cave system. Most Clare caves and their tributaries are of this nature, with all stream passages starting at or near the shale edge and then running out in the limestone. Upper Poulelva and most of Upper Poulmagollum are similar to this and are obviously in close adjustment to the topography. However, little else of the system is capable of this description. Branch Passage, Low Road, Cotter's Gallery and Sump Canyon all appear to be major tributary passages, entering the Main Streamway from the east. If so, all are very obviously out of adjustment to the topography of the region in so much that in each case the present stream, if any, is manifestly too small to have eroded the passage in which it flows. In some cases the stream is washing the passage free of infilling, and in all cases there are no apparent sources for the streams on the surface, as the upper end of each passage is a considerable distance from the present shale-limestone boundary. On the basis of these passages alone, it is probable that much of the cave is older than the present cycle of erosion, for it would be impossible for these passages to have been started, and even less to have developed, if they are tributaries, in their present position as much as a quarter of a mile from the edge of the shale. Thus, it can be argued that these passages can only have been formed when an impervious rock extended beyond the present shale-limestone boundary. It seems very unlikely that a glacial deposit, overlying the area, could have been present long enough to initiate and supply the developing cave system. For although the Caher River flows for much of its length on boulder clay and there are large mounds of glacial material on the Poulacapple (east) side of the valley, there is no evidence that there has ever been much on the Slieve Elva side, nor are there any remnants of moraine, apart from limestone erratics, above the cave. If then boulder clay could not have overlain the area long enough for the passages to develop, the shale itself must at one time have extended considerably further out than at present. There can have been only one erosional agent powerful enough to have eroded the shale edge back to its present position, an ice sheet or glacier. If this is the case and the ice of the last glaciation to affect this area was responsible for exhuming the bench of the Mid-Carboniferous peneplain on the valley side, not only all the probable tributaries* mentioned above, but much of Poulmagollum Main Streamway and The Maze must have been formed before the last glacial advance (Würm II).

* It is unknown which, if any, of High Road, Low Road and Sump Canyon is the original continuation of Branch Passage Gallery.

CAVE INFILLING

If the lack of adjustment between the cave and the topography of the area above it points to the conclusion that much of the system is not post-glacial, it should be possible to find considerable evidence for this hypothesis in the cave itself.

Firstly, there are many parts of the cave which are no longer active streamways and have become floored with gour pools, covered in moonmilk or formations, or fossilized. These are Baker's Rift and other passages around the top of Poulmagollum Pot, Gunman's Cave, The Sewer, much of Branch Passage, Cotter's Gallery, Sump Canyon, East Tunnel and Straw Tunnel. A few of these passages were stranded above the present active waterways because their stream found a lower route. Most of these passages, however, lost their stream in some other way, as no lower passages exist which could have captured their water. Their fossilized nature is therefore probably attributable to changes in their catchment areas.

Secondly there are several passages which have become choked. In the accounts of the cave the infilling is variously described as mud, clay, infilling, boulder clay, debris or laminated or varved boulder clay. In those cases where the last term has been used a careful examination of the filling material has been carried out and in every case this term refers to an ochre-coloured, very fine grained, very sticky mud deposit which has been laid down in very thin layers or varves. These layers can be peeled apart easily and resemble closely the deposit to be found in the Main Chamber of Pol-an-Ionain (Collingridge, 1960). It is thought that in many other parts of the cave the term mud or clay might have been used to refer to a laminated deposit, as a careful examination of all deposits has yet to be made. This material is, in the author's opinion, the clay matrix of boulder clay, very fine rock flour produced by the constant grinding of rock particles with each other and the surface over which they pass, when being carried by an ice sheet or glacier. The passages which are known to be filled with this laminated clay deposit are the southern continuation of Branch Passage Gallery, High Road, the 300-ft. oxbow continuing the line of the Main Streamway below High-Low Road Junction and the two tributary passages south of that. This deposit has also been found in Main Streamway, between Main Junction and The Maze, in East Tunnel, Low Road and in Cotter's Gallery in a disturbed state. Thus, at least the whole of Poulmagollum below Main Junction has been either filled, or nearly so, with boulder clay which was laid down in very large quantities under nearly static water conditions, for no larger material is mixed with the clay. Fresh supplies of muddy, but not turbulent, water coming at intervals presumably led to the varving. It is not possible to conceive of a period in the recent past when such conditions could have prevailed. Under present conditions the cave is occasionally, in times of

exceptionally heavy rainfall, flooded at its lower end and the normal flow at Killeany is very much increased (*Plates 19A and B*). However, the water must at all such times be turbulent and deposits a black-brown, peaty soil if anything. Probably the only time in the cave's history when the necessary conditions could have prevailed was immediately after the last glacial retreat, possibly at that time, described by Charlesworth (1928), at the end of the second maximum of the last glaciation (Würm II) when the Burrens were among the first areas to emerge from the ice, which then flowed south, on both sides depositing the marginal moraines which fringe the area. There was then a great deal of boulder clay on the surface above the cave with periglacial conditions of frost and thaw producing much surface water. Under these conditions, which included repeated flooding by colder and muddy water from the surface, these deposits could be laid down. The post-infilling development of the passages below Main Junction has been relatively slight, as the vertical difference between the floor of the choked passages and the floor of the streamway at their junctions does not exceed 3 ft. If, therefore, the stage of infilling followed the last glacial retreat, as it appears to have done, most of the development of most of the passages of Poulmagollum below the pothole must have taken place before the last glacial advance.

OXBOWS AND ABANDONED PASSAGES

(*Fig. 53*)

Ollier and Tratman (1956, p. 156) state that "in the main the Clare caves are now occupied by the streams which made them and abandoned passages are the exception". In Poulmagollum-Pouelva oxbows and other abandoned passages abound. The abandoned passages which are not true oxbows have generally reached that state as a result of a change in their catchment area. True oxbows, which are higher and often dry passages, result from the stream which formed them taking a different route. There are four main types of oxbows in this system.

Type A. Roof Level Oxbows. These have a common roof level with the present streamway. They are rarely of any great height and are generally completely offset from the stream passage, connecting only at their ends. They were formed at the same time as the streamway, in the period of phreatic and paraphreatic development which followed the initial stage of bedding-plane anastomosis, the stream having taken two main channels. Eventually the stream became concentrated in one channel which developed at a greater rate and the oxbow passage was abandoned.

Type B. Cut-off Oxbows. These are formed where the meanders wind so sinuously that erosion on the outer side of a bend causes the stream to break through the downstream wall of the passage and enter the upstream side of the next meander. The stream has therefore taken this more direct

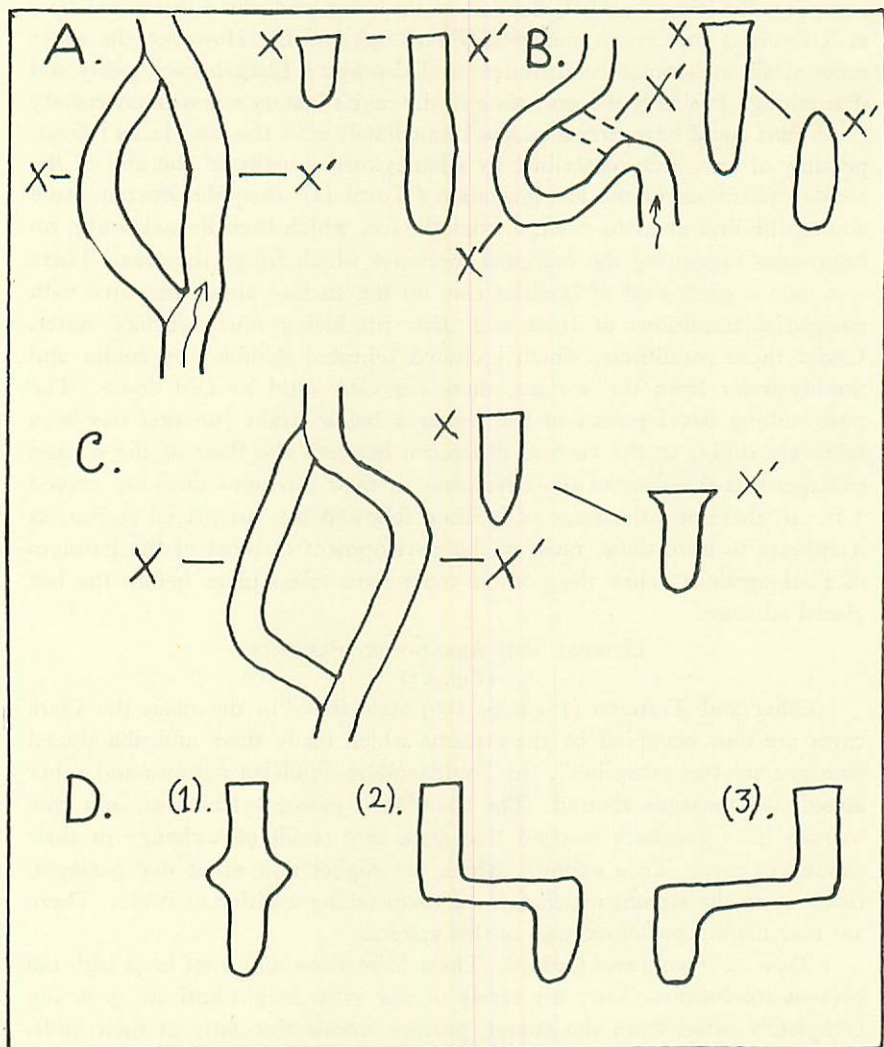


Fig. 53.

route, leaving a true oxbow, in the surface geomorphology sense. Examples of this are very rare, as few of the passages wind sufficiently. There is, however, at least one fine example in Shaft Gallery.

Type C. Top of Passage Oxbow. This type of oxbow occurs throughout the cave but in Upper Poulmagollum, Upper Poulelva and Shaft Gallery in most noticeable form. In these parts of the cave the height of the stream passage at several points suddenly decreases. This is caused by the top of

the meandering passage swinging completely away from the present streamway. Where it rejoins the stream passage the height of the latter is restored. This type of oxbow, which was once the streamway, lost its water gradually when the water found a weak bed in the floor of the passage connecting to a point lower down the streamway. Seepage along this bed and downcutting opened it out until eventually it was large enough to take all the stream and the previous route was abandoned as a high oxbow. In Upper Poulmagollum the first oxbow below Pollbinn is of this nature. Where it begins, the stream passage height drops from 15 ft. to 5.5 ft. as the 9 ft. high oxbow swings off to the left. After 175 ft. the oxbow rejoins the stream passage restoring the height of the latter to 17 ft. This process of seepage and eventual abandonment of the stream passage is probably the way in which the Waiting Room and Main Streamway oxbow was formed at Main Junction (*Plate 17*) and very probably the Main Streamway Junction with High-Low Roads. It will be seen from *Fig. 53* that the cross-section form produced is somewhat similar to that of type B but the mode of formation is quite different.

The process is observable in its initial stages between Main Junction and High-Low Road Junction. During the dry Easter of 1962 it was found at one point that the stream was no longer flowing on the passage floor. However, 40 ft. further on the stream was observed welling up strongly from a slit in the rock floor of a 2-ft. deep pool. A more advanced stage of this process is to be found in Branch Passage Gallery, where, at several points, the stream disappears down an impassable bedding plane passage to the right. The cavers' route follows an oxbow, at the lower end of which a step down leads to the stream again. The most remarkable case is to be found in Upper Poulmagollum 300 ft. upstream from Poulmagollum pot. Here most of the stream slips down a low bedding plane passage and reappears at the First Waterfall. In dry weather this thus makes an oxbow of the whole of the Poulmagollum system between these points. However, the situation is complicated by the fact that at the pothole the roofs of the at present partly deserted passages, Gunman's Cave and Shaft Gallery, lie some 50 ft. lower and are below the floor level of the developing streamway which crosses both passages; these must eventually be rejuvenated successively by the developing route cutting down to their roofs.

Type D. Abandoned Meander-belt Pseudo-oxbow. These connect along the whole of their length to the present stream passage. This is the result of a change in the amount of water, level of the water table or some other such occurrence. It is proposed that passages of the same width and meander shape, i.e., acute, sinuous or gentle meanders, were formed by roughly the same size streams flowing under the same conditions of slope and speed. Therefore, if one passage is very much taller than the other it is a result of the same process having been in operation for a much longer period in the

taller passage and not of increased water supply, for this could only lead to a different width and meander form. Thus, if an increase occurs in the volume of a stream which is flowing in a meandering passage which it has cut, that stream will be no longer in adjustment with the passage form and, consequently, will start to alter the passage ground plan and cross-section to suit its needs. Between First Waterfall and Main Junction two sets of meanders are present, one above the other. The lower meander, in which the present stream flows, crosses backwards and forwards beneath the upper meander belt. Both passages are connected along their whole length although they wind within different meander belts of a different wave length, therefore forming many pseudo-oxbows. The three typical sections produced are shown in *Fig. 53, D (1)-(3)*.

THEORY OF FORMATION

The most recent parts of the cave are Upper Poulmagollum and Upper Poulelva, both of which lie partly under the shale and owe their present development to streams which come off the shale and enter the line of swallets and collapse features along the shale-limestone boundary. These two passages are evidently in adjustment with the topography of the region. Oxbows of types A and C are fairly common to both. The initial development of beds by anastomosis is obvious in the roofs. The roofs of both passages are very near to the surface, a feature of most of the juvenile, post-glacial Clare caves. This is very obvious at Pollbinn. It would appear that the water that seeps underground, after coming off the shale, tends to enlarge a route in a bed near the top of the limestone rather than to sink to any considerable depth. Both upper systems, on developing into vadose caves each taking a full stream, have proceeded to cut down steadily through limestone and chert bands towards their base level. Thus, as the passages approach the pots their vertical height increases, although the roof bed remains the same. In Upper Poulelva the junction with the pot is a simple waterfall (*Plate 18*). In Upper Poulmagollum the pot junction is complicated by several abandoned passages and chambers which take no stream and by the loss of most of the stream down a bedding plane, as described above. There are no type D oxbows in the upper passages as only one meander belt is present.

Below Poulmagollum pothole the pattern is much more complex. There is a bed, or junction of beds, which has given rise to a considerable network of passages, for the roofs of Shaft Gallery, Gunman's Cave, The Sewer, Muddy Link, Branch Passage Gallery and the many small, choked passages between these, are all formed with the same roof bed. Evidently when the lower part of the cave was initiated, a very considerable phreatic sponge-work must have been formed here. Before all the passages had become

fully vadose, the linking passages such as The Sewer and Muddy Link were formed, but soon abandoned except by the streams which entered them by the avens along their lengths. Three main vadose passages eventually developed out of this phreatic maze, namely, Branch Passage Gallery, Gunman's Cave and Shaft Gallery. Despite the proximity of the entrances of these two latter passages on either side of the floor of the pot, they can never have had a common source of water for any appreciable length of time, as one must rapidly have asserted itself and drained the other. However, both originated in the same bed and were downcutting over the same period. Of the two passages Gunman's Cave had the larger stream originally, as at roof level, at the junction of the two passages, Shaft Gallery is a 1.5-ft. wide, tightly meandering passage which enters the very much wider roof plane of Gunman's Cave as it sweeps out of that passage and downstream above what is now the Main Streamway. Also at a lower level Gunman's meanders less and is generally wider than Shaft Gallery. The possible sources for the streams, which formed these two passages, are in doubt. It must be assumed, for reasons stated above, that the present Upper Poulmagollum stream is of a much later date than the period under discussion (p. 218). Baker's Rift evidently once contained a stream which fell into the pot or made connexion with one of the lower passages by a pitch before the pot was formed. It probably flowed into Shaft Gallery, for it trends in that direction, and gained its stream from some of the avens which are known to exist nearby, and which would have been near the shale-limestone boundary before the ice last covered the area. For Gunman's Cave no such abandoned passage is known. Excavation against the north wall of the pot might reveal a passage but it seems more likely that in the phreatic stage of development it gained some of its water from the Muddy Link and associated passages and some from a large aven where the pothole now is. Phreatic markings are observable on the walls of the pot up to 20 ft. above the floor. Presumably as the aven developed while taking a stream from the pre-Würm II shale edge, so also did Gunman's Cave. The end of this parallel development of Shaft Gallery and Gunman's Cave came after a change in the meander form of both of them.

About 100 ft. downstream from the entrance of Shaft Gallery, a ledge is present at head level which is the result of a considerable widening of the passage at that level. The canyon above and below this level is about 2 ft. wide, but the upper part of the passage meanders differently from the lower. This widening continues downstream but gets gradually higher above the stream until, at the junction with Gunman's Cave, it is 12 ft. up and exactly at the level of the floor of that passage. Gunman's is wider at floor level than at its higher levels and below the junction of the two passages the wide section continues with even greater width. Above it, the upper part of the

passage, which is about 2 ft. wide, meanders from side to side. Below it, in the bottom 12 ft., the passage is no wider but its meanders are so out of phase with the upper level that in places they cross at right angles, one above the other, forming type D pseudo-oxbows continually. Down to First Waterfall the widening is about 12 ft. above the stream. From First Waterfall down to Main Junction the wide part gradually lowers, relative to the stream, and is up to 20 ft. wide (*Plate 15B*). It marks the limits of the upper passage's meanders. The lower meander trench is often considerably cut out beyond the limits of the belt of widening (*Plate 16*). It is twice as wide as the upper passage. It can be assumed that this widened section coincides with, or is the result of, the last stage in the development of Gunman's Cave and the same process of development affected Shaft Gallery at the same time.

Below Main Junction the profile of the canyon passage is less complex (*Sect. 14*). The passage widens to as much as 30 ft. at stream level. The stream has a less steep gradient from here downwards and is obviously now concerned with lateral corrasion rather than vertical erosion. It is possible that the widening between the upper and lower meanders, above Main Junction, represents a period in the cave's history when this part became graded and for a while the stream there was involved in lateral corrasion. At that time, when the water supply of Gunman's Cave was stopped, this period of lateral corrasion also stopped, presumably because the stream was no longer at grade and downcutting began again in the Main Streamway. The most likely time for these events to have occurred was immediately after the last glaciation. It could well be that at that time in the cave's history the aven partially supplying Gunman's Cave collapsed to form the pot. The former shale boundary having been pushed back, Gunman's Cave catchment area no longer existed. With the retreat of the ice much of the glacial material was washed into the pot and the passages, choking many of them and causing diversions of the underground drainage. It is possible that many of the dry valleys were formed at this period before the underground drainage reasserted itself. But if the ice was powerful enough to remove the shale it must also have been capable of removing such minor features as the existing dry valleys. However, no valleys cross the exhumed platform of the Mid-Carboniferous peneplain from the present shale edge so the period of origin of these dry valleys is as yet quite undetermined.

Since the formation of the pot the streams have been reconcentrated on the shale and passages have been formed leading to the pots. Slowly some of the lower parts of the cave have been washed clear. This process is continuing. Shaft Gallery rapidly asserted itself as the main stream passage after the removal of its filling, remnants of which are to be found on all ledges and on the walls between the widened section and the roof. The widened section, which had been at grade, was abandoned by the new

stream as it proceeded to cut down to its new base level. At Main Junction the continuation of the stream passage was choked by varved boulder clay and the stream cut, or washed clear, its present low route through to Branch Passage streamway. It is of importance to note here that the varved boulder clay occurs on the last remnant of the widened section just beyond Main Junction. There, that section is almost indistinguishable from the general widening at floor level. Above Main Junction this varved boulder clay deposit is certainly nowhere in existence below the level of the widened section.

It is probable that below Main Junction the only post-glacial processes operating in the Main Streamway have been the removal of filling and widening at stream level, as there are no double meander belts and the gradient of the floor is less steep. In the tributary passages the post-glacial sequence of events varies. Branch Passage has become largely fossilized since losing its formative stream and only its lower part is active. This takes the Branch Passage Gallery stream which diverted itself either before its southerly continuation silted up or because it was forced to find an outlet by the choking of its southern extension. This extension of Branch Passage Gallery points in the direction of High Road and Sump Canyon. Either of these could be its continuation were it not that Sump Canyon is far too narrow to have been formed by the whole of the same stream and High Road, at its most northerly point, is a 200-ft. wide bedding plane. This plane is floored with silt so it could possibly be a roof level bedding plane with the choked passage beneath. Low Road stream, which is of unknown origin, is in the process of excavating its boulder clay filling and widening the passage at floor level. Cotter's Gallery is the passage which has been altered most from its original form. Its formative stream has long ceased to flow. The chambers at its end are the result of massive frost shattering and collapse. The route followed rises rapidly through several beds of limestone. Its floor is of blocks fallen from the frost-shattered roof beds. It is evidently very near the surface and was much affected by peri-glacial conditions.

Below the Cotter's Gallery junction with the Main Streamway, the sequence of events is complicated by the relationship of that part of the cave with Pouleva. This pothole stands right at the edge of the remnants of the Mid-Carboniferous peneplain. It was formed along the line of several, very marked, close together, north-south calcite veins. Only two passages of any size are to be found in the Pouleva system. Pouleva streamway was formed by the waters of Poulmagollum. It is an unimpressive passage, which is unrelated to the pot in its formation, except for the fact that the water from Upper Pouleva uses the pot as part of its route to join the streamway. Running due east from the pot and connecting to it by a series of joint-controlled passages, is a mud-choked passage, the greater part of which is the Craven Canyon. The Pouleva stream passage cuts across this and is incised

in its floor and infilling. Thus, that passage is more recent than the infilling. Other minor streams from The Maze cut across it at right angles also. At its far end, considerable collapse has blocked its continuation into The Maze. The survey has revealed, however, that its line is continued by the East Tunnel, an abandoned, phreatic passage which follows a marked east-west joint out under the valley floor. The whole of this east-west passage is the only one obviously connected to the Poulelva pot, as is shown by the disregard of the present stream passage for its line as the latter flows towards Killeany. Craven Canyon was infilled before the Poulelva stream passage was cut and East Tunnel is pre-Würm II, for remnants of varved boulder clay are to be found undisturbed in it. It would appear that the Craven Canyon and East Tunnel represent the line of the drainage of the bottom of Poulmagollum and Poulelva before the last glaciation, probably to a rising out in the valley floor, but a quarter of a mile further up it than the present rising at Killeany. Much of The Maze was formed at the same time as this passage. The Würm II glacial advance led to much collapse, shattering and infilling of that section. After the glacial retreat, the excavating Poulmagollum stream was diverted to the south-west into a new bedding plane before it reached The Maze. This bedding plane, even now, appears to be very recent, being only 1 ft. high with large pendants extending almost down to the floor. This new route led to the abandonment of The Maze, and the formation of the Poulelva stream passage as the stream cut down to its new water table and rising. Poulelva pot was probably an aven at the shale edge. Small ones exist throughout the system and large ones are not unknown elsewhere in the area, for example Poulmagree. The hour-glass cross-section of the pot could have been formed by the upper slopes collapsing. It is possible, but no more, that it was formed, like Poulmagollum pot, during or at the end of the last glaciation when peri-glacial conditions led to the aven collapsing. However, there is little material which is obviously glacial in origin in the lower levels of the pothole and no dry valley leads into its upstream edge. Thus it would seem probable that this pothole was formed at a later date than Poulmagollum Pothole.

This theoretical account is an attempt by the author to provide a possible sequence of events based upon the present knowledge of the cave and its catchment area. Much remains to be done to fill in the details necessary for a truly comprehensive understanding of the history of this system's development. However, certain points have emerged so far. This cave system is unlike most of those in this area which have been described previously in so much that some of the passages are occupied by streams that are misfits. Most of the system is out of adjustment with the topography of the area, abandoned passages abound and there is evidence of a period of considerable infilling. The only other cave in the area which is in any way comparable

is Faunarooska Cave on the west side of Slieve Elva. That also has two distinct sections. That part under or near the shale is not more than 15 ft. high and is typical of Clare; clean-washed, meandering, and a T-shaped canyon passage. The lower part starts 450 ft. out from the shale edge. It has considerable evidence of infilling by "stratified muds" and much of this section is over 30 ft. high and the passage has no stream (Shaw and Lloyd, 1959). While Poulmagollum is an exception amongst the Clare caves it is true to say that typical caves of this area are quite exceptional to the general type of caves. For as Bretz has stated, "Most living cave streams are misfits engaged in altering the ground plan or chambers and cross-section to suit their needs and are doing so by the familiar processes of ground streams." "Most caves are out of adjustment with the topography of their region and therefore are older than the present cycle of erosion."

THE SURVEY

The survey of Poulmagollum and Poulelva Caves was made using 100-ft. linen tapes reinforced with steel wires (so-called Metallic Tapes), and R.A.F. hand-bearing, liquid-filled, prismatic compasses type 06A. No tripods were used. A simple clinometer was used in Gunman's Cave, Shaft Gallery, Baker's Rift and High Road but not in any other part of the cave, as the rest of the passages have such a gentle slope that the use of this instrument would give no increase in the degree of accuracy of the survey. A more accurate instrument could not be used under the conditions imposed by the limited man-hours available on a series of holiday visits to the caves. Each survey station was marked and numbered with chalk as it was set up.

A desk computer was used to turn the bearings and distances obtained by the survey into a system of rectangular co-ordinates based on north-south and east-west axes; the origin of these was arbitrarily taken as the point where The Sewer leaves Gunman's Cave. The computations were checked using survey tables. The positions of Pollismorahaun and Poulelva pothole in relation to Poulmagollum pothole were obtained from the 1 : 2,500 Irish Ordnance Survey maps and converted to the same system of co-ordinates. The results of all the computations were plotted at a scale of 200 ft. to 1 in. on squared paper and this has been reduced photographically for publication.

There are five closed traverses in the system. These are described below and with each is given the misclosure expressed as a percentage of the length of the individual traverse. On the published survey these traverses have been closed by distributing the error along the traverse. The computed error is well within that to be expected with the instruments used.

Two other adjustments have been made to the survey. These are the junctions of Cotter's Gallery with the Main Streamway and Craven Canyon with the Poulelva Stream Passage. In both cases an untrue picture was

obtained of the relative direction of the passages at the junctions due to the necessity of tying in the survey of one passage with one of the already fixed stations in the joining passage. Both adjustments are minor. For the sake of clarity in drawing the position of Upper Poulelva Passage, where it is shown close to the Poulmagollum Main Steamway, has been adjusted slightly to the west. The Upper Poulelva Passage actually just crosses the Main Streamway twice and is partly vertically above it, though the vertical separation is about 50 ft. On the scale used it is impossible to show this clearly.

Well over 800 man-hours were spent surveying this system and in all 31 members took part in the actual surveying. At least the same amount of time has been spent in preparing the report, computing the results and drawing out the survey.

THE CLOSED TRAVERSES

1. Gunman's Cave—Main Streamway—Branch Passage—Branch Passage Gallery—Muddy Link. Closing error ± 00.5 per cent.
2. Gunman's Cave—Main Streamway—Branch Passage—Branch Passage Gallery—The Sewer. Closing error ± 1.1 per cent.
3. Main Streamway—High Road—Branch Passage. Closing error ± 0.5 per cent.
4. Baker's Rift—part of Upper Poulmagollum. Closing error ± 2.5 per cent.
5. Poulelva pothole—Craven Canyon—The Maze—Main Streamway—Gunman's Cave—Poulmagollum pothole—Poulelva pothole (across the surface). Closing error ± 2.0 per cent.

SUMMARY OF PASSAGE LENGTHS

POULNAGOLLUM

A. Upper Poulmagollum		Ft.	B. Lower Poulmagollum		Ft.
1.	Short Gallery	1,432	1.	Shaft Gallery	567
2.	Long Gallery	1,490	2.	Gunman's Cave	452
3.	From junction 1 and 2 to pot-hole	2,609	3.	Muddy Link series	458
4.	Pollnua streamway	151	4.	The Sewer	343
5.	Pollnua dry	173	5.	Main Streamway	5,677
6.	Baker's Rift	289	6.	Small tributaries	412
7.	Roof passages	319	7.	Branch Passage	1,284
	Total	<u>6,463</u>	8.	High Road	1,479
			9.	Low Road	424
			10.	The Maze	2,360
			11.	East Tunnel	648
			Total	<u>14,104</u>	
C. Branch Passage Gallery			D. Cotter's Gallery and Sump Canyon		
1.	B.P.G. West	508	1.	Sump Canyon	1,240
2.	B.P.G. East	789	2.	Tributary	175
3.	Main B.P.G.	6,098	3.	Cotter's Gallery	900
4.	Dry Extension	300		Total	<u>2,315</u>
5.	Minor tributaries	220			
	Total	<u>7,915</u>			

Grand Total 30,797 ft.

POULELVA			
E. Upper Poulelva	Ft.	F. Lower Poulelva	Ft.
1. Main Streamway	2,682	1. Pothole to Main Stream	180
2. Tributaries	351	2. Main Streamway	1,227
3. Roof passages	180	3. Pothole stream	194
		4. Craven Canyon	540
Total	3,413	Total	2,141

Grand Total 5,554 ft.

Total of Poulmagollum—Poulelva Caves 36,351 ft. = *c.* 6.8 miles.

ACKNOWLEDGEMENTS

This investigation of the Poulmagollum—Poulelva Cave System has been greatly helped by the kindness of many owners and tenants of land in the area. To all these we are very grateful, especially to Mr. and Mrs. J. Cosgrove of Caher Bullog. They in particular have suffered losses of beasts from these falling down the potholes or from straying abroad. Sometimes these misfortunes have been the direct result of careless visitors knocking down the walls and leaving gaps through which the beasts can go. We would like to take this opportunity of reminding would-be visitors to these caves that permission to visit them must be obtained from Mr. Cosgrove at Caher Bullog.

Mr. and Mrs. D. O'Collaghan have always made our parties most welcome at Ballynalackan Castle and we very much appreciate their kindness and patience. Cavers are notorious for not keeping to their own time-tables for meals.

APPENDIX I

DYE TESTS

The first known dye test was reported in 1944 (C. & D., p. 114). It proved that the water which left Upper Poulmagollum a short way upstream from the pothole passed through Pollbeg to appear at the First Waterfall. In so doing it must cross above both Shaft Gallery and Gunman's Cave.

The U.B.S.S. tested swallet E33 with fluorescein in July 1958. Colour was seen in the Main Streamway below the First Waterfall but not at it. The point of entry of the colour was not determined. This test gives the southern limit of the Poulmagollum catchment as the next swallet south is Pollismorahaun, which is the uppermost entry point for Upper Poulelva.

On July 13th, 1961, three swallets along the shale edge north of Poulmagollum were tested. The most northerly one tested was E3 where 500 g. of malachite green were put in. It was thought to feed Branch Passage Gallery West. But no party, unfortunately, went far enough up this passage, which has long stretches of deep water pools, to see if the dye had come through but as it did not appear in either the Long or Short Gallery of Upper Poulmagollum, though ample time was allowed for it to travel the few extra hundred yards, it is reasonable to conclude that the swallet does feed into Branch Passage Gallery West.

Further south at swallet E9 500 g. of methylene blue were put into the stream and about 15 min. later two lots, each of 500 g., of congo red were put into swallets E16 and 18. In the Long Gallery water methylene blue was seen but congo red was not definitely seen in either the Short or Long Gallery but only downstream from the junction of these two passages. Where there was foam the blue stain was in foam pushing the pink-stained foam up from below. The reasonable conclusion is that swallet E9 is a feeder of Long Gallery and E16 and 18 are feeders of Short Gallery. They are the right distances apart on the survey to make it possible for the congo red to come

through in advance of the methylene blue in spite of the difference in time between the two dyes being put in on the surface.

Fluorescein put into the Flooded Bedding Plane of Poulmagollum very soon appears in the streams which form the water flowing along the Poulelva Stream Passage but on the occasion of the test the other streams encountered along the Craven Canyon were not coloured. The streams were low then and probably sufficient time was not allowed for the fluorescein to penetrate into all the ramifications of the water system between the Flooded Bedding Plane and Poulelva.

The same dye has been used on two occasions to test the route taken by the water from Upper Poulelva after it reaches the floor of the pothole. This water, though it disappears near the north end of the pot only a short distance from where the Poulmagollum water comes in, takes a separate route turning south under the floor of the pothole to appear from the right a short way down the Poulelva Stream Passage.

Both Poulmagollum and Poulelva waters have been tested for their point of rising before the two systems were proved to be joined. The waters rise at Killeany on the right side of the rising where they are joined by the water from Cullaun I on the left side. Under low to medium water conditions the two streams do not join till just before they emerge at the rising.

APPENDIX 2

SWALLETS AND SURFACE DEPRESSIONS

(Fig. 52)

The whole series along the east side of Slieve Elva from the north to the south have been examined and recorded in considerable detail. There are so many of them and in places they lie so close together that a detailed description of each would make an impossibly long account. In the northern part they seem to fall into three major groups, each group being associated with one of the three passages that form the northern and western end of the Poulmagollum system. The most northerly set, numbers 1-5, are presumed to feed into Branch Passage Gallery West, the middle group, Nos. 6-13, into the Long Gallery and the southern group, Nos. 16-18, into the Short Gallery. The continuing ones, Nos. 19-26, are presumed to be the sources of the various small tributaries entering on the east side of Short Gallery. The last of the major depressions coincides with Pollbinn (south) and beyond this there are no large depressions till Pollismorahaun is reached (No. 34).

The water flow in all of these is very variable and a large stream will dwindle to a mere trickle in a few days if there is no more rain. It is noteworthy that in several of this series, Nos. 6-24, the streams going into the hollows at first run in the limestone outwards and eastwards from the shale edge before turning south and going finally underground. This coupled with other linear depressions running down from east to west in the limestone bench suggests that the original points of engulfment in these particular cases were as much as 100 ft. out from the shale edge than they are now. In a good many of these hollows the shale is slumping down into them.

No. 14A is located at the extreme southern end of a shallow closed depression lying immediately east of the limestone bench described above (p. 253). It is a small opening with vertically fluted sides and appears to be the product of local seepages out of the peaty soil. A few feet down it appears to open into the roof of a very narrow canyon passage running approximately west-east. No entry is possible here, which is a very great pity as it is so close to the explored end of Branch Passage Gallery West. No. 30B is a small stream, channelled partly by man, which comes off the shale to go underground at the extreme north-east corner of the garden wall of Caher Bullog Farmhouse. Nos. 36 and 35 are openings close to the east side of Poulmagollum pothole. Both have been covered over with stones by the farmer presumably because they were deep enough and large enough to be a danger to cattle.* No. 36 is about 50 ft. long and No. 35 is a round pile about 10 ft. in diameter. Both lie over the north-west running passage of the Muddy Link series and may well be connected with it.

The stream for No. 32 stays on the surface for some distance after leaving the shale. Its channel east of the road owes something to artifice. In the last few years it has opened a new route and now, 1961, goes underground immediately east of the road instead of some way further on as it did in 1958. No. 33 also used to cross the

* In this area it is unusual for such clints to be covered up unless they are unusually deep and wide.

road to supply the farm beyond as a joint source with No. 32. It has been diverted into a channel along the west side of the road and after about 100 yards goes down into a rock-filled hollow, which is steadily getting larger and deeper. The road is likely to collapse into it before long. This is the extreme south end of the Poulmagollum drainage as it runs into Poulmagollum while Pollismorahaun, the next opening south, is the upper end of Upper Poulelva.

From Pollismorahaun right down to Cahir Cloggaun West-1, which is well south of the Poulelva catchment and not shown on *Fig. 53*, every opening has been carefully examined even, in some cases, to the extent of temporarily dismantling a field wall. Several of the openings are extensive especially in a north-south direction along the shale edge, but it is disappointing that none of them provides more than a few feet of passable passage. Bullock Pot, if it was re-opened, might be passable as far as Upper Poulelva, into which it must almost certainly run. The only stream with a reasonably large catchment area is the one that goes underground at Poll Cragreagh, where there is a cave starting from the swallet, though there is an easier entrance in the field to the south (Lloyd and Tratman, 1961) (Clare 4, E. 35.2 in., N. 2.9 in.). Further south again is the fair-sized stream at Cahir Cloggaun West but the passage can only be followed for a few feet from the swallet (Clare 4, E. 34.5 in., N. 2.3 in.). South again is Cahir Cloggaun West-1 (Clare 4, E. 34.0 in. N. 2.0 in.) which provides a thoroughly unpleasant system over three-quarters of a mile long, to crawl, wriggle and creep through: but all these last three do not drain into the Poulelva cave. Beyond is the drainage from the south end of Slieve Elva and this area is outside the scope of this paper.

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