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SNAIL HOLES (HELIXIGENIC CAVITIES) IN HARD LIMESTONE – AN AID TO THE INTERPRETATION OF KARST LANDFORMS

by

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ABSTRACT

Geologists in the early 19th century debated the origin of deep tubular holes bored into hard limestones in several European countries and decided that land snails, especially the 'grove snail' *Cepaea nemoralis,* were responsible. Recent research on the Mendip Hills in England confirms this view. The fact that snail holes are bored in subaerial conditions at a maximum rate of c. 1.5 mm in 10 years makes them a useful tool in karst landform interpretation. The local Ipswichian topography of a Mendip closed basin is reconstructed assuming that hundreds of borings in Twin Titties Swallet are pre-Devensian snail holes.

INTRODUCTION

In the 19th century there was lively controversy among geologists and naturalists about the origin of certain tube-like cavities in limestone. Though widely distributed and locally common, these cavities are seldom noticed because they typically occur at or near ground level, where they rise vertically from the undersides of overhanging ledges.

The cavities have a characteristic form that, once seen, is always recognizable. They have almost circular orifices about 20 mm in diameter, above which they rise as smooth circular tubes that either maintain the same width or expand to branch into diverging tubes, each of the original diameter. They are holes such as one could make by thrusting the fingers into wet cement mortar.

Three possible origins were proposed:

(*a*) normal atmospheric weathering,

(*b*) boring by marine molluscs, in particular *Pholas*,

(*c*) boring by land snails.

By 1870 the land snail hypothesis had ousted the others, though one celebrated geologist remained sceptical. Interest failed, and modern geologists and geomorphologists seem largely unaware of the existence of snail borings except, perhaps, as a quaint outdated theory.

THE SNAIL HOLE DEBATE

The recognition of snail holes in Britain may be credited to the Rev. John Hodgson. In his *History of Northumberland* (Part 2, vol. 1), published in 1827, there appears (p. 193), a description of Carboniferous Limestone outcrops near Whelpington that form 'grey projecting masses, the *under* surface of which is bored upwards into cylindrical holes, which are from one to four inches deep, and tenanted, especially in winter, by the banded and yellow varieties of the *Helix nemoralis.* The *limax*, while it occupies these cavities during the summer, . . . probably elaborates its den in the same manner that some of the *pholades* work their way into clay or wood, or . . . in the hardest stones'.

Buckland (1839, 1841) described similar holes on the under surfaces of Carboniferous Limestone ledges near Boulogne and at Tenby. The latter had been located by the Rev. Stapleton, who thought they were *Pholas* borings. Buckland rejected this idea because of their irregular shape and their absence from the upper surfaces of ledges. He considered that they were borings made by generations of land snails, probably *Helix aspersa*, using acid secretions, and that earlier observers had probably ascribed them to 'the action of the weather, or water, or to original irregularities in the composition of the stone'.

Trevelyan (1846) revisited Hodgson's site and confirmed that 'the thoroughly sheltered position of the *under* surface of the rock precludes the possibility of the holes being an effect of weathering'. In France, Bouchard-Chantereaux (1861) dealt at length with the holes in Bois des Roches, near Boulogne. He described the scepticism with which Constant Prévost's claim, made about 1830, that borings in the marbles of Mt. Pelegrino in Sicily were the work of land snails, had been greeted by French naturalists. He used a sledgehammer to examine the complex interiors of deep interconnecting holes and concluded that *Helix hortensis* bored them, using acid secretions, mainly during the winter period. His paper includes clear illustrations of rock honeycombs.

Mackintosh (1867) referred to the identification by William Pengelly, about 1864, of *Pholas* borings ('lithodomous perforations') in Devonian limestones at Kent's Cavern and elsewhere near Torquay*. They demonstrated, he thought, ancient sea levels at least 70 m higher than the present. Bonney (1869, 1870) examined supposed *Pholas* borings near Llandudno in North Wales and in Derbyshire, the latter at 420 m above sea level. He argued that the local topographies showed no signs of recent marine inundation, and that the borings had been made by snails. Rofe (1870) clearly and concisely reviewed the atmospheric, marine and land snail theories in the light of studies by Miss Hodgson and himself on burrows near Ulverston. He concluded that land snails, using their rasping tongues and, possibly, acid secretions, excavated the burrows.

Rofe's review seemed to end the debate, but one geologist was not convinced. H. B. Woodward, a prolific geological writer, was influenced by 'memoranda made by my father, the late Dr. S. P. Woodward, when on a trip to the Mendips in 1842. He observed that Dr. Buckland's "snail holes" occur frequently on the rocks and in the rock walls, often low down, but always on the windward side. *Helix nemoralis* was the usual

* The urbanization of Torquay and district has destroyed most of the sites described by Mackintosh, including the 'wonderful natural arch' at Upton. Cavities in the roof of Kent's Cavern, just inside the entrance and exit doors, appear to be small simple snail holes. On Berry Head at Brixham simple holes and scrapes can be found but the local Devonian limestone is fissile and disintegrates before complex holes can form.

occupant. They are, he added, clearly due to weathering, and not to snail action' (Woodward, 1874). In a footnote to Mackintosh (1867) H. B. Woodward wrote 'the late Dr. S. P. Woodward – than whom no higher authority upon Mollusca can be quoted – decided against the snail-theory . . .'

It is possible that neither S. P. nor H. B. Woodward encountered genuine snail holes. The mollusc expert's claim that they are restricted to the windward side of rocks exactly contradicts the findings of Buckland, Trevelyan, Bouchard-Chantereaux and Rofe, who found holes mainly in sheltered positions. The geologist Woodward was confusing snail holes with waterstones in his 1874 paper when he continued 'the rocks are in many places perforated with holes and burrows, which penetrate the stone in every direction, and appear devoid of any regularity. They occur on exposed situations, and may be seen on the surface of the ground after removing the turf. They are due to the action of rain, and the carbonic acid which it imbibes ... . Blocks with these perforations are the usual ornaments in the cottage gardens.'

H. B. Woodward's scepticism was still manifest in his classic book *The Geology of England and Wales* (1887, p. 605). His influence, together with the apparent practical unimportance of the subject, led to it being all but forgotten in the mid-20th century.

RECENT WORK

Snail holes were independently rediscovered by several workers in the 20th century. In the Mendips, Swanton (1912, pp. 26-27) found them in Carboniferous Limestone outcrops on the south side of Brean Down. They were occupied by *Helix aspersa,* and Swanton concluded that they had been bored by many generations of this snail. He understood that snail holes are 'by no means common in England', but Stanton (1986), having identified them near Priddy in 1984, found them in large numbers at sites from Brean Down in the west to Nunney in the east.

Stanton examined several thousand snail holes at more than 60 Mendip sites. From the presence of holes in stone quarries only about 200 years old he deduced that they are still being formed, at a rate of deepening that can reach 15 mm in 100 years. He established a snail hole development sequence of increasing complexity: shallow scrape – simple hole – complex hole – rock honeycomb (Fig. 1), a sequence into which any snail hole can be fitted. Stanton noted that most holes are too narrow to accept adult individuals of the 'garden snail' *Helix aspersa,* but they neatly fit adult individuals of the yellow and black banded 'grove snail' *Cepaea nemoralis* (originally *Helix nemoralis*). He concluded that Mendip snail holes were and are being bored by *C. nemoralis*, which very commonly inhabits them in summer but does not use them for winter hibernation.

SNAIL HOLES IN KARST LANDFORM INTERPRETATION

The presence of snail holes in a limestone rock face shows that it has been accessible to snails for periods of at least 50 years (shallow scrapes) up to thousands of years (rock honeycombs). The holes develop in outcrops very close to vegetation, usually within a metre of ground level. They are especially common in rock overhangs that are or have been screened by growing grass.

On vertical rock faces above overhangs, snail holes are often exposed in long section. Half of the tubular boring remains, rising to a bluntly rounded end. It might be supposed that external wasting of the rock face had exposed the snail hole, allowing an estimate of its age to be made, but other explanations (e.g. that the half-tubes have been formed by snails beneath a coating of moss, as seen in woodland outcrops at King's Castle near Wells, ST 568455) are possible. At some localities the half-tubes are so common, approximating so closely in each case to a tube neatly bisected down the long axis, that exposure by rock wasting seems an unlikely explanation. Possibly, therefore, they indicate that the outcrop was moss-covered for long periods in its history.

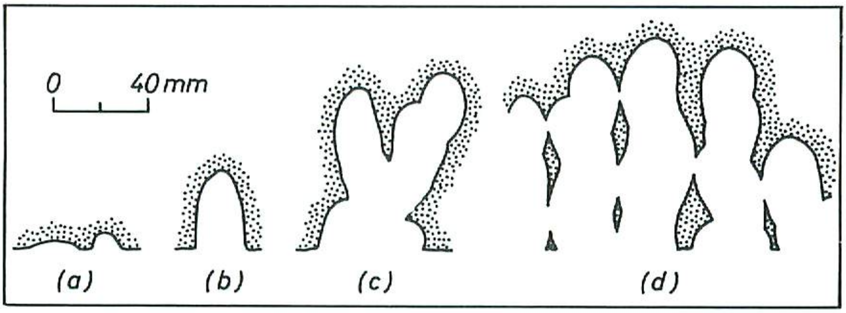


FIG. 1 — THE SNAIL HOLE DEVELOPMENT SEQUENCE.
(a) SCRAPES. (b) SIMPLE HOLE. (c) COMPLEX HOLE. (d) ROCK HONEYCOMB.

Because snail holes normally grow vertically upwards, they can indicate the original 'way up' of a displaced block of limestone. Several such blocks have been seen with old holes terminating sideways or downwards and, in one case near Cross Swallet (ST 515498), new holes growing upwards.

In the Mendip karst landscape, where there has been intensive open-cast mining for metals and stone pitting for wallbuilding and limeburning, it is often hard to tell whether a particular depression or rock face is artificial or natural. If complex snail holes or rock honeycombs are present in it the feature is presumed to be natural because the time required for their formation is so great – unless, possibly, the mining was Roman. However, in the Ubley and Charterhouse Rakes (Stanton & Clarke, 1984), supposedly the product of Roman lead mining, only a few simple holes have been found, near the tops of the rock faces.

A few simple holes are also present in the limestone and Dolomitic Conglomerate faces of the rakes in the Chancellor's Farm orefield (ST 5353), and at two places, low down in the rakes, complex snail holes occur. They appear to indicate natural sinkholes predating the mining.

Of course, the complexity and depth of snail holes are no more than a rough measure of their age. Thus in stone pits about 200 years old the holes range from scrapes 1 to 2 mm deep to simple holes 30 mm deep. In the Bronze Age 'Cove' at Stanton Drew (ST 597631) a conglomerate pillar placed upright some 3000 years ago has in its limestone cobbles snail holes of no great complexity and not more than 50 mm deep.

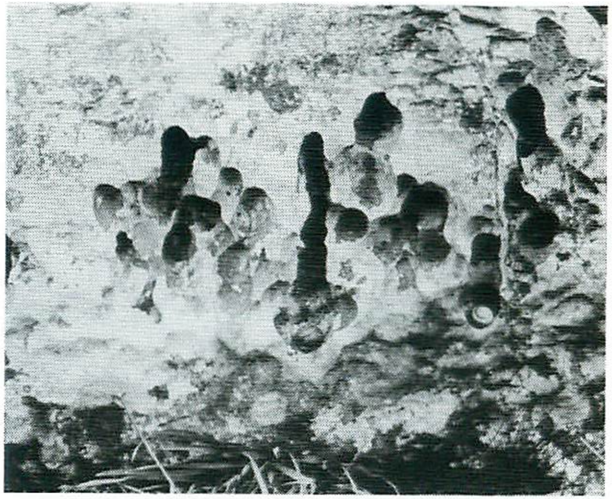
The presence of snail holes in areas affected by soil erosion can be used to identify rock outcrops that have *not* been recently uncovered. Snail holes are absent from the smoothly rounded limestone surfaces that develop beneath a soil cover, though they can be temporarily buried when an anthill is built against them. Near Westbury Quarry (ST 508502) a cluster of simple holes is present 0.3 m down a vertical rock fissure only just wide enogh to admit a forearm.

The assertion by the mollusc expert, Dr S. P. Woodward, that Mendip snail holes are confined to the windward sides of limestone outcrops, is manifestly incorrect. Any rock face with overhanging ledges near ground level may have them, whatever its aspect. If southwesterlies are taken to be the prevailing winds, most Mendip snail holes are on leeward faces, but this is only because the holes are so common in the 'closed basins' of the plateau (Barrington & Stanton, 1977, pp. 223-224) where cliffs mostly face north or northeast.

Where small natural cliffs have been quarried for stone, the presence of complex snail holes on the ends of remnant promontories allows the original cliff line, and the volume of stone removed, to be estimated. A good example is beside a ruined limekiln in the Cabin Bottom closed basin (ST 500515).

PLATE 1 (OPPOSITE) — SNAIL HOLES ABOVE GROUND

a. COMPLEX HOLES IN ROCK FACE NEAR CROSS SWALLET (ST514499)
b. SMALL ROCK HONEYCOMB NEAR CROSS SWALLET (ST515499)
c. SMALL SIMPLE HOLES LESS THAN C.200 YEARS OLD IN WALLSTONE QUARRY NEAR BRIMBLE PIT (ST503511)
d. CLOSE-UP OF SIMPLE HOLES IN CABIN BOTTOM, LOOKING VERTICALLY UPWARD (ST497518)



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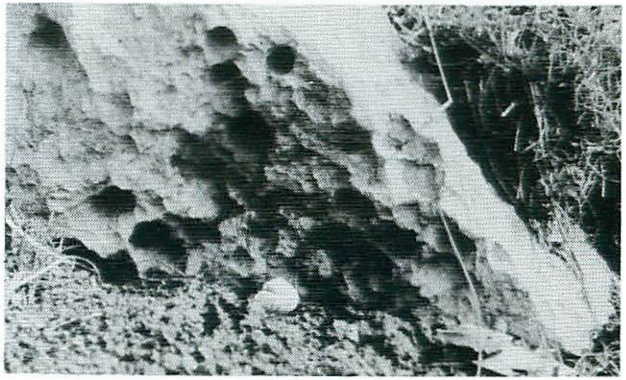

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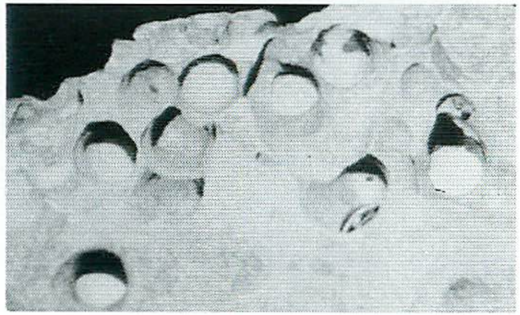

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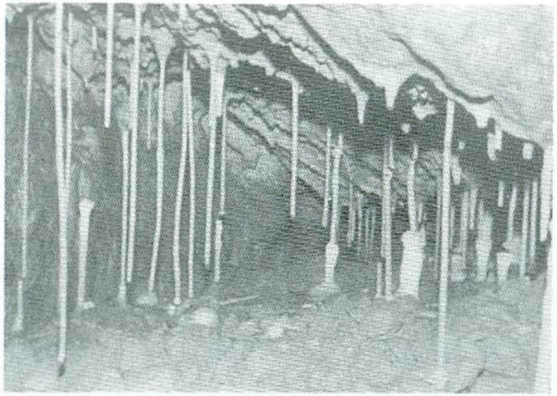
SNAIL HOLES IN LIMESTONE



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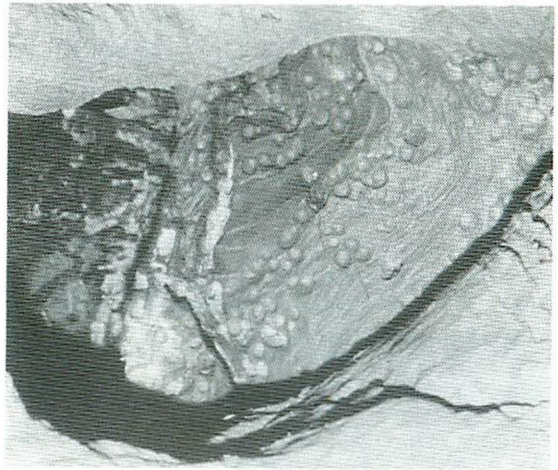

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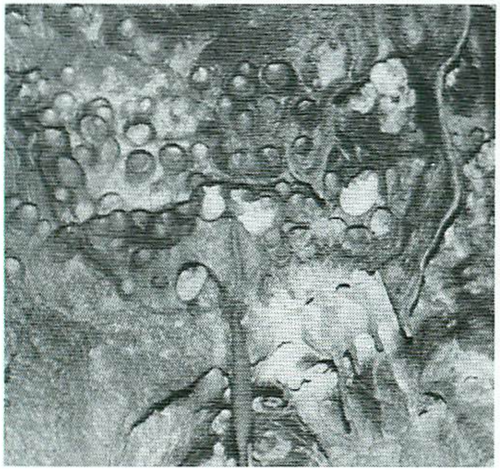

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SNAIL HOLES IN LIMESTONE

PLATE 2 (OPPOSITE) — BELOW GROUND IN TWIN TITTIES SWALLET
a. STRAW STALACTITES FRACTURED AND DISTORTED BY SETTLEMENT OF CLAY FILL
b. SIMPLE HOLES IN AN AVEN (LOOKING VERTICALLY UPWARD)
c. SIMPLE HOLES PARTLY OVERGROWN BY STALACTITES
d. CLOSE-UP OF SIMPLE HOLES SHOWING ROUGH CORRODED SURFACES (LOOKING VERTICALLY UPWARDS)

CAVE HISTORY DEDUCED FROM POSSIBLE SNAIL HOLES

A small cave called Twin Titties Swallet (ST 522505) near Priddy contains enormous numbers of cavities that at first sight appear to be snail holes. The section (FIG. 2) shows how the holes are present from entrance to end of the cave, which is about 50 m long and 25 m deep. The entrance is in the floor of the Gargill closed basin, beneath a limestone outcrop containing normal snail holes. It was entirely blocked by debris

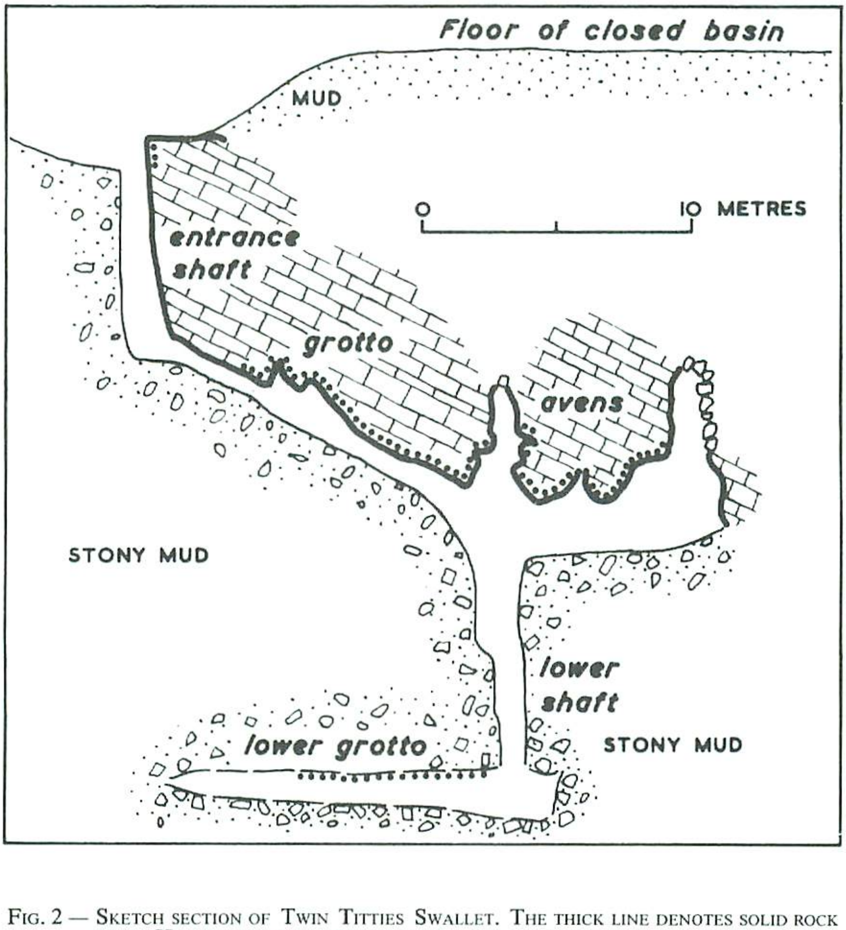

FIG. 2 — SKETCH SECTION OF TWIN TITTIES SWALLET. THE THICK LINE DENOTES SOLID ROCK ROOF. HEAVY DOTS INDICATE AREAS OF SNAIL HOLES, WHICH IN THE LOWER GROTTO OCCUPY AN OVERHANG OF THE CAVE WALL.

until 1968-69 when it was dug open by the NHASA (North Hill Association for Speleological Advancement) caving group (North Hill Consortium, 1969).

The underground holes are confined to downward-facing surfaces, i.e. the cave roof, inverted ledges and overhanging walls. In many of these places they are so closely packed together that little of the original rock surface remains. Their form is basically similar to that of open-air snail holes, but there are several important differences of detail.

Open-air snail holes vary from short and simple to long and very complex, whereas the underground holes are all simple and less than 80 mm deep, with no branches, though a few holes coalesce. Open-air holes are typically tubular with parallel sides, but the underground holes are broadly conical, narrowing upwards to a rounded end. The abundance and close spacing of the underground holes has no match on the surface outcrops. The larger underground holes are only 4 to 5 times as deep as the smaller ones, whereas the open-air holes have a much greater size range. However, insoluble fossils project into the underground holes as they do into the open-air holes, in one case to an extent that would seem to preclude access by snails to the end of the hole.

The underground holes are demonstrably very ancient, for they are coated and covered by thick dripstone deposits from which hang long stalactites.

The cave floor is a massive fill of more or less stony silty mud which from its unsorted texture probably sludged into the cave and filled it to the roof where this was low. Downward movement has not totally ceased, as shown by the fracturing of stalactite pillars joining roof to floor. When the cave was first explored a few holes in the roof, as much as one metre above the floor, contained mud fill, showing that the floor deposits have settled or compacted to well below their original level. Many of the possible snail holes must still be buried, and some have already been exposed by digging.

It is believed (Barrington & Stanton, 1977, pp. 222-224) that Mendip sinkholes tend to form and enlarge in warm interglacial climates, only to become filled with massflow deposits during the intervening periglacial phases. In this case the cave fill, burying the possible snail holes, is likely to be a mixture of lake-bed mud and local stone, dating from the Last or Devensian periglacial phase. The holes themselves, being older than the fill, could have originated in the previous (Last or Ipswichian) interglacial, or less probably during an interstadial of the Devensian.

If, therefore, the underground holes really are snail holes, they may be as much as 100,000 years old. Possibly they were not excavated by *Cepaea nemoralis* but by a different kind of snail with different habits. This could explain the anomalous spacing, size range and shape of the ancient underground holes compared with modern open-air ones. Nevertheless it seems unreasonable to propose that any variety of snail went deep into a dark cave to make its holes, and so one must deduce that daylight could at that time reach to the end of the cave as presently known.

On this assumption, a reconstruction of the adjacent Late Ipswichian landscape can be attempted. The Gargill closed basin was largely free of lake-bed muds and was a steep-sided rocky doline or chasm, vegetated with trees or grass (depending on climatic conditions). Rock buttresses projected into the chasm and the present cave had an impressive entrance, more than 10 m high, in one of them. A network of smaller passages and shafts linked the cave to the exterior, perhaps along the lines of caves in karst towers.

This reconstruction requires the fill on the cave floor to be some 20 m deep, which is possible. It would have accumulated gradually in the cave under Devensian periglacial conditions. Much of the mud and silt would have reached the area as windblown dust. Flooding by summer meltwater formed more or less temporary lakes in which the mud accumulated and eventually buried the older rugged topography.

The conical shape of the underground holes may have developed, or been accentuated, at a time when the cave suffered intermittent flooding. Air would be trapped for a period at the top of each hole, so that solutional widening would be more active at the bottom than at the top. In fact the walls of many holes are rough and corroded, with delicate mineral veins and crystal aggregations standing up to 3 mm proud of the limestone surface. Seldom, however, has the perfectly circular cross-section of a hole been significantly distorted, as might be expected to happen if solution was the main agent of hole excavation.

The possibility remains that the underground holes are not snail holes but were formed by some underground weathering process that is as yet unexplained. If so, their abundance in this cave, and their apparent total absence from other caves, must also be explained. The snail hole hypothesis would of course be strengthened if the form of the rock topography beneath the lake-bed muds were shown, by geophysical or other means, to be compatible with the reconstruction here proposed.

NOTE: Like stalactites, snail holes are hundreds or thousands of years old and cannot be replaced. Avoid damaging them.

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