Proc. Univ. Bristol Spelaeol. Soc., 1975, 14 (1), 83-105.

THE HYDROLOGY OF THE COOLAGH RIVER CATCHMENT AND ITS CAVES, CO. CLARE, IRELAND

by
B. B. PERRATT and E. K. TRATMAN

ABSTRACT

This paper is based on three main ideas. First that the Coolagh River Valley was formed by ice action during the last glaciation. Second that during the retreat stages of the ice caves were developed and swallet retreat took place. Third that its form differs from that of the Aille, which was cut in the Clare Shales, because the Coolagh River valley was cut very largely in the underlying Carboniferous Limestone and not in the shales.

INTRODUCTION

In the descriptions in this paper the names and numbers of sites have been taken from the primary sources. The first source is 'The Coolagh River Cave' (Bendall and Pitts, 1953) and the second is the series of accounts brought together in 'The Caves of Northwest Clare, Ireland' (Tratman, Ed. 1969). The latter includes the coding and numbering used in earlier papers on the caves.

The name 'Coolagh River' only appears on the Irish Ordnance survey 1 in to 1 mile map. On other maps the same river is called the Glenaruin River. The former name was used in the first major paper on the cave and it has been retained in this and other publications.

The coding, *e.g.* B7 for the Poldonough entrance, was used in the 1969 publication and to change the coding now is inadvisable. Suffixes have been used for additional sites. The original coding is now seen to have some anomalies. These have arisen because ideas about the caves when the coding was first used are now in need of modification in the light of further knowledge gathered about the caves. These anomalies are continued in this paper to avoid confusion and the necessity for a correlation table.

In the area of Northwest Clare dealt with in this paper the higher land from east to west comprises Poulacapple, Slieve Elva and Knockauns Mountain. The southwest part of Slieve Elva is also known as Blake's Mountain,

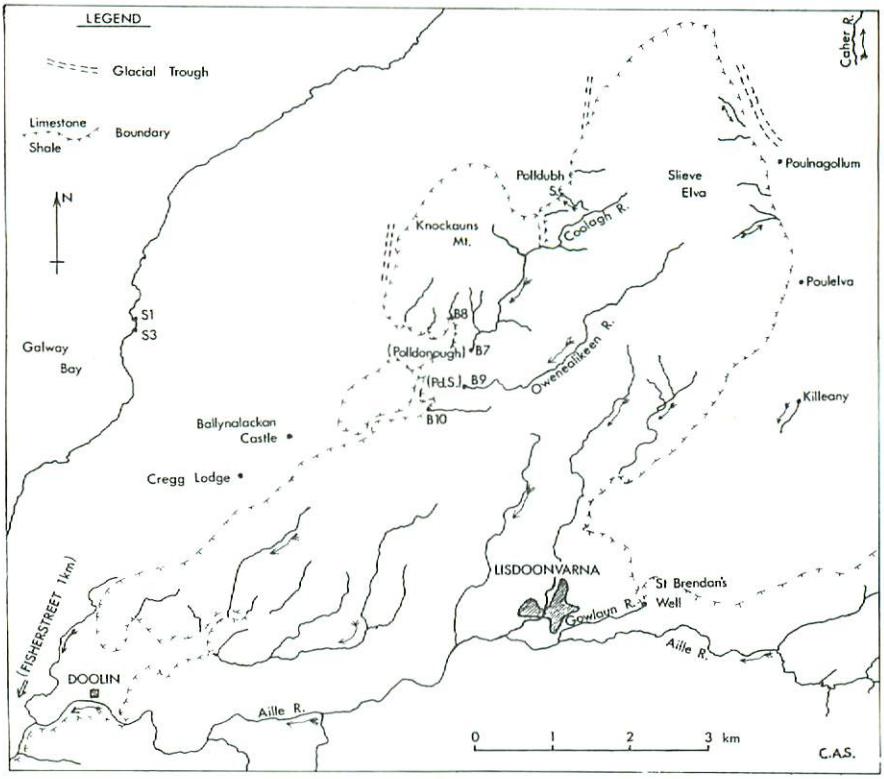


Fig. 27. Based on Ordnance Survey by permission of the Government of the Republic of Ireland. Permit No. 2312.

(*Pl.* 4). The area is drained by two river systems. The eastern one is known as the Aille (cliffed) River and the western one as the Coolagh River (*Fig.* 27).

THE AILLE RIVER

The Aille River is briefly considered to serve as a comparison with the Coolagh River. Its catchment is largely on the Clare Shales and most of its course is on these rocks and not on the underlying Carboniferous Limestone. It derives, by its Gowlaun (short) tributary, water from the shales of the east side of Slieve Elva and the west side of Poulacapple via the cave systems that run from these areas to the resurgence at Killeany. Some water is also derived by percolation through the limestone of the Killeany valley zone. The water soon sinks again south of Killeany and the permanent resurgence is at St. Brendan's Well, which is the source of the Gowlaun River. Percolation water as far south as the pothole of Poulnagollum (Caher Bullog) drains north to the Cahir River and thence to the sea and not to Killeany.

The principal feature of the Aille river valley is the relatively gentle slopes of the upper part of the cross section, which slopes are succeeded by the deep narrow gorges incised into the shales, (Collingridge, 1969, pp. 44-46). The gorge form continues down to Roadford, about 2 km from the sea. Here the river has cut down to the limestone, where an increasing amount of water is being swallowed into the Doolin Cave System. The larger swallets are nearer the river mouth and the smaller ones further upstream. Passage sizes within the cave correspond to the size of the swallets. The water resurges within the tidal zone at Fisherstreet. Only under high flow conditions does some of the river water remain on the surface right down to the sea.

THE COOLAGH RIVER

The river rises on Blake's Mountain, the southwest part of Slieve Elva. It is ordinarily a short river ending at the swallet of Polldonough (B7). The rest of the valley system is normally dry down to its end beyond Cregg Lodge Swallet (A6). The essential difference between this valley and that of the Aille is that the Coolagh River valley has been cut through limestone and the water is, except under flood conditions, out of sight and running through caves to the resurgence at S3 in the inter-tidal zone. Its valley form is thus very different from that of the Aille. **Its form is an expression of the underlying geology.**

DESCRIPTION OF THE VALLEY AND ITS ASSOCIATED DEPOSITS

The Northern Area

Within the basin or catchment of the Coolagh River there are sub-basins of considerable extent (*e.g. Pl.* 4, Bs 1-3). These contain varying quantities of glacial drift. Lack of exposures of bed rock in these areas make it difficult to define the limits of the drift in relation to the outcrop of the Clare Shales. The drift is, in the main, derived from the shales and the overlying Cronagort Sandstones. Seepages provide standing water and small local streamlets in the valley floor (*e.g. Pl.* 4 from B10e to B12).

Strewn along the peat-covered limestone immediately west of the shale outcrop, from north of Polldubh North (B1) south to the col, which connects the north end of Knockauns Mountain to Blake's Mountain, are a number of limestone erratics (*Pl.* 6A). At the beginning of the col and the rise onto Knockauns Mountain these erratics form an imposing boulder field, outlined on plate 4 as B4b. Some have been pushed up over the shoulder of Knockauns on the south-sloping aspect. Pools of standing water can be seen in the photograph. These pools are on a patch of boulder clay, which here covers the limestone. There are no obvious limestone erratics in the head of the Coolagh River valley down as far as B6, though it is possible that a few have fallen into the head-gorge when this was formed.

The original post-glacial drainage of the Pulldubh area (B1-B3) was westward to a large closed depression with cliffed sides, which have been deeply incised by streams running west from the shale edge. The depression is thought to have been formed towards the end of the last glaciation. Its floor is now covered with an unknown thickness of water-sorted fine material, (mostly shale), derived from glacial drift. The cave of Pollballiny, which is north of Polldubh, runs under the floor of this depression and ends in a sump.*

Water from Hawthorn swallet, still further north, resurges at the bottom of a deep grike in the north side of the depression only to go down steeply again to the west.* (Pollballiny and Hawthorn swallet water routes are not shown on plate 4). B1c is a tiny cave remnant almost at the top of the wall of the depression. The cave was formed under phreatic conditions.

The next stage of the drainage was the development of a series of swallets (B1-B3) at the shale edge and the passages from these form the Polldubh System, which drains south. The water resurges at B4, the head of a gorge cut in the shale. Here it is joined by the Coolagh River from Blake's Mountain. The top of the limestone is exposed. Very shallow caves have been formed immediately below the undulating surface of the shale/limestone unconformity (*Pl.* 6B). Under low flow all the water will be running in these caves.

At the approach to B6 the gorge opens out. All the water resurges to run on the top of the limestone and then over drift, which has many sandstone blocks of large size in it. This drift, must, in the main, be lying on a thin shale cover over the limestone as shale forms the river bed at B6a and limestone is not seen again until close to Polldonough (B7).

At B6a in the right bank the exposed shales are slumping into the river. It is a well known site where *goniatites* can be found. In the bend of the river here is a large mound of drift, which contains limestone erratics (*Pl.* 7A). The material here is unsorted and some of it is so large that it can only have been deposited by ice and cannot have been brought down by the river. At the approach to Polldonough, (B7), the river has cut a channel, on the left, through an alluvial flat. The depth of the incision into the limestone can be seen as the cave mouth is over 2 m high, (*Pl.* 8A). This is the beginning of the Coolagh River Cave. There are two entrances. The limestone is exposed for only 20 m upstream from the cave mouth. The surface of the alluvial flat is just above the level of the cave roof at both entrances. There is shale *in situ* on the top of the limestone at the cave mouths.

The section exposed at B7 suggests that at some late stage the cave became blocked and a lake was formed, as indeed it can form today under flood conditions (Tratman, 1968). One flood is known to have risen to within 2 m of the top of the col separating B7 from B9 (Polldonough South).

* In July 1974 the sump was passed. A dye test showed that the Hawthorn swallet water entered Pollballiny beyond the sump.

The height of this col is about 185 m. I.O.D. There may be a thin covering of shale or only drift on this col. The width of the col between the shale exposures is about 9 m. Patches of drift can be seen on the floor of the continuation of the valley at 100 m from the col. The valley southwards is a U-form with a flat bottom. At B7a (*Fig.* 28) farm drainage goes down freely and at B7b the 1967 flood produced a direct opening through drift into a cave passage close to the line of the 'Coolagh River Passage' in the main cave. No shale is seen in the sides of the collapse. At B9a (*Fig.* 28), the same flood produced another opening, this time into the downstream end of 'The Canal' passage from Polldonough South. It can be seen here that the passage is a canyon in the limestone roofed only by drift. B9b is similar to B9a. The two shake-holes at B9d are quite shallow. Contrarily the two at B9c are deep and lie below the level of the main swallet, B9; they receive little water from the north. Under flood conditions they fill up from below, overflow and the water runs back to B9 and cascades into the stream there and continues to do so until the cave mouth is submerged by flood waters.

Upstream from B9 drift is exposed in the banks of the Owenealikeen river (*Pl.* 4. O.R.). A little further up there is an exposure of shale in the left bank. Before this is reached at about 100 m from the cave mouth a section is exposed through lacustrine deposits (*c.f.* B7).

The course of the Owenealikeen is interrupted, except in flood, at B9e, where water is lost. Water re-appears at B9f, where its volume is less than at B9e. This water continues as the O.R. and in wet weather a tributary comes from Bs2. This shallow depression is floored with peat, which, where sections are exposed, rests on drift. This depression does not ordinarily flood. It is presumably floored with limestone under the peat and drift and drainage is underground. The Lower Owenealikeen River (L.O.R.) does not ordinarily carry much water.

There are two possible surface routes out of the swallet depression of B9. The more obvious one is over the shakeholes at B9c to the col at road level at B9g (*Fig.* 28) where there is a narrow gap at about 160 m I.O.D. The form, after allowing for the effects of road-making, is a flat-bottomed U. Beyond is the slope down to Pollclabber (B10) with B9i as a grike-like opening, which never floods. This is connected by a small descending passage which joins Mud Passage at roof level close to B10 (April 1974). Any original flow over this col was very shortlived as there is only the faintest trace of a deserted watercourse here.

The less obvious route is to the col, B9h, at about 155 m I.O.D. There is only drift along this line. The route opens out and slopes down to a shallow depression (*Pl.* 4, Bs3), which contains a thick formation of peat. Its drainage is largely underground and there are two major cave passages beneath it. The course of the Lower Owenealikeen runs along the southern edge of the basin. The descent of this stream is abrupt and very steep down to Pollclabber (B10). Drift is exposed against the low cliff and there is no alluvial flat. The

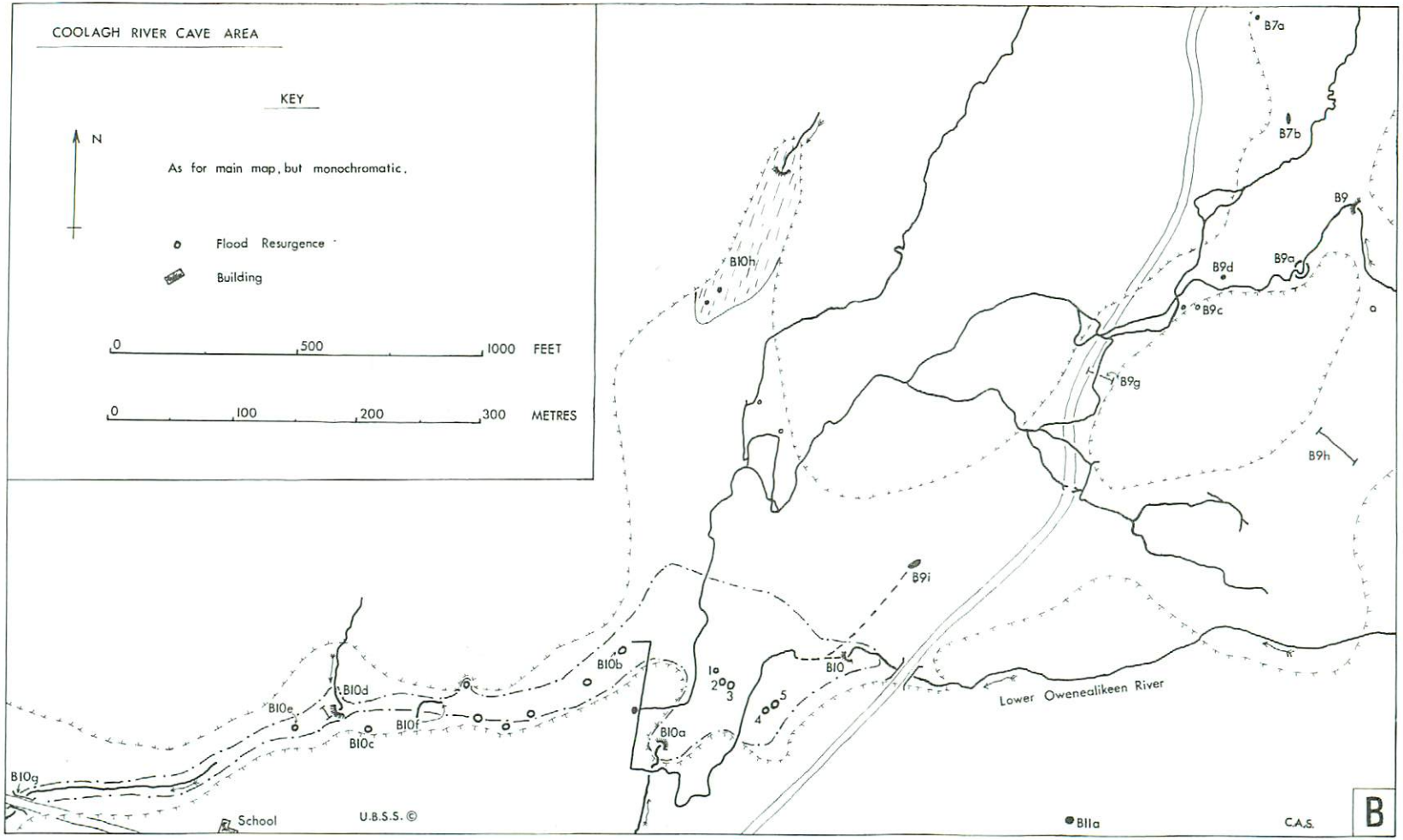


Fig. 28. Area 'B' of plate 4. Based on Ordnance Survey by permission of the Government of the Republic of Ireland. Permit No. 2312.

entrance to the roof level of Mud Passage is above the level of the floor of the active swallet and in the southeast corner (April 1974).

B10 Area (Fig. 28)

To the southwest of B10 is the minor swallet B10a. Its development has beheaded an older drainage line running out to the series of five shakeholes marked. All of these and B10a serve as resurgences under flood conditions. No. 2 has collapsed so often that the farmer has abondoned attempts to keep it filled up. The extent of the temporary lake is seen in figure 28. The shallow shakehole marked approximately over the Terminal Passage (*Fig.* 28), is well above the valley floor and flood waters do not rise here. The lake drains over the surface down the valley to the School House Sink (B10d) and beyond. Water from B10a now crosses over the roof of Mud Passage and appears as a cascade on the north side close to the junction of Mud Passage with The Terminal Passage (April 1974, dye test).

B10b is an open rift in the limestone covered only by drift, which contains large sandstone blocks, some as large as 75 x 40 x 20 cm. This rift must communicate with the Final Bedding Plane Passage just beyond the furthest accessible spot. Under very low flow conditions, running water can be heard at the bottom. In the cave an aven just north of this rift has been climbed. The climbers, (whose movements could be heard very clearly at B10b), reached a measured height of 36 m from the cave floor. They estimated that they were about 3 m from the surface. The aven was narrowing and was sealed by unstable boulders and stones.

B10f, Pollcloghaun, is close to the beginning of the steep descent to School House Sink (B10d). It is at B10f that water first comes up from the cave under flood conditions. The valley here is about 4 m wide, floored with limestone and with a low cliff 2.5 m high on the east side. There is no drift on the floor just here. Above the left bank cliff is a shakehole, B10c, which is only separated from the main valley by a thin limestone wall. Its bottom is below the valley floor but water will rise and stand to a level of at least 2 m above the valley floor before any flood water appears at B10f.

Pollcloghaun has been explored (Williams, 1969). The water route is blocked upstream by a choke. Downstream the passage bends round to the south and ends in a sump. Joint control, as the survey demonstrates, has played a very important part in the development of the passages.

At the School House Sink, (B10d), which is choked with mud and boulders, the descent is steep. There is much drift but no alluvial flat. It receives some water from the north. In flood it soon fills up and overflows. Its downstream and south walls are limestone cliffs, which form the top of the col. Just beyond there is a gentle slope to B10e where water bursts up through drift, which is at least 2 m thick, and before the swallet itself overflows. Further down the drift has been eroded into a V-shaped valley with more drift slumping in from the sides. The slope is at first steep and a

little seepage water, enough to form a tiny stream, is always present down to School House Bridge, B10g. The opening under the bridge just manages to accommodate the maximum flood flow. Its dimensions are known and if the speed of flow is estimated at 1.5 m/sec, (and the water is moving very fast here), the flow is about 13 cumecs. The rectangular section of the flood channel immediately beyond the bridge is man-made.

Just beyond the bridge on the right, and above the floor level of the flood channel, there is always some water. This is seepage water. More is added from a similar source at B11d to form a small stream which runs down to B12. The water at B11d is not derived from swallets B11b and B11c.

B12 Area

At the swing west the valley opens out to B12, which is an open rift in the limestone running N-S. Its downstream face is a limestone cliff. At the north end this bends round to the east and is masked by a steep grass covered slope. At the south end the rift has the form of a filled in, circular pothole. The rift is blocked by drift material which includes large sandstone and limestone blocks, the latter being derived mainly from the cliff face. The rift is about 50-75 cm wide, narrows downwards and is obstructed by debris. The slope is very steep. The small stream from the seepages has cut a channel on the left through the drift, which is seen to have alluvium on its top, which is below the level of the rock lip downstream. The whole has many similarities to the lacustrine deposits at B7 and B9.

At the south end and a little east of the main rift is a parallel one (B12a). It was choked. Part of the choke was cleared (July 1974) but the way down was too narrow.

Up in the hillside to the southeast of B12 is the enormous shakehole of B11 (Poulnagun, Wilkins 1972 and *Pl.* 7b). It lies well within the shale margin. The hole is 18 m deep and of this only 5 m are in limestone. From the bottom at the south end two pitches lead to a large passage, which is an oxbow for a main streamway, at about 100 m I.O.D. This can only be part of the Coolagh River Cave system. Nearby is another shakehole, B11a, where the process of collapse is not yet complete. It is steadily getting larger and deeper. The water here no longer overflows down the flood channel cut to drain it.

B11b and B11c are two small swallets at the shale edge, with limestone exposed at a depth of 2 m from the surface. There is drift here. B13a, B13b and B14 are all swallets at the shale edge. All exhibit drift which presumably is the sole covering over the limestone down the slope to B12. B13a, according to an inscription in the cave, was first explored by the South Wales Caving Club in 1963. It descends steeply and there is a pitch of 12 m down from a false floor. The cave ends in a mud and boulder choke with much calcite deposition.

At B12 the downstream lip of the limestone barrier or col has been

rounded off, presumably by glacial action and for some 50 m has no drift on it. The minimum width of the channel is 12 m. The descent is at first gentle then comes an abrupt step down, (*c.f.* Pollcloghaun, B10f), with limestone exposed. The channel is here 11 m wide and 2 m deep. In the centre is a subsidiary channel 1 m deep and 4 m wide. Water bursts up here and again a little further on. Beyond there is a permanent pool at a sharp bend north against a limestone cliff. At this bend a high level route goes off west and takes a nearly straight line to opposite Ballynalackan Castle (B20), where it turns down into the main valley.

After another 50 m or so and under another limestone cliff on the right the valley swings round to the west. There follows about 300 m of valley with a V section and interlocking spurs. There is much glacial debris, which is slumping into the valley. At B15 water bursts up in flood time and again at B16, where there is always a little seepage water, enough to form a tiny stream, which is less in volume than that at B12. At B16, on the right side, is an enormous block of shale with its bedding fairly well preserved. There is, at present, no shale anywhere near from which this mass could have been detached and slumped into the valley. It can only have arrived at its present position by glacial action. The walls of the valley are very steep and in places cliffed, up to a level of a well-defined bench some 8-10 m above the valley floor.

The Southern Area

At B17 is another limestone barrier running N-S across the valley between limestone cliffs. It is not so spectacular as B12 and the main swallet, totally blocked, seems to have been under the north cliff. A shallow lake is formed here in flood by water coming down the valley. There is permanent seepage water downstream from the barrier on the south.

The two limestone masses of B18 and B19 show considerable effects of ice action on their east facing slopes where they abut on the high level ice route (see above). There are two small cave remnants in B19 high up in the side of the valley. Both have been formed under phreatic conditions. B19a has its roof less than 0.5 m below the plateau level above it.

Ballynalackan Castle stands on a limestone platform. A separate piece of high level route passes round this to the north, over a col to debouch near the farmhouse and thence to the coast. To the west and north of Castle House, there is a small area of shale *in situ* (B20a). It has probably been preserved at this low level by the mass of B20. The levels are such that they may indicate a small local fault with a downthrow of a few metres. There are no exposures which can be used to verify the existence of this fault. The extent of the shale is shown by the wood to the left of the house in plate 10.

The castle plateau itself is at 123 m and is matched by a similar plateau on the south side of the valley. The level form of the Castle bailey must surely owe something to man but its main form, like the other flats of the

area (*Pl.* 9), seems to have been due to planation by ice. Under the 10-15 cm of soil cover the joints in the limestone are unopened, nor is there any evidence for grikes under the adjacent flats though these do have drift over them. It would seem that this drift must be alkaline (see Trudgill, 1972). Towards the bridge (B21) the valley narrows slightly and there is an unknown depth of drift in the floor. Just beyond the bridge at B21a there is always a small stream, which eventually sinks at Cregg Lodge (A6). A well sunk here (B22) to 5 m depth was entirely through drift though there was one prominent band of shale debris. There were many sandstone blocks and the diggers stated that the material was of the same kind that mantles much of the adjoining land. At the well, fast pumping of 2000 gallons lowers the water level by about 1 m and it takes 2-3 hours to recharge; so this water is not the main Coolagh River Cave water.

Poll-an-Ionain Area (A5), (Fig. 29)

Downstream from the well there is a considerable amount of drift on the left but not so obviously on the right. Soon the valley opens out and there are limestone cliffs on both sides. The valley ends blindly in the area of A5-A7 (*Pls.* 9 and 10). There is drift material against the western slope and a massive moraine on top of the limestone about 250 m southwest of the end of A5. A low col, 50 m east of A9 and A10, which lie a little way down the slope, leads to another cliffed depression. This has at first, a steep slope up at its west end (*Pl.* 9). The slope then becomes more gentle till the general level of the erosion of the plateau is reached. There are shallow shakeholes under the limestone cliffs of the south side of this upper slope.

A5a is recorded as 'swallet' on I.O.S. maps. It has been completely filled up and its original form is difficult to determine but photographic records made before it was finally filled up showed it as a typical swallet with a low cliff exposed at its west end. The inlet valley is still just traceable. A6 is Cregg Lodge swallet. This will fill up in flood time and overflow the col to the higher swallet of A7 (*Pl.* 8B). A8 is a small limestone bluff with slightly opened joints. Air is forced out here when A7 is being flooded. A9 and A10 are two minor swallet-like hollows with limestone cliffs to the west and south. There is no drift above the cliffs.

A11 is a very shallow well cut in drift very close to the limestone outcrop. It gets its water from seepages out of the limestone and the drift here is quite thin. A12 is a low cave of the bedding plane type with much breakdown. It is in the base of the cliff with its entrance just above the valley floor. A13 and A14 are two of the more obvious old phreatic cave remnants, which have their bases well up the northern cliff face. There are several other remnants suggesting the former existence of a shallow phreatic network cave truncated by the formation of the depression.

A15 is a deep conical depression near the centre of the valley floor (*Pl.* 10). It appears to be entirely in drift. Its western lip is at the same level

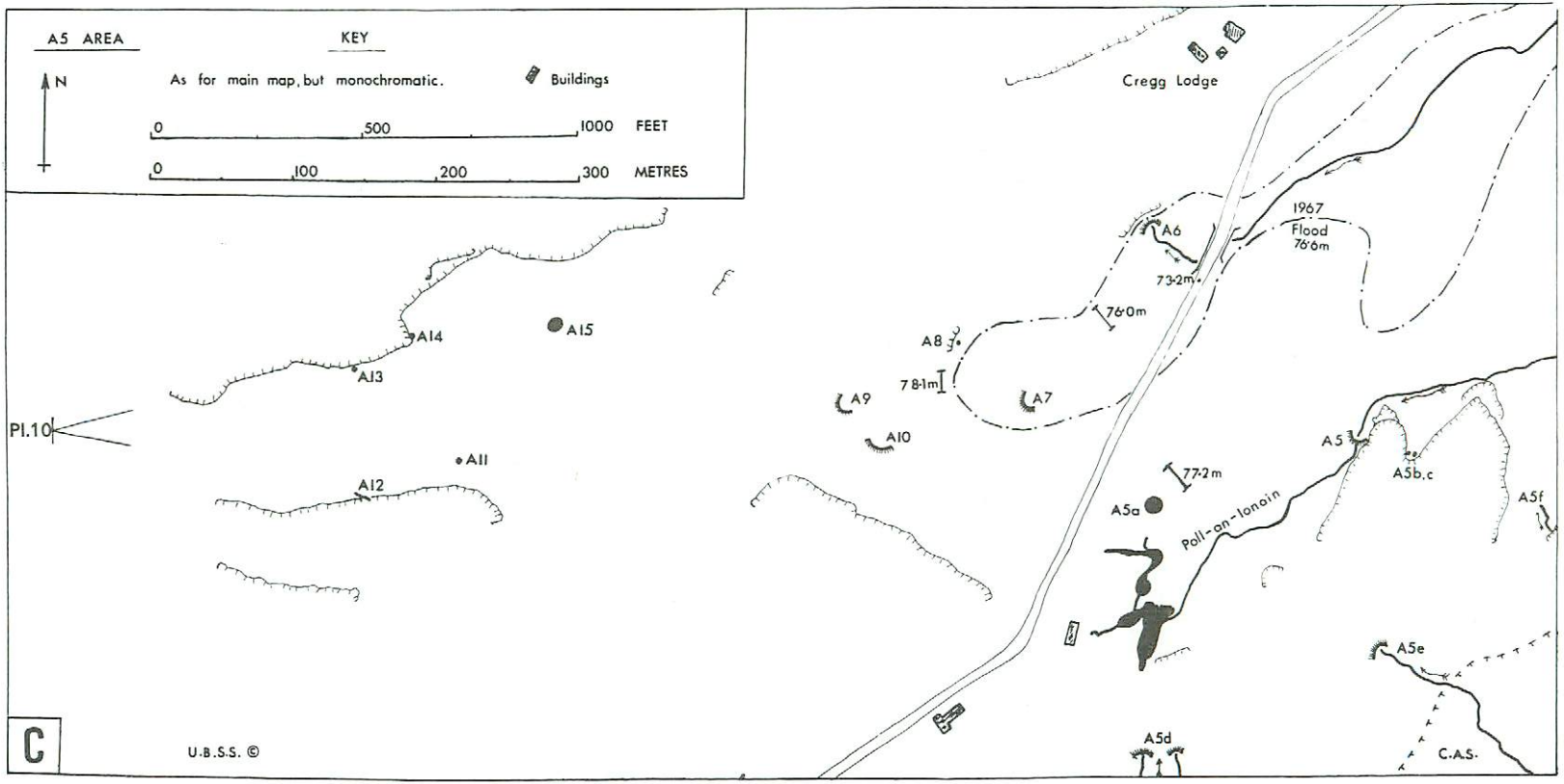


Fig. 29. Area 'C' of plate 4. Based on Ordnance Survey by permission of the Government of the Republic of Ireland. Permit No. 2312.

as the roof of A6 though its base is 3.5 m lower. A6 is the lowest of the swallets. Yet A15 does not flood up even when A6 and A7 are totally submerged by flood waters. At A15 there is a considerable amount of drift containing the usual variety of erratics. Over this is alluvium some 0.4 m thick. The drift seems to have been intruded over the eastern lip of the depression, which has its general floor level about 4 m below that of A5/A7 area. The limestone outcrops indicate that there is no great depth of drift in the western part of the depression.

Under high flood conditions, which occurred in 1967 within two hours of the commencement of the rain, all the swallets, including B7, B9 and B10 at the head parts will be submerged to a depth of 3-4 m. The water spreads down the valley from the B10 area at considerable speed. It will fill each of the sites described in turn but B12 takes the longest time to fill up and overflow. In the A5 area, A6 and A7 will be totally submerged and the water level may rise to about 2 m above the coping stones of the bridge seen in plate 8B. Then only a slight ridge of alluvium will stop the water getting into both A5 and A5a. Once the rain has stopped or even slackened the flood waters will disappear with astonishing rapidity.

THE CAVES FROM NORTH TO SOUTH

Polldubh. There are several entrances. In the main it consists of a single canyon passage of considerable size. It ends in a sump in a bedding plane. The water resurges at B4 but some remains underground in very shallow caves. At B6 all the water comes up.

The Coolagh River Cave. (*Pl.* 5). The survey was originally published in 1953 (Bendall and Pitts). It is packed with information including that on hydrology. The through route from B8 into the Cascade Branch has been passed. Mud Passage has been passed (April 1974) along a high level series to Pollclabber (B10) at a point south of and above the swallet floor. There are ramifying high level passages in this area. The bedding plane running west from the Terminal Passage has been followed for about 80 m to a permanent sump, which has proved impassable to divers. The avens to the surface run up from near the sump.

Bendall and Pitts drew attention to the way in which the newest water routes, as yet impenetrable to man, are along bedding planes at increasing depths. There is a tendency for the water to disappear towards the south and some returns flowing north, *e.g.* in the Flooded Bedding Cave. This passage and the two passages of the Upper Bedding Cave have only limited connections to the two major swallets, B7 and B9. The volume of water that comes in is considerable. Only part of this, because of the volumes concerned, can come from the swallets. The situation of these passages in relation to the surface mark them as drainage routes for percolation water from the two

depressions described, Bs2 and Bs3, (p. 87). The practical difficulties of proving this are very great and not least of these is the risk of being drowned by floodwaters because the tests would have to be carried out under high flow conditions.

Within the cave is Balcombe's Pot. It could be just a simple plunge pool but it is unlike any other plunge pool in any of the Clare caves. It is over 5 m deep and has boulders at the bottom. It is at least possible that the pot connects with a lower developing system of bedding plane passages quite impassable to man.

The direction of flow in flood from shakeholes B9c suggests that most of the water supply under them is from B7.

Towards the lower end of the Coolagh River Cave joint control of passage direction becomes increasingly evident and phreatic solution features more obvious. Joint control is very evident in Terminal Passage, which runs straight along a major joint in the 196° direction. Furthermore the water flows north, except perhaps under high flood conditions. The partial divisions in this passage are phreatic features. Pollcloghaun shows marked joint control.

Pothole B10c (p.89) must be fed from some unknown source. Probably from an area to the south or by a high level conduit out of the Terminal Passage area.

Bendall and Pitts also commented that there had been a filling stage in the cave. This, they said, came late in the history of the cave and that the fill was being removed.

B11, Poulnagun (Pl. 7B). The actual streamway entered is an oxbow. The water comes in from the south along the 196° direction. The passage turns west and then southwest at the limit of exploration. There are many indications of frequent flooding to considerable depths. This happens after quite moderate rainfall. The volume of water passing is large. Pieces of peat, grass and other debris indicate origin from a large open swallet or swallets. The water is peaty brown. The only source that fits these facts is the Coolagh River. This has yet to be proved by a dye test.

The Coolagh River Cave water is last seen in Pollcloghaun running south. It would be quite feasible for the water to reach B11, some 550 m away southerly. Joint control and hydrostatic head could make the water flow in any direction. The postulated route would take it under, or very close to, the collapsing depression of B11a.

B12-20 have been described above.

Poll-an-Ionain (A5), and A5a, A6, A7. The entrance to A5 now lies at the bottom of a hollow under the cliff. The route passes first under a large fallen roof slab. Its proper position can be determined to within 1 m for height. In the cliff on the left bank, upstream from the bedding plane roof slab, and along the same plane, is a series of small half tubes. These must once have been inside the cave and therefore collapse has caused retreat of

the roof downstream. Rock is not seen along the right bank, but only drift. The whole bears a resemblance to B7 and B12 on a smaller scale. The good grassland of the basin floor suggests that fine stream-borne alluvium is present. The level of the temporary lake in 1967 was about 1 m from the top of the col between the main valley and the hollow of A5. Now A5 has only its own catchment to feed it but this catchment has a considerable area.

The route into the cave is first through breakdown masses where much weathered calcite deposits are seen in places. Soon a high canyon passage is reached. The upper part of this turns off to the south and is completely choked. The water now takes a lower route to the Main Chamber. The stream, after rain, is by no means a misfit for the passage it now occupies.

At the Main Chamber the route is up over massive fallen blocks and much mud. The stream appears again in the lowest part of the chamber. It is eroding a coarse, stream-laid fill (*Pl.* 11). In the chamber there is a large amount of mud deposited over and amongst a mass of boulders, produced by breakdown, and above the coarse fill. The mud is laminated and can be reasonably interpreted as varved. This term is used here to describe the structure of the lamination. It must not be taken simply to imply seasonal deposition. Any flood could produce a varve. The mud has a marked slope down from north to south. It has been introduced from the north. Features in the chamber indicate a pronounced phase of phreatic development.

There is a separate choked passage, with its roof level with that of the Main Chamber, coming in from the east. This could be the choked passage of the entrance part returning.

The '1959 Series' of large but mostly mud-filled passages are probably only separated by mud from the Main Chamber. At the north end of the series is an aven. The top of this, horizontally, is less than 35 m from swallet A5a and probably not far below it. It is considered that the mud fill entered from this swallet.

The end of the '1959 Series' runs west as a large passage with much fine fill in it. The passage is in two parts connected by a constriction. The upper part, which can be reached from the lower, is not completely choked. In 1973 digging was done here by U.B.S.S. and good progress made with no complete choke in sight to the limit of visibility.

A5e has a small stream which goes down through the drift just beyond the shale margin. A5d consists of two soak-away swallets with streams, both small, going down through red mud.

A5b and A5c are the remnants of the two walls of a high level phreatic cave exposed in the two sides of the gully between the two parts of the main cliff above A5. Indeed the gully owes its origin to the cave there for the roof has been planed off by ice. There are two unusual features about this cave remnant. First, at the northern limit of the visible cave walls, the width is over 10 m, which is much greater than any other of the cave remnants known in this area. Second A5b, shows fine-mesh current scalloping indicative of the onset of vadose conditions and turbulent flow.

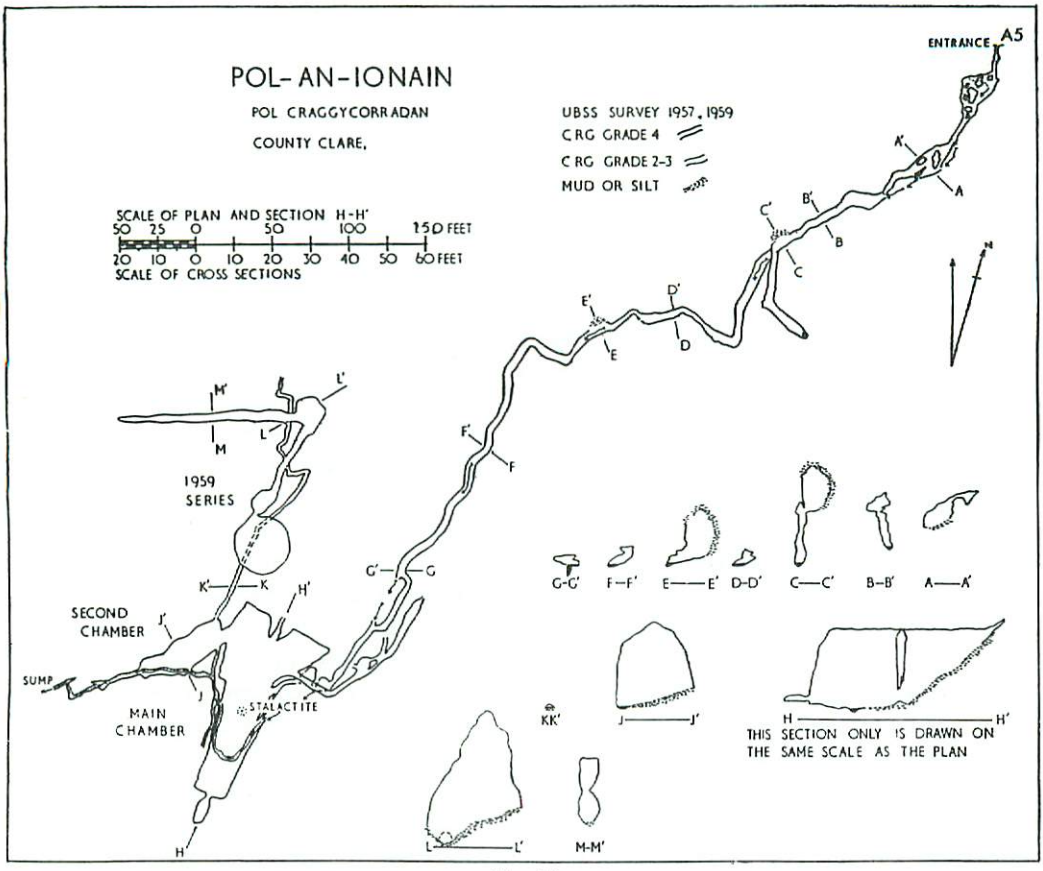


Fig. 30

WATER TRACING

Water from the Polldubh and some other swallets has been traced into the Coolagh River. The original survey of the cave, here reproduced as plate 5, shows the water tracing done in the cave. From the end of the known Coolagh River Cave the water has been traced to the inter-tidal resurgence of S3 (400 m south of Pollsallagh, S1). The water from A5 and A6 also resurges at S3. Divers have verified that there is no lower opening and that all the water comes out through a single opened bedding plane. The water, still in a bedding plane, can be reached again down through a widened grike, S4, 200 m inland. As the tide rises water backs up in the cave and under low flow state the water at S4 tastes as salt as the sea.

In July 1975 a young salmon, about 30 cm long, was found in the streamway of the Coolagh River Cave just above Balcombe's Pot. It can only have reached that position via the inter-tidal resurgence of S3, over 3.5 km

away. This implies the existence of fairly open passages, not necessarily passable to man. On the other hand two dye tests on the water of Pollballiny gave negative results at S3. It is probable that the water runs to the submarine resurgence S5 (Clare 4, E.51 cm, N.46 cm) off Trawee. Thus the original drainage of the Polldubh area was westerly to the Pollballiny depression and underground, presumably, to S5. The development of the Polldubh series of swallets turned the water south into the Coolagh River and thence, eventually to S3.

DISCUSSION

The extent of the denudation produced by the last glaciation was considerable. The enormous masses of calcareous drift along the coast are remarkable and withstand erosion by the sea. The glacial troughs that have been ploughed along both flanks of the northern part of Slieve Elva and on the western flank of Knockauns Mountain and the tangled mass of moraines in the Oughtdarra area are examples of this erosion.

The Coolagh River valley is considered to have been cut to its present form in the limestone by ice and this form has only been modified by subsequent flowing water. The presence of old high-level cave remnants postulates a shale margin rather different from that now seen (*c.f.* The Aillwee Caves, Drew 1973). The shale cover would have been relatively thin over much of the ground. The thin mass of shale outcropping at Ballynalackan House is a reminder of the former limits of the shale. The cave remnants also suggest that there was probably an older valley that helped to channel the ice. The exact ramifications of the ice cannot be determined and the local sub-stages of the ice retreat need further study. A puzzling feature of the valley is the change in size below the School House bridge (B10g). It implies a substantial addition to the ice.

At the southern end of the valley are the two closed depressions (*Pls.* 9 and 10). They were over deepened. They contain A5-7 and A11-15. The latter depression is considerably deeper than the former. There was a separate ice contribution for A11-15. The flatness of the limestone surfaces edging the valley and beyond to the west must surely have been produced by glacial planation (*Pl.* 9).

The southern part of the area would be likely to lose its ice cover marginally earlier than the area to the north. But ice might still remain in the valley floor after it had gone from the surrounding higher land. This would not preclude sub-ice water flow, *c.f.* eskers, and the ending of permafrost conditions so that the water could go underground. So the first caves to develop would be in the southern closed depressions from which there are no stream-cut overflow channels to the west or south. Thus Poll-an-Ionain is the first cave to be considered. It presents a combination of features, which are difficult to interpret. The Main Chamber and the 1959 Series both exhibit many phreatic features.

The water from the Coolagh River valley itself, (which here was first formed by the ice of the last local glaciation), first used A5a and A5, probably largely contemporaneously, during the early stages of ice retreat. Once this retreat had begun there would be great volumes of water at near freezing point available. Ground was likely to become unfrozen under the ice and cave formation could start with melt waters from under the ice forming the first channels. This has been shown to occur in other areas (Ford, 1973), though the cave described could be a pre-glacial cave re-activated under a glacier of later date.

Once the ice had retreated there would be a diurnal variation of the near freezing water flow. This would flood the closed depressions. The water would slowly make its way through the previously formed channels mentioned in the preceding paragraph and the depression would be drained overnight. The channels being close to the surface would develop rapidly under phreatic conditions from the aggressive action of the ice-cold water. There must have been a relatively small outlet for the water to permit drainage through the channels/chambers each night with consequent lowering of the water in the depression. There is in fact no sign of much overflow from A5-A7 depression into A11-15. The resurgence of this water is presumed to have been at S3 as no other possible resurgence is known and S3 is the present resurgence. Under the conditions stated there would be time for the phreatic chamber and passages in Poll-an-Ionain to be formed.

It seems likely that the conditions stated would result in the accumulation of considerable amounts of water-deposited drift in the A5-7 depression. Such deposition is known to have taken place at the well at B22. These same conditions would result in little deposition in the further depression, A11-15 and the section exposed at A15 confirms this.

The outlet from the underground channels would remain constricted for a long time as the aggressiveness of the water would be dissipated by the solution of the limestone in the upper parts of the cave and thus the Main Chamber of Poll-an-Ionain would act as a reservoir for a long period. Eventually the route to the sea at S3 was further developed.

The relative levels of the swallets in the A5 area show, except A6, so little variation that they were all probably in use simultaneously and continued to function until most of their headwaters were captured higher up the valley. A6 is much lower than the rest and is marked as a younger swallet. Even now these swallets habitually take small streams and are fully re-activated in flood times. It is also possible that the opening to the surface from Poll-an-Ionain recorded by Collingridge (1960, p. 50) at CC, functioned as a swallet for a short time (*Fig.* 30).

The mud infilling in the Main Chamber and the 1959 Series of Poll-an-Ionain is considered to have come in through swallet A5a and down the aven LL′, which has its lower parts plastered with mud.

The swallet behind the limestone barrier at B17 does not seem to have

TABLE 1

Relative Heights in A5 Area

	Feet above I.O.D.
Spot level on road at Cregg Lodge Bridge	241 (73.2m)
Flood level 1967	252 (76.6m)
Roof of A6	230 (69.7m)
Lip of A15	229 (69.4m)
Bottom of A15	213 (66.2m)
Col A6/A7	250 (76.0m)
Col A7/A9, 10	257 (78.1m)
Col A5a	254 (77.2m)
Col A5*	254 (77.2m)
Roof of A5	250 (76.0m)

* A5 was shut off from flood by a bank of re-deposited fluvatile drift.

functioned very long because of its characters and because there is a good quantity of drift retained in the valley upstream of it. The downstream lip is well rounded and wide but has no channel incised in it. A probable reason for the short life of B17 was the development of the very major swallet of B12, already described. At a late stage B12 became blocked and lake deposits formed behind it. Subsequently the site was re-activated. This sequence of fill and re-excavation came late in the history of the site. B12 also marks the limit of the sub-basin Bs4 and it can also be seen from plate 4 that there is a large area to the north through which water must percolate freely, for there are no streams. Most of this water is likely to enter the cave system. A similar argument is applicable to other areas of limestone adjacent to the valley.

B12 marks the downstream limit of the sub-basin. The upstream inlet to this is at the School House Bridge. Above this the valley has been partly cleared of glacial drift up to the top of the cliff at the actual swallet B10d. This cliff forms the next limestone barrier across the valley. There are no lacustrine deposits upstream of this swallet. It has its own local catchment. Pollclabber, like B10d, has no lake deposits behind it and also likewise has a short steep descent into it. It is suggested that both are very recent developments in the history of the cave system. Between B10d and B10 are various openings that pour out water in times of flood. *These are the result of water being forced to the surface by hydrostatic head.* The openings are not swallets though it is possible that local percolations did help to open up the joints and so assist resurgence from below. It is possible, though, that opening 2 of figure 27 (p. 88) may have served for a short time as a swallet for B10 and B10a.

The extension of the limestone exposure north to B10h is rather peculiar. In its southern part the floor is very smooth with a very flat U

section. It seems to be a simple extension of the shallow intermittent lake area of B10. There are two places from which water from the cave comes up. Further north there is an abrupt step down followed by two shakeholes and finally by a swallet at the head. The stream here has only a very small catchment and seems quite inadequate to have cut even this head part of the limestone extension or to have played a major part in the apparent series of swallet retreat. The explanation of the form of B10h is not obvious.

B8c and B8d are active swallets in a complicated closed depression. B8c takes quite a large stream derived from a considerable catchment area. The farmer states that this part of the depression does not ordinarily flood, even after heavy rain. In July 1974 some digging was done here and a steeply sloping fluted rock face was exposed. There is a considerable amount of glacial drift material, which seems to be slumping in from the sides of the hollow and to be earlier than the actual swallet. Below this slumped material is a sand/gravel choke now being eroded. Just to the west of the active swallet are two other choked openings.

B8d is a series of depressions, the product of swallet retreat from north to south. The primary swallet at the north was opened in July 1974 and entry gained by a descent of about 6 m to an E-W cross rift. There was much mud. The main passage could be followed north for about 16 m to where the fill reached the roof. This short piece of cave showed the effects of joint control very well. The area floods with very little rain. The opening was back filled at the request of the farmer.

B9 and B7 are typical swallets at the shale edge and mark the present limit of swallet retreat. Polldonough North, B8, is also at the shale edge and there has been considerable retreat upstream from the original point of engulfment. At the original place the top of the limestone is about 3 m below the surface but there is no indication that there was an earlier drainage over the surface southwards. A view of the area from the southern slope of Knockauns Mountain suggests that the B8 stream and the tributary that joins the Coolagh River at B6a have both beheaded an earlier drainage which ran out southwest towards B8a.

In the area of B7 the sub-basin Bs1 has its main inlet at the mouth of the shale-walled gorge. The rest of the basin seems to contain drift, which must be lying on an unknown thickness of shale.

From B6 to B4 the shale forms cliffs along both sides of the valley, which is nearly straight. In this case incision by the Coolagh River probably played a major part, but there is a secondary factor. The water from Polldubh Cave came up close to the surface of the limestone. Eventually this was dissolved to expose the bottom of the shale, which, left unsupported, rapidly collapsed to form the present gorge.

For explorers the Coolagh River Cave is the most dangerous cave in northwest Clare because of its propensity for total flooding as a result of ordinary rainfall. A heavy storm can produce this condition within a couple

of hours and well before that the cave would have been impassable against the current and volume of water. A hydrostatic head of over 30 m will build up and force water to the surface in the B10 area.

There are mud banks at the end of the terminal bedding plane in the cave. There is a sump at the downstream end of Pollcloghaun. These are indications of water being held up by obstructions. This could be the effect of simple smallness of passage size relative to the water coming down or it could be due to breakdown products obstructing flow. B11 is one obvious source of such a breakdown. But the obstruction at B10d and at B13a is in each case boulders and mud. More particularly mud at B13a. So if obstruction is the cause of flooding there must be other obstructions along the line than the collapse at B11. B12 is blocked but it will take a lot of water before it fills up and the water runs on down the valley. A5e and A7 are both blocked by mud and in A7 there are also boulders. A6 is still impassable but is relatively clear of mud and is kept clear by its own little stream. On the other hand A15 is not known to flood.

FILLS

Fills have been described for Poll-an-Ionain (Collingridge, 1960) and within the Coolagh River Cave (Bendall and Pitts, 1953, pp. 200, 242). They are present in Poulnagollum and Poulnagree. In each case they are being removed. Lacustrine deposits have been described at B12, B9 and B7. They may or may not be contemporaneous. The only common feature to all these fills is that they belong to a late stage in the sequence of cave and valley development. They pose a problem that is yet to be studied thoroughly.

SUMMARY

1. From the initial sites of engulfment in the A5-A9 area the water found its way to the resurgence S3. This was then above tide level as there is ample evidence for a late postglacial rise in sea level (Charlesworth, 1963).

2. Retreat began with new swallets developing up the valley. From these swallets connection was always established with the original resurgence route. This connection need not have been direct. The river underground need not lie under the ice-cut valley but could be offset from it. The course could cross and re-cross under the valley. Parts of the course must lie under the valley floor because *water bursts up through the floor in several places.*

3. Breakdown products would assist, by passive obstruction, the accumulation of mud as a part of the normal sequence of swallet abandonment. The process would be repeated with each retreat stage.

4. The passages would still be capable of taking large volumes of water before flooding occurs. This is known to be the case in the Coolagh River Cave itself.

5. The minor swallets such as B11b and B11c, B13 and B14 would contribute their quota of water into the cave system before the head-waters coming down could reach these areas. It is possible that B8c also adds its quota.

6. In the sub-basins the drift and peat are largely non-calcareous. These act in the manner of a sponge, holding the water while it becomes charged with acids making it very aggressive. If the peat and drift lie directly on limestone, and in some of the basins they certainly do, then fresh rain falling on the surface rapidly forces aggressive water to leave the bottom to enter the rock and thence to the cave system. Passages in the cave system below sub-basin 3 are good examples of development by water supplied by percolation. It is admitted that some of the water in these passages is derived from the major swallets of B7 and B9.

7. In the lower reaches of the valley there are areas of limestone with only a thin soil cover. Percolation does occur here on quite a substantial scale.

8. The effect of these secondary supplies of water, taken in conjunction with the obstructions noted, fill the passages below the known end of the Coolagh River Cave system so that comparatively little water from the head swallets can get out of the bottom of the cave and has to rise to the surface. At every successive swallet down the valley the flood water meets the same conditions and so rapidly fills up the relatively minor amount of space left and overflows again. This applies right down to A7.

9. It follows that access to what may be large canyon passages interrupted by bedding planes and chokes would most likely be possible at such sites as B12a, B11 and A6. A15 is another possibility as it is close to the drainage line to the sea but its failure to show water even under extreme flood conditions must imply that the passage from A6 goes very deep and that there is an obstruction beyond A6 so that the passages still further on are large enough to take all the water that gets past the obstruction without filling up.

10. A20 is a minor resurgence known as Pouliskaboy (hole of the yellow water). The supply for this is small and derived locally from glacial moraines through which it also sinks. Its continuation is likely to be small and to have lots of mud. Its position is such that it must drain to S3.

CONCLUSIONS

A. In the original paper on the Coolagh River Cave (Bendall and Pitts, 1953) the authors and their colleagues made a careful study of the cave. This paper was well ahead of its time. They stated (1953, p. 241) that 'it is probable that when the inlier [Poldonough, B7] in which the active swallets occur was first exposed the streams were being engulfed by one or more blocked swallets lower down the valley'. That is there had been swallet retreat. They refer to the mud and dripstone fillings (1953, pp. 240 and 242),

which had filled parts of the cave. These were being removed. Dripstone was being eroded by flood waters and also by increased flow of [aggressive] water at the sites of [former] deposition. 'The development of the cave was interrupted on at least one occasion when deposits of mud were laid down. The event must have occurred at a relatively recent date in the cave's history for no passages have been discovered which were obviously formed since'.

Our own conclusions on swallet retreat and a late filling stage agree with theirs but the ideas are extended to involve the whole valley. On the late filling stage it has been concluded that it is a stage common to many caves of the area.

B. During the last local glaciation troughs were cut in the limestone along both flanks of Slieve Elva and the west flank of Knockauns (*Fig.* 26). These could be the product of sub-glacial melt waters and not directly due to ice action. They do not define the limits of the ice for, towards the higher land, there are smooth limestone benches entirely denuded of shale. None of the troughs cross the summit areas as do, for example, similar troughs in the Bricklieve Mountains.

C. The valley as a whole was cut by ice of the last glaciation. The various sub-basins were formed in the same way. The shale remnants in the valley area were completely removed save for the small area, adjacent to Ballynalacken House, which area seems to have been protected by the massiveness of the rock on which the nearby castle stands.

D. In the course of downcutting the ice destroyed older, shallow and small caves. Remnants of these survive near the tops of the cliffs at B1c, B18 and B18a, A5b and A5c, A13 and A14. The remnants all exhibit characters suggestive of formation under phreatic conditions.

E. The shale-walled gorge at the head of the valley was produced by a combination of downcutting and undermining. The field of limestone erratics north of the gorge demonstrates that the gorge did not exist when these were deposited by the ice.

F. The major collapse of B11 and the incipient collapse of B11a have in part the same origin as the north gorge. The main differences are that there was no stream to do the downcutting and the supporting limestone was removed by water forced up from below through the limestone to the overlying shales. This is still operating but water has not been observed by us to reach the top of the limestone. It may still do so.

G. The numerous shakeholes in the B10 area are escape routes for water forced up at least 40 m from below. Local percolations may have helped to create these holes by an initial opening up of the joints.

H. A detailed sequence of development of the cave systems has been given. The important part played by percolation water in the production of the notorious flooding regime has been described.

I. It is thought that the unknown cave route does not always follow under the present valley. More probably it takes a zig-zag course, which is

largely joint controlled, to the inter-tidal resurgence at S3. It is considered that at each successive retreat connection was established with the route to the sea. Passage under the valley is demonstrated by the manner in which the water bursts up through the floor in several places.

J. The role of percolation water in the production of flooding can be extended to other caves. The 'sponge' principle set out in paragraph 6 of the Summary will apply and there will be direct percolation where conditions are suitable. For example the very large and rapid increase of flow in Branch Passage Gallery West in Poulnagollum is derived in the main by percolation through the floor of a peat lined closed depression. The swallet contribution is minimal.

ACKNOWLEDGMENTS

The authors wish to thank all those who helped in the field work behind this paper. A number of the photographs were taken specially for this paper by Mr. C. J. Johnson. Dr. J. K. Pitts has supplied the prints for plate 9. Explorations to settle various points have been done by many. These have included Messrs. A. Boycott, C. A. Self, C. Smart, J. D. Walford, A. G. Wilkins and R. G. Willis. Mr. C. A. Self has also drawn the maps for plate 4, and figures 27, 28 and 29. To all of these and to others who have assisted we are very grateful.

BENDALL, R. A. and PITTS, J. K. 1953 The Coolagh River Cave. *Proc. Univ. Bristol Spelaeol. Soc.* 6, (3), 228, 245.

CHARLESWORTH, J. K. 1963 *Historical Geology of Ireland.* Edinburgh.

COLLINGRIDGE, B. R. 1960 Poll-an-Ionain. *Proc. Univ. Bristol Spelaeol. Soc.* 9, (1), 47-57.

1969 In *Caves of North West Clare, Ireland.* Ed. E. K. Tratman. David and Charles, Devon.

DREW, D. P. 1973 A Preliminary Study of the Geomorphology of the Aillwee Area, Central Burren, Co. Clare. *Proc. Univ. Bristol Spelaeol. Soc.* 13, (2), 227-244.

FORD, D. C. 1971 Alpine Karst in the Mt. Castleguard-Colombia Icefield Area, Canadian Rocky Mountains. *Arctic and Alpine Research.* 3, (3), 239-252.

TRATMAN, E. K. 1968 A Flash Flood in the Caves of North West Clare, Ireland. *Proc. Univ. Bristol Spelaeol. Soc.* 11 (3), 292-296.

TRATMAN, E. K. (Editor) 1969 *The Caves of North West Clare, Ireland.* David and Charles, Devon.

TRUDGILL, S. T. 1972 The Influence of Drift and Soils on Limestone Weathering in N.W. Clare, Ireland. *Proc. Univ. Bristol Spelaeol. Soc.* 13, (1), 113-118.

WILKINS, A. G. 1971 B11 (Poulnagun), Co. Clare, Ireland. *Proc. Univ. Bristol Spelaeol. Soc.* 12, (3), 295-298.

WILLIAMS, N. 1969 Pollcloghaun. *Cambridge Univ. Caving Club Jrnl.* 1, (4), 13.

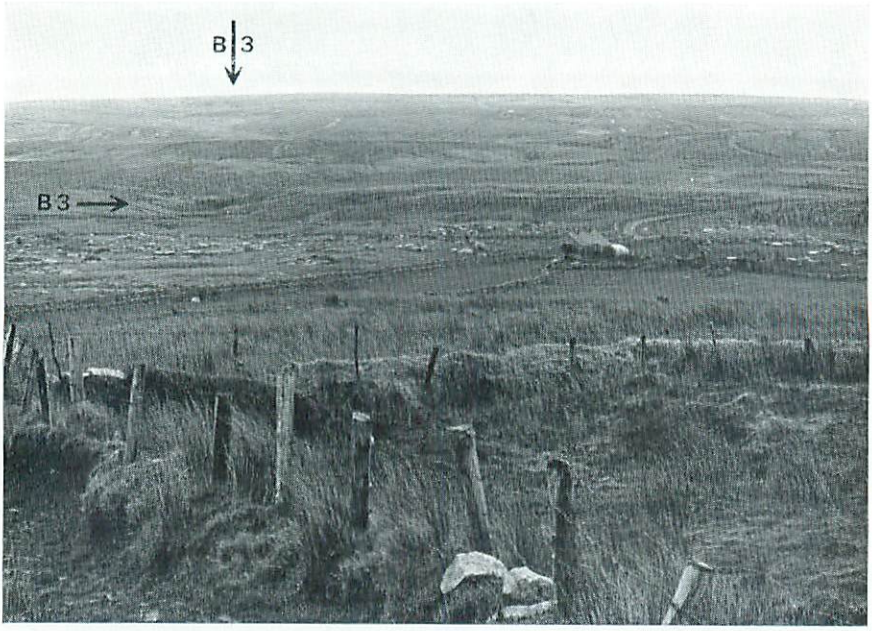


Plate 6a. Boulder field of limestone erratics along the west side of Slieve Elva. The white patches are standing water on boulder clay. April 1972. Photograph C. J. Johnson.

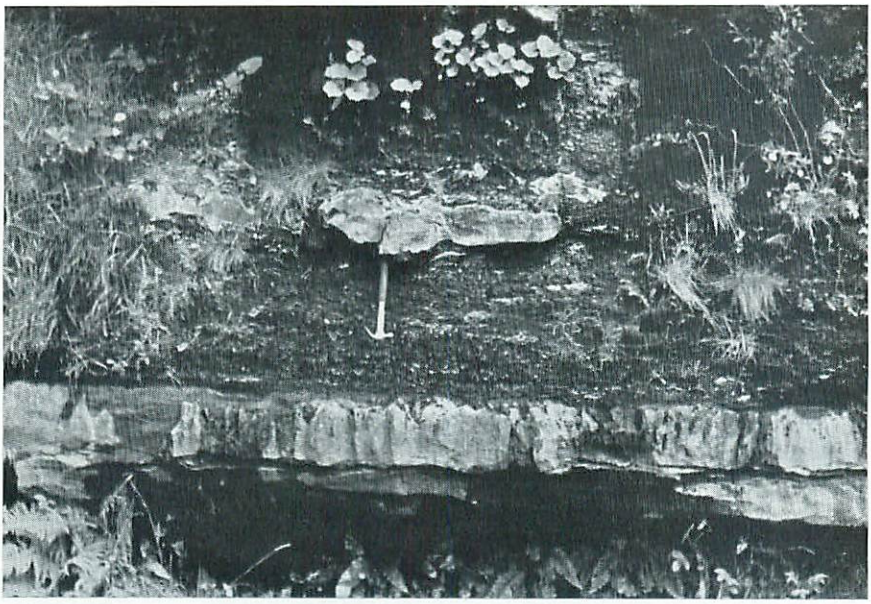


Plate 6b. Shale/Limestone unconformity in the Glenaruin (Coolagh) river valley. Note slight undulation of the surface of the limestone and the shallow-lying cave below, opened by collapse. Photograph, E. K. Tratman.

Plate 7a. Glacial deposits in the Glenaruin (Coolagh) river valley at B6a. Note the large size of some of the boulders. The whole rests on shale, which here thinly-covers the limestone. Photograph, C. J. Johnson.

Plate 7b. View of B11 (Polnagun) looking north. Photograph, E. K. Tratman.

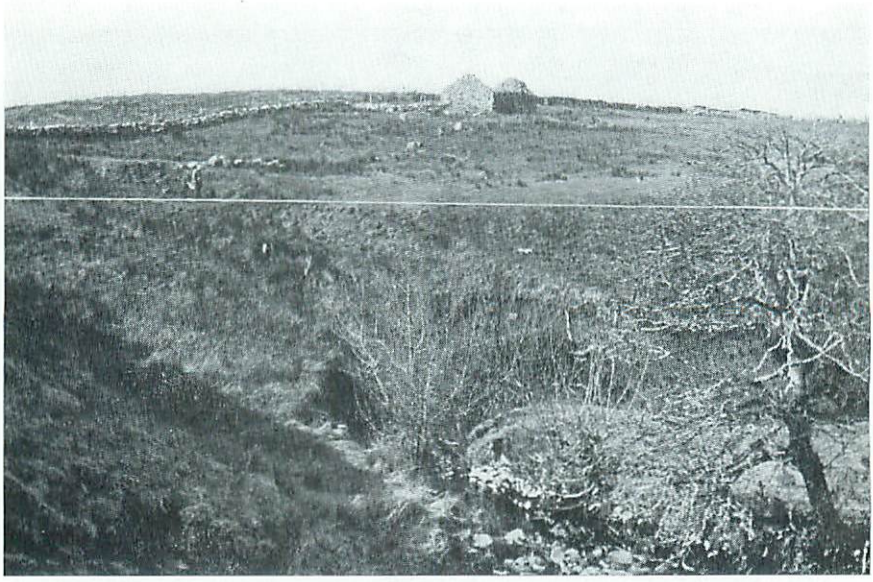


Plate 8a. Polldonongh, B7; the white line marks the flood level of August 1967. Photograph, E. K. Tratman.

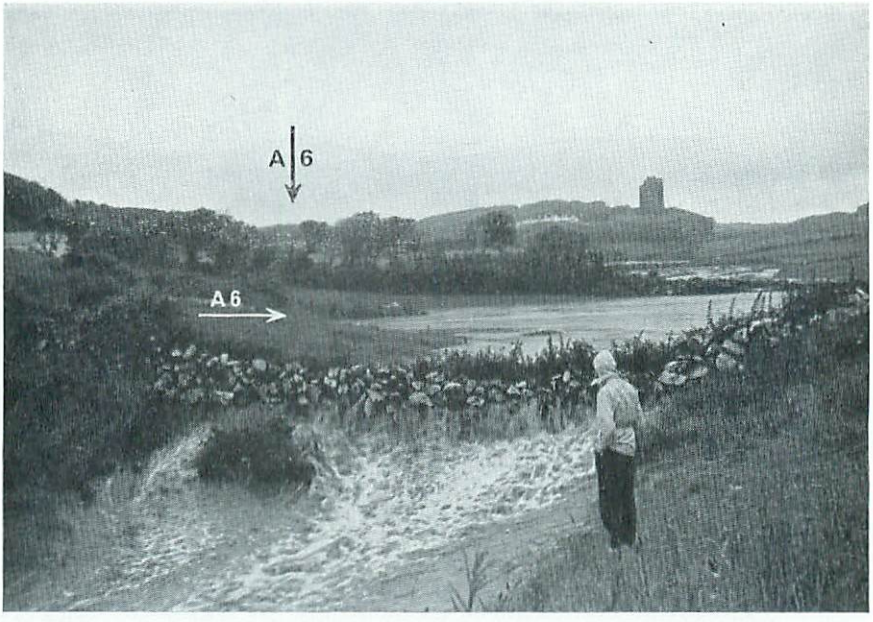


Plate 8b. The flood of August 1961 near its maximum in the A6 and A7 area. A6 is completely submerged and the lake formed is overflowing into A7 but has not yet filled it. Photograph, D. Savage.

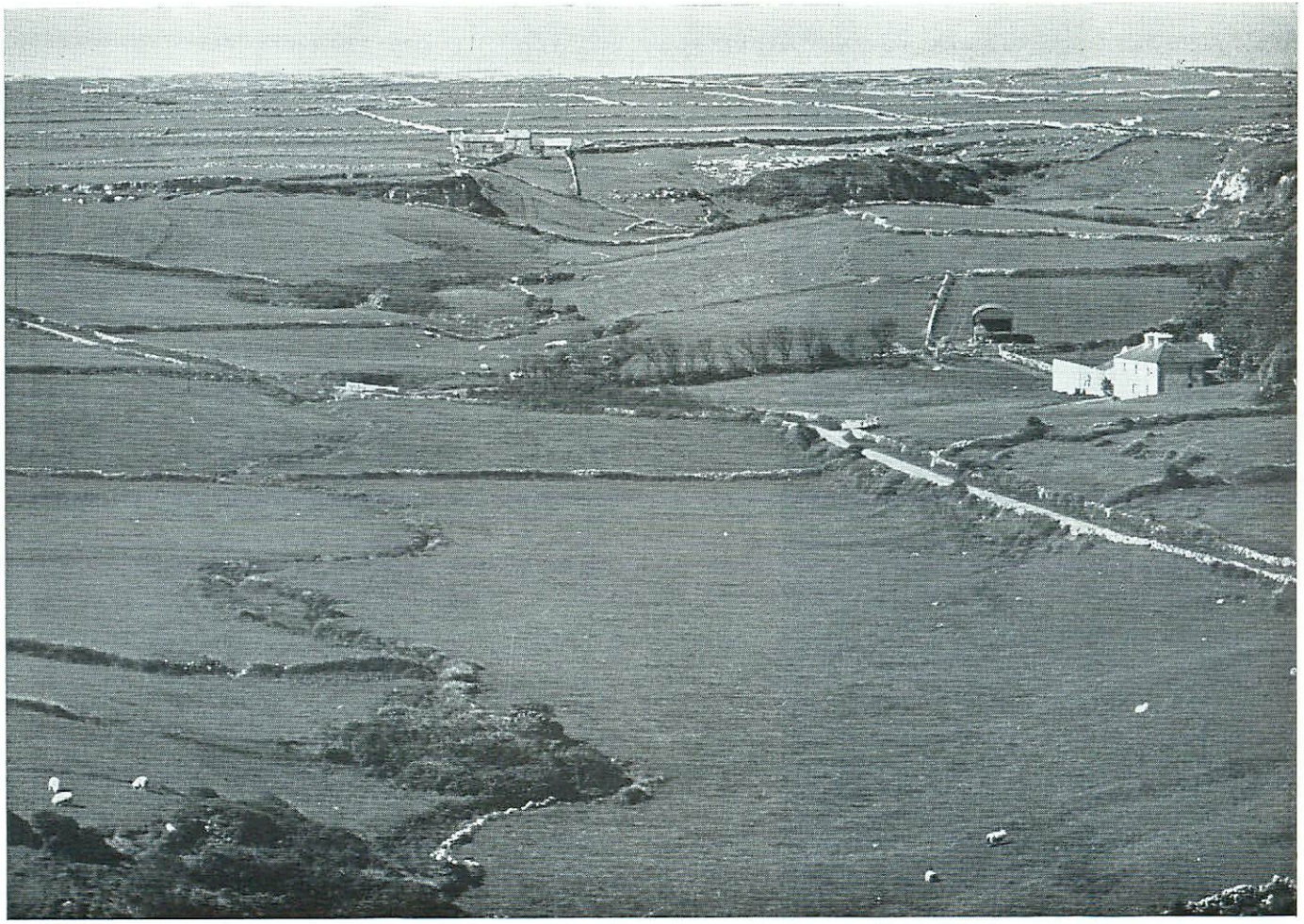


Plate 9. View south from the tower of Ballynalackan Castle over the closed depressions of A5-A7 and A11-A15. The small stream comes from B22. It runs into A6 which is just visible as a bush-filled hollow, to the left is A7. The glacially-planed surface of the limestone is very obvious. It extends to the coast. Photograph, J. K. Pitts.

Plate 10. View looking north to Ballynalackan Castle and house. The deep hollow of A15 is conspicuous in the middle distance. The trees to the left of the house mark the shade outlier. Photograph, E. K. Tratman.

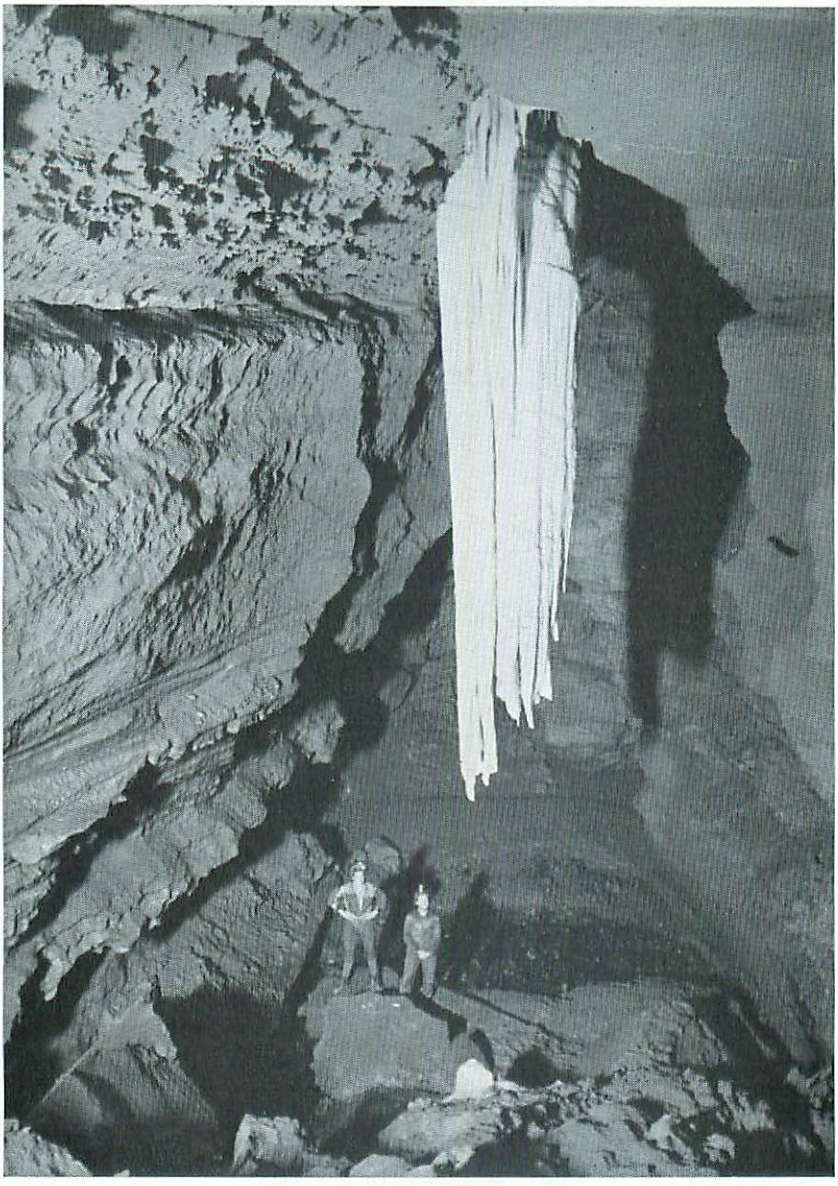


Plate 11. The Main Chamber in Poll-an-Ionain. The Great Stalactite is seen to be free-hanging. In the background the coarse stream-laid fill underlies the laminated mud and is being eroded by the present stream. Photograph, D. M. M. Thompson.

HYDROLOGY OF THE COOLAGH RIVER

KEY

- Road
- Bridge
- Coast
- Contour (metre)
- Cliff
- Closed Basin
- River
- Intermittent Stream
- C.R. Coolagh River
- L.O.R. Lower Owenealikeen River
- O.R. Owenealikeen River
- Shale / Limestone — Geological Boundary
- Col
- High Level Ice Channel
- Proved Water Tracing
- Postulated Water Tracing
- Flood Limit
- Swallet
- Cave
- Resurgence
- Shakehole
- Hill , Hollow

N

0 2000 4000 FEET

0 500 1000 METRES

GALWAY BAY

S1 S3 S4

via Oughtdarra East

A20 A15 A6 A5

B1c B1 B2 B3 BLAKE'S MTN

Pl.6A B5 B4b B4a B4 C.R. BLAKE'S BRIDGE

KNOCKAUNS MOUNTAIN

DUGGAN'S WELL

B6 BS1 B6a C.R. B7 BS2

B8 B8b B8a B8d B8c BS4

B9 B9f B9e O.R. BS3 L.O.R. B10

B11d B11c B11b B11 B11a B16 B15 B12 B18 B17 B14 B13 B13a B20a Castle B20 B21 B22 B19 B19a

B

C

U.B.S.S. ©

C.A.S.

NAMED SITES

B1–3	Polldubh Swallets
B4b	Erratic Boulder Field
B7	Polldonough
B8	Polldonough North
B9	Polldonough South
B10	Pollclabber
B11	Poulnagun
B20	Ballynalackan Castle
A5	Poll-an-Ionain
A6	Cregg Lodge Swallet
A20	Pouliskaboy
S1	Pollsallagh
S3	Coolagh River Resurgence

Plate 4. Based on Ordnance Survey by permission of the Government of the Republic of Ireland. Permit No. 2312.

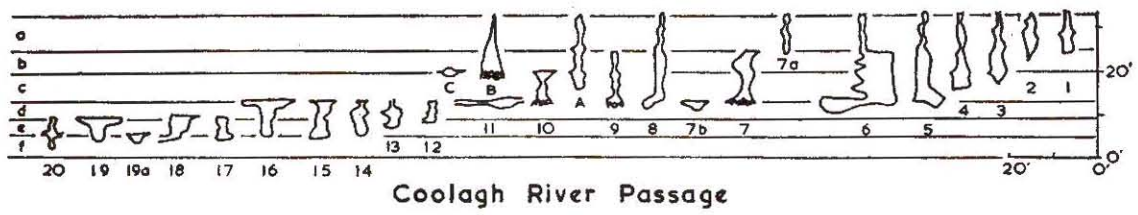
COOLAGH RIVER CAVE

Co. Clare, Ireland.

U.B.S.S. SURVEY

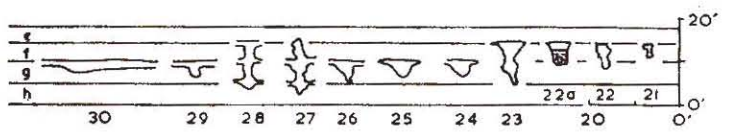
SURVEYED BY R.A.BENDALL N.G.BLACKWELL & J.I.LIGHT. AUGUST 1949 & AUGUST 1950.

DRAWN BY N.G.BLACKWELL

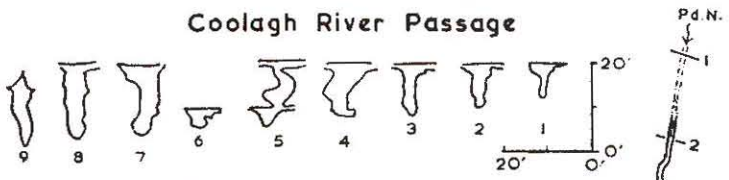


Coolagh River Passage

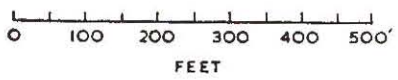
[ALL CROSS SECTIONS LOOKING DOWNSTREAM]



Coolagh River Passage



Cascade Branch



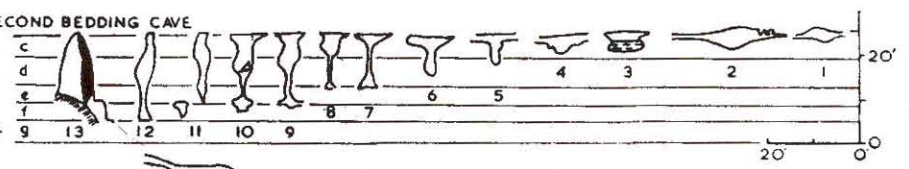
C.R.G. GRADE 5 SURVEY

C.R.G GRADE 2 SURVEY

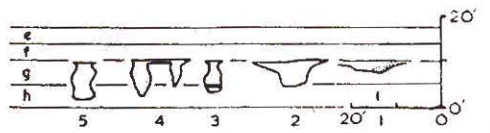
WATER FLOW

Pd. POLLDONOUGH WATER

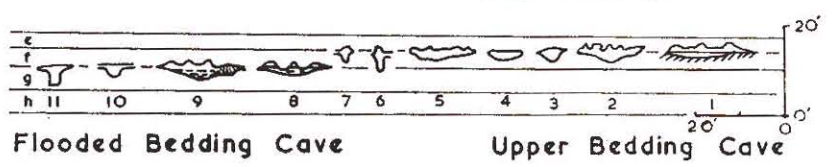
Pc. POLLCLABBER WATER



Double Passage

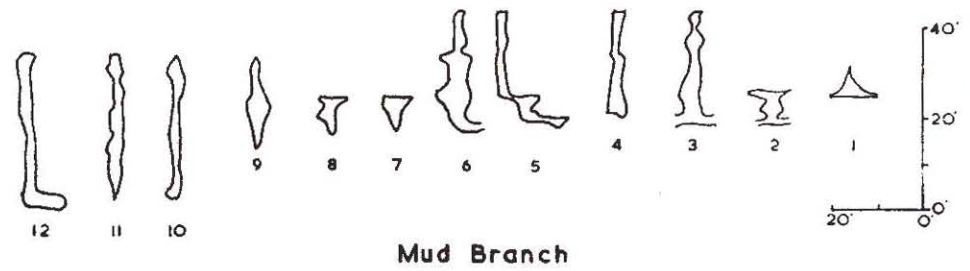


Gour Passage

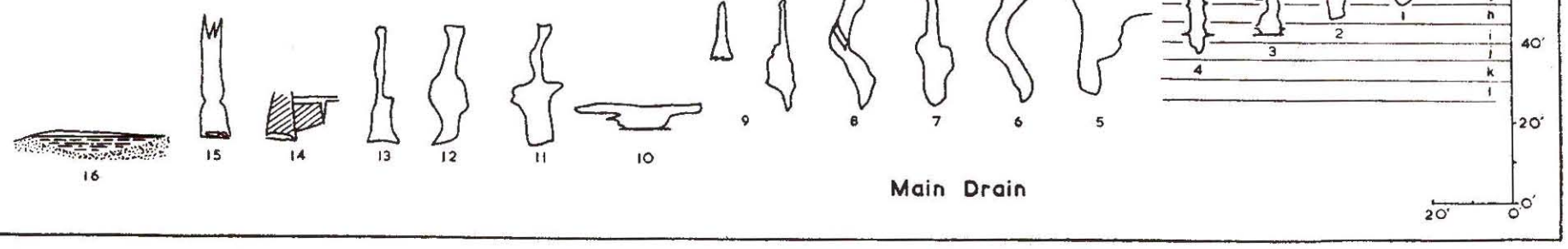


Flooded Bedding Cave

Upper Bedding Cave



Mud Branch



Main Drain

Plate 5.