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A Trans-Craven Cave System appraised

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Abstract: There have long been notions, proposals, concepts and dreams relating to a single integrated cave system extending beneath the Yorkshire Dales to form an underground route from Barbondale in the west to Wharfedale in the east. Since exploration of the links that established the Three Counties Cave System, a significant segment of a Trans-Craven Cave System is now a reality, and it is appropriate to re-assess the scope for further extensions towards the east. Prospects for finding linking cave passages to Ingleborough are good, and are just about conceivable as far as Fountains Fell. However, links become progressively more tenuous farther east, even though significant lengths of cave passage undoubtedly await discovery within the Wharfedale catchment.

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The limestone karst terrain of the Yorkshire Dales, along with its extension into Lancashire and Cumbria, is known to contain many of Britain's longer and deeper caves. But new discoveries are made every year, and it is clear that there are many more cave passages yet to be found beneath the great limestone benches of the Yorkshire Dales karst. The challenges for Dales' cavers are to find the missing links to connect the many known caves into much longer systems, which can place the Dales with higher rankings on the list of the world's longest caves, or at least keep ahead of any caves in Wales. The limitations of geology and topography mean that neither the Dales nor Wales will ever be conspicuous on a list of the world's deepest caves.

There are those who would argue that a Trans-Craven System has long existed within the limestone of the Askrigg Block. However, this is only in the form of a fissure network, probably very well integrated, that represents the initial, or inception, stage of openings within the limestone, from which all the caves subsequently developed (Lowe and Waters, 2013). Increasing recognition of the role of rising hypogene water (as opposed to descending rainwater) in the early stages of cave development has reinforced the concept of a Trans-Craven network. But this consists only of micro-fissures, and is not a cave system, where a cave is defined as an opening of human size. Hypogene waters have been responsible for development of the spectacular maze caves in the northern Pennines (Harrison, 2016). Though more of these systems are now being found, they are all confined to the relatively thin and effectively isolated Yoredale limestones, and there is no indication that fissure networks have been enlarged into extensive cave systems within the Great Scar Limestone. To make the concept meaningful, a Trans-Craven Cave System, with passages of humanly passable dimensions, would have to be one that consists of streamways that are the classic Dales caves linking sinks to resurgences, along with abandoned galleries that they intersect.

Ideas of a huge integrated cave system, with explorable passages extending across, or beneath, the Yorkshire Dales really started when Dave Brook (one half of the Leeds-based Brook Brothers) wrote about the possibilities of a Three Counties Cave System (Brook, 1968). This was partly inspired by their successful linking of a number of caves into the West Kingsdale Cave System, though an even more extensive integration of caves had already taken place farther west, in and around Ease Gill. Dave Brook's exposition on the potential links beneath Leck Fell and Ireby Fell made a Three Counties Cave System appear quite conceivable, but it took until 2011 for his concept to become reality, when a high-level connection was finally engineered between Notts Pot and Lost John's Cave (Allen, 2012).

Extending Three Counties into Trans-Craven was the obvious next step in speculation and concept. This did involve far more unknown and hypothetical links when it was proposed by a second Dave Brook (who is a member of the Bradford Pothole Club), and his cave system reaching between Barbondale and Littondale was rather a bold concept, laced with abundant wishful thinking (Brook, 1971). However, caving techniques and our understanding of the Dales karst have moved on apace, and significant extensions of an integrated cave system eastwards from Kingsdale do now seem plausible, though they become progressively more tenuous in the limestone east of Pen-y-ghent.

***Figure 1**: Part of Easter Grotto, one of the finer passages in the Ease Gill part of the known Three Counties Cave System.*

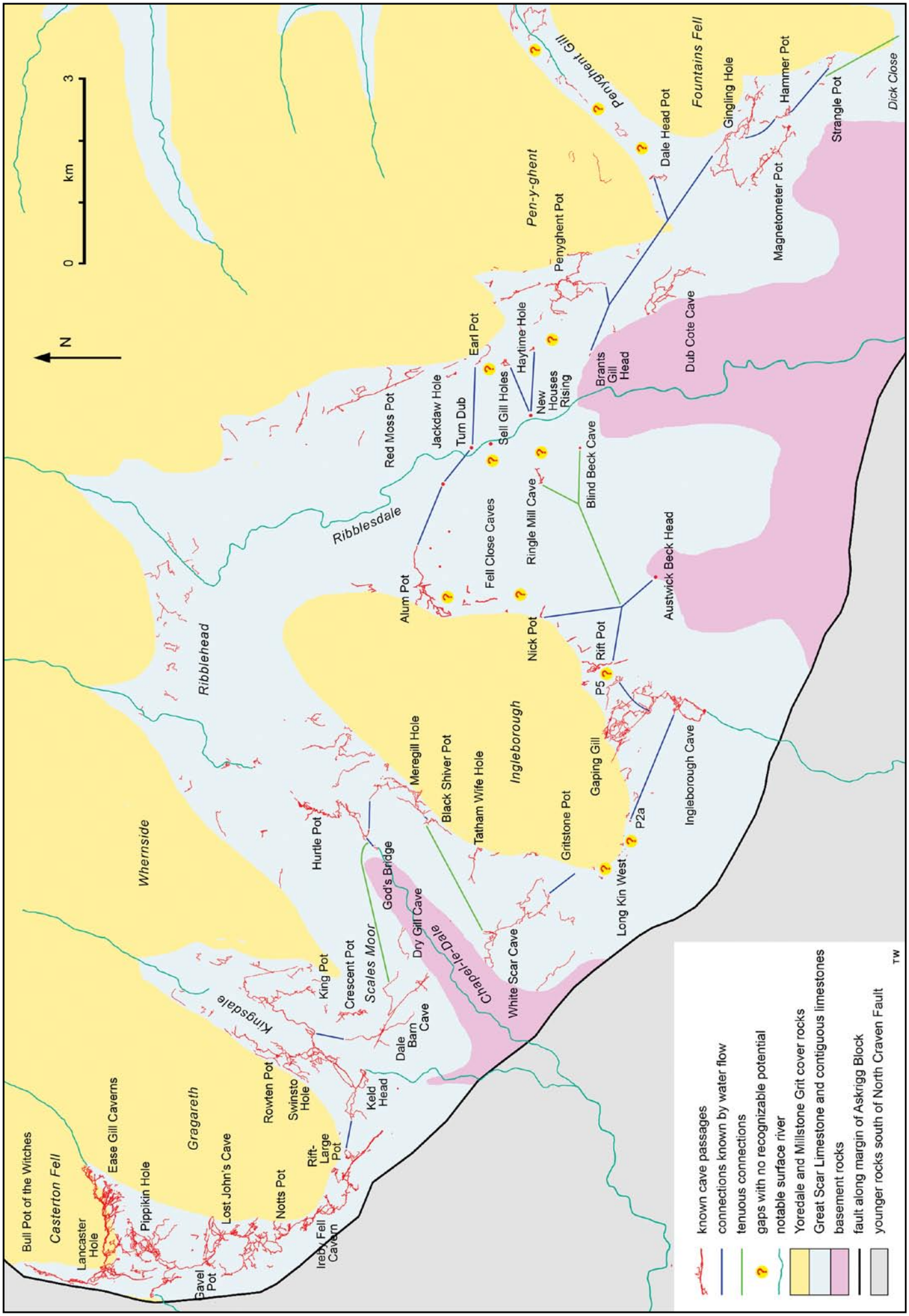

***Figure 2**: Known cave passages and potential links within the western, and slightly more realistic, half of a Trans-Craven Cave System.*

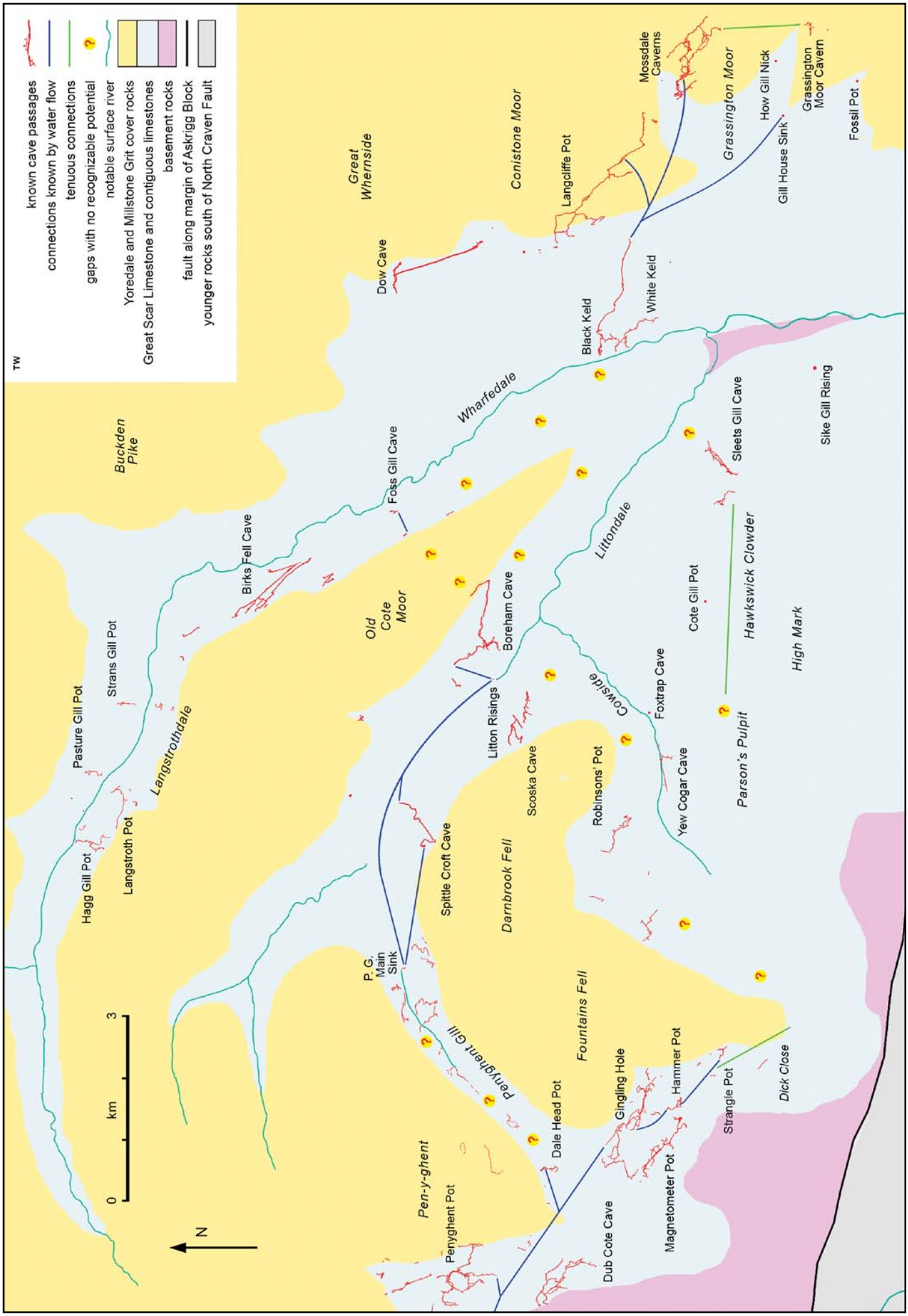

***Figure 3**: Known cave passages and potential links within the eastern, and rather more speculative, half of a Trans-Craven Cave System.*

Figure 4*: View from the southern slope of Gragareth, and almost above Eastern Front in Large Pot, within the Three Counties Cave System, towards Ingleborough, which could be reached by a Trans-Craven Cave System.*

Consequently the ideas of Brook and Brook were recently resuscitated and up-dated, and also extended across Wharfedale to Grassington Moor, by Dave Haigh and John Cordingley (2017). Compilation of the area maps for the chapters in Volume Two of the BCRA's *Caves and Karst of the Yorkshire Dales* (Waltham and Lowe, 2017) then provided some impetus for the present authors to re-examine the potential connections and likely gaps in any grand integrated cave system. Further details on the caves that are known, and sources of further information, can be found in the systematic chapters of the BCRA book; references to some of the Trans-Craven missing links are cited in this text as page numbers alone, in the style of [p356]. Some more speculative parts of the story are included here, but speculation can always go further, and this is to the good if it promotes caving that leads to great new discoveries.

The sequence discussed below is from west to east, so starting with the known and becoming steadily more conceptual. It should be noted that the term *dry cave* is used in these pages to describe one that is accessible by conventional cavers, and may well contain substantial streams and lakes; this is as opposed to *underwater caves* that are accessible only by cave divers.

Three Counties Cave System

The western sector of the Trans-Craven Cave System is already a reality with the great integrated cave system, consisting of nearly 90km of passage, beneath the flanks of Gragareth (Fig.2). The northern part of the currently known network is the system linking Lancaster Hole to Ease Gill Caverns, first explored in 1950. Its northernmost part is Bull Pot of the Witches, connected in 1966 to Lancaster Hole through a sump 120m long. The upstream sump at the northern end of Bull Pot has been followed to a point only a few metres from the exploration limit in the downstream sump of Aygill Caverns [p294], and the link should be possible with further perseverance and some good luck. At the northern end of Aygill Caverns, New Year Passage is an abandoned high-level that appears to have carried drainage from Barbondale in the distant past. There is, however, a gap of some 1500m to the known comparable passage in the Crystal–Bucket Cave System [p278], and extension of the Trans-Craven Cave System into Barbondale will probably require finding a convoluted route through broken ground within the Dent Fault Zone.

The known cave system continues southwards from Casterton Fell since the passages in Link Pot were explored beneath the Ease Gill valley in 1978. These connect to Pippikin Pot with its extensive passages found in 1970 beneath the northern slopes of Leck Fell. The streamway in Pippikin Pot has been connected to that in Lost John's Cave, as they converge underwater; the link was first dived in 1989 via almost exactly 1000m of water-filled passage with a single break through the dry gallery of Pooh's Revenge. A dry, high-level gallery between Pippikin Pot and Gavel Pot almost certainly does exist, perhaps via a southerly extension of the old trunk passage in Witches Cave Two [p322], but there is a gap of more than 400m between the passages currently known. There is then no dry connection between Gavel Pot and Lost John's Cave, though one is highly likely to exist via the high-level gallery in Big Meanie and Death's Head Hole. It is also possible that an alternative route lies farther to the west as a link between the abandoned trunk conduits through Gour Hall (in Pippikin Pot) and along Duke Street Two (in Ireby Fell Cavern), which are both far larger than the old phreatic passages in Gavel Pot [p320]. The layout of the known caves appears to suggest that there is a great deal of very old passage yet to be found in this western corner of Gragareth's limestone, though as yet the paleo-drainage is not fully understood [p325].

Since 2011, Lost John's Cave has had a dry link to Notts Pot Two via the Lyle Cavern High Levels, with a hugely engineered route through chokes in faulted ground into Sir Digby Spode's Inlet, a tributary to the Notts streamway. Upstream in Notts Pot Two, a sump of 210m currently provides the only link to Notts Pot, though high-level passages on both sides have been explored to within 30m of each other [p315]. The sump was first passed in 1985, and was the exploration route into Notts Two. Upstream from the lower reaches of Notts Pot, a sump 170m long was first passed in 1976 to provide the link into Ireby Fell Cavern. From there, dry passages can be followed to the southern end of Eastern Front buried in the flank of Kingsdale. The convoluted route through the lower reaches of Ireby Fell Cavern, Rift Pot and Large Pot was first passed in 2010 after extensive excavation of sediment and debris, and the final extension into Eastern Front was found as recently as 2014.

At present there is no explored link between the cave systems of the Three Counties and Kingsdale, so this is the first break in the putative Trans-Craven Cave System. However, Eastern Front and the upstream exploration limit in Keld Head are little more than 300m apart, albeit with the former about 50m above the underwater conduit. There is a proven flow route from Marble Steps to the eponymous inlet in Keld Head, but diving

this would not link to the Three Counties Caves. A link could be dived from Keld Head up an as-yet-unidentified tributary that carries the stream from the Red Herring Series in Large Pot. Perhaps just as feasible is finding some way down through the sediment fill in the Eastern Front [p307] and into a drain through to the Keld Head conduits, though such a route may be immature and unpleasantly constricted. Ashton Shaft, near the current limit of exploration in Keld Head, could be a part of a link between the two levels [p343]. As indicated by flowstone as much as 9m below water level in Keld Head, there must be low-level outlets, probably now choked, at sites as yet unknown, suggesting that there is more passage to be found, perhaps farther down-valley, beneath the western flank of Kingsdale. Any of these, or some other route through unknown high-levels, is likely to be explored within the foreseeable future.

Kingsdale is already crossed by the East Kingsdale Branch of the Keld Head cave system that passes beneath the dale floor with an unbroken underwater traverse of 3050m, first explored in 1991. However, this leads only to the inlet systems of King Pot and Brown Hills Pot, with little prospect of Trans-Craven continuation eastwards. The likely site for progress could be a flood overflow from the East Kingsdale Branch to the Boottrapper Sump in Dale Barn Cave [p345]. This hydrological link is not yet proven, and any outlet from the East Kingsdale Passage has not yet been seen by passing divers. But flow patterns suggest its existence, and exploration in the water-filled Boottrapper Passage is already past the halfway mark.

Once into Dale Barn Cave, there is dry passage through to Chapel-le-Dale, and also an active stream route that is largely, but not fully, explored to Dry Gill Cave in the same dale. However, both these passages are truncated above the outcrop of basement rocks in the side of Chapel-le-Dale. The lack of any obvious way on is the first really serious break in the Trans-Craven concept. The best prospect for a link is a flood-route from Dry Gill Cave to God's Bridge. The Dry Gill resurgence appears to reach a maximum flow that is far less than could be expected from its large catchment on and beyond Scales Moor, suggesting the existence of another outlet that takes off the flood peaks [p344]. This could be out through Ullet Gill Cave, which produces large flood flows, or it could extend farther to the north and down the dip to God's Bridge, where any pulse of floodwater could easily be hidden within the massive flood flow from this resurgence. The complete lack of any resurgent streams between Dry Gill and God's Bridge during normal weather also suggests the presence of a passage parallel to the dale that collects local drainage from a large part of Scales Moor. In flood conditions this is then utilised progressively, and its overflows to dale-side outlets are each located in the faults and shallow synclines that are features within this limestone block. It is also possible that an up-dip phreatic passage was developed by water flowing down Chapel-le-Dale, and this could provide a link between God's Bridge and Ullet Gill, which is still utilised as a flood overflow; immediately behind God's Bridge the outflow is through immature bedding-plane caves, and this could be a further indication that older, parallel passages could well exist under the dale's Whernside flank. Abandoned high-level galleries could also exist beneath Scales Moor, parallel to and farther north than those in Dale Barn Cave, but no sign of such has been recognised to date.

Ingleborough and Pen-y-ghent

God's Bridge Risings carry drainage from all of upper Chapel-le-Dale together with that from a large sector of Ingleborough. Proven flow-lines and potential dive sites could yield the required Trans-Craven links. From the main God's Bridge resurgence, any upstream route (possibly passing an inlet from Scales Moor or Dry Gill Cave) is unexplored for 200m upstream into known passage below Meregill Skit, and both ends are very low, underwater, bedding-plane caves [p381]. The water-filled passage upstream from Meregill Skit also becomes an intimidatingly low bedding-plane passage little more than 100m in. There, it is still 300m short of the current limit of exploration, in somewhat larger passage, nearly 700m into the downstream sump in Roaring Hole [p377]. The 200m of static sumps (active in flood) between the lower reaches of Roaring Hole and the downstream end of Meregill Hole were first passed in 1991. From Meregill Hole, the 80m of underwater passage through to Black Shiver Pot has not yet been traversed and may require some clearance of cobble banks to become passable.

Figure 5*: The expanse of limestone pavement on Scales Moor, which could drain into a cave linking Dry Gill to God's Bridge.*

Onwards from Black Shiver Pot, there is as yet little evidence for reachable and traversable cave passage. It is reasonable to consider that an old, abandoned, high-level trunk passage underlay an ancestral Chapel-le-Dale and once carried drainage out towards the Craven Lowlands. The large, high-levels through the Battlefield chamber in White Scar Cave would seem to be a fragment of such a trunk route, though now heavily choked with clastic sediment at both ends [p351]. There are further fragments of old passage in the lower reaches of Black Shiver Pot and in the F.D.S. Series of Tatham Wife Hole [p354], but none is on the scale of a Chapel-le-Dale trunk drain. When the ancestral Chapel-le-Dale had a wide outcrop of limestone between Ingleborough and Whernside, and there was no exposure of basement rocks behind

Figure 6*: Part of the Western Front, in White Scar Cave, a fragment of an old trunk passage down Chapel-le-Dale now heavily choked with breakdown and clastic sediment.*

***Figure 7**: Old phreatic tunnel in the far reaches of the Sleepwalker Series in White Scar Cave, which could extend into a link across to the caves of Newby Moss.*

any high-level outlet across the Craven Fault, a deep, phreatic, cave drain almost certainly developed beneath the dale floor. It appears that a southerly meander of this survives in the White Scar Cave Battlefield. Whether the rest was entirely removed by glacial deepening, or whether parts remain hidden within either flank of the dale, remains open to speculation; any discovery may well depend on exploring a younger stream passage that happens to intersect a part of the old trunk route.

Concepts of a Trans-Craven route via White Scar Cave and Newby Moss meet many problems, but alternative routes past Ingleborough have even less potential. It is possible for long cave passages to develop beneath the cover of shale and grit that now forms the summit mass of Ingleborough; analogies can be drawn with caves in Nidderdale, in South Wales and beneath a pre-Anglian Ireby Fell. Within the Gaping Gill Cave System, North West Extension is known to reach far beyond the overlying shale margin [p400], and North Passage, Centenary Way and other elements around Main Chamber could be viewed as too large to originate solely within the confines of Fell Beck [p391]. Fault-guided passages through from the areas around Meregill or White Scar cannot be dismissed as impossible, though they are firmly in the realm of optimistic speculation. In contrast, there is a great deal of known cave passage within a grand loop round the northern side of Ingleborough; Hurtle Pot and its neighbours, the many stream caves at Ribblehead, and the passages of Red Moss Pot through to Birkwith Cave are all conspicuous. But none offers serious value in a search for a Trans-Craven Cave System. All the modern drainage is broken into isolated small catchments each to its own resurgence, and no significant lengths of old trunk passage have yet been found within an area of limestone that has probably not long been exposed to cave development.

Even if White Scar Cave can be reached underground from upper Chapel-le-Dale, there are considerable difficulties in recognising any way forward. Drainage to White Scar Cave includes that dye-traced from Gritstone Pot, so cave passage does extend that far and probably to some other sinks high on Dowlass Moss. From Gritstone Pot, it is about 1200m to the P2a sink, which is known to drain to Ingleborough Cave. Along the intervening limestone bench, the stream that flows through Boggarts Roaring Holes escapes sideways to Skirwith Cave, and water sinking into Long Kin West escapes sideways to Moses Well. It is impossible to know how extensive are any lengths of abandoned rift passage that should exist within the heavily faulted limestone of Newby Moss, and where any of them might cross the underground drainage divides [p358]. Similarly, it is difficult to predict in which direction such ancient rift passages drained, and where might lie any low-level, bedding-guided collectors to provide the missing links. There is minimal horizontal development in the caves known to date, and this sector of Ingleborough could present another major gap within any Trans-Craven cave.

Eastwards from the P2a sink, cave passage is known to exist even though little has been explored, as its water has been traced to the inlet sumps in Ingleborough Cave. Another dye-traced flow-line links Ingleborough Cave with P5, though the sump in P5 is impassably small [p365] and the inlet passage where the water joins the underwater conduit from Main Chamber has not yet been reached. High-level passages already explored provide the link that would make Gaping Gill part of any Trans-Craven Cave System.

Beyond P5, and towards the north, there is another problem area for a Trans-Craven Cave System. Fragments of old high-level passage are known in P5, Marble Pot and Rift Pot, but so much of the cave development in this area is guided by faults lying across any connecting route that it is difficult to identify potential sites to search for connecting passages. Once through to Rift Pot, or perhaps to the unexplored conduit from Marble Pot, the Allotment potholes all drain to Austwick Beck Head (Long Kin East Cave into Rift Pot and the P14 sink into Nick Pot were dye-traced in the early 1900s), so Trans-Craven connections are possible, even if they are largely underwater.

The situation is more problematical again beyond Nick Pot. Youthful high-level caves are unlikely to provide links through to the Alum Pot caves, because the modern streams through the Fell Close and Gillgarth caves return to daylight and have largely surface courses down to the Ribble [p373]. There is as yet zero evidence of any old, mid-level, abandoned conduits in this area, though there is enough limestone to yield new discoveries. The greater potential has to be at low-level, out towards the River Ribble. There is every likelihood that a system of bedding-guided cave drains has at some time, or times, in the past carried water from The Allotment and Moughton down-dip to resurgences in Ribblesdale north of Horton [p369]. Austwick Beck Head appears to be a relatively youthful capture of that drainage, which only developed after late-stage glacial deepening of Crummack Dale. Floodwater still takes a northern route, as Austwick Beck Head appears to reach a maximum flow when large flows of turbid water pour from Blind Beck Cave. Only a short passage has been explored at the latter site, though the underwater passage lies open beyond its furthest point reached. The nearby Ringle Mill Cave might be another distributary, though swallet flood waters do not now reach it; its flow is always clear percolation water. Passages east of Ringle Mill Cave are totally unknown. There could be another distributary from Alum Pot to an un-named flood rising just south of Turn Dub,

***Figure 8**: Looking eastwards across upper Ribblesdale, where any Trans-Craven link might have to be through the underwater passages of Turn Dub, close to the tarn just visible in the valley floor right of centre. See also Figure 2.*

which maintains a small output when Turn Dub ceases to flow. The source of its water is unknown, and it could well have linking passages both to Turn Dub (probably underwater) and to the conceivable Allotment flood outlets.

Turn Dub is the key to the potential cave system crossing Ribblesdale, though only for cave divers, and only after clearing clastic sediment from some of the water-filled passages. This rising carries water from Alum Pot and also from Penyghent Long Churn, Earl Pot and other adjacent sinks east of the Ribble [p431]. However, its catchment is separate from that of New Houses Rising, and again from that of Brants Gill Head; so active streamways cannot provide the onward connections for the Trans-Craven Cave System. Cave passages could carry flood overflows across normal catchment divides, but a comprehensive programme of dye-tracing would be needed to confirm their presence. Prospects for links through abandoned high-levels are also poor. Jackdaw Hole contains the only segment of old trunk passage yet known, though there are smaller fragments of equally old, largely choked, high-level cave in Earl Pot, Sell Gill Holes and Haytime Hole [p430]. With an even greater gap to known old passages in Penyghent Pot, there is no immediate prospect for linking the caves, though nothing can be ruled out, including a possibility of old passages along the Hull Pot Fault.

Once into any of the caves within the Brants Gill Head catchment, concepts of a Trans-Craven Cave System can take a giant step forward. Dye-tracing has proved flows from numerous sinks and caves along the Ribblesdale flanks of Pen-y-ghent and Fountains Fell, the farthest south being Rough Close Sink, just to the south of Strangle Pot. It is almost certain that sinks on Dick Close, at the extreme southern end of Fountains Fell, also drain to Brants Gill. Most of the known potholes reach down to sumps, and considerable lengths of the known passages are accessible only to divers. However, the steady, northerly dip of the limestone suggests that freely draining streamways guided by the bedding planes are likely to fill some or many of the gaps between the cave passages already explored. Long underwater passages are probably dominant in the downstream, northern part of the catchment, behind Brants Gill Head and within its flood overflow to Douk Gill Cave. But the long cave passages already known above water level in Dub Cote Cave, Magnetometer Pot and the Fountains Fell Master Cave are probably replicated through much of the catchment that lies farther south, farther upstream and farther up-dip. Furthermore, the large size of some of these old phreatic tunnels implies that they were fed by large catchments that may once have extended farther south or east, raising the prospect of finding more abandoned passage that could constitute Trans-Craven links beyond Fountains Fell [p421]. The potential for major discoveries is probably greater here than in most other parts of the Dales karst, though there is a serious shortage of obvious ways from the surface down into this cave network.

Littondale and Wharfedale

Beyond Fountains Fell and into the large catchment of the River Wharfe (Fig.3), extensions of any Trans-Craven Cave System become increasingly speculative. North of Fountains Fell, there is little prospect of finding connected cave passages along the length of Penyghent Gill. Dale Head Pot could be reachable as it drains to Brants Gill Head, but the rest of the Gill is distinguished by caves that are relatively youthful within an equally youthful valley [p468]. The known caves are all short streamways to their own nearby resurgences, with no extensive dendritic system of cave drains, and there is minimal indication of abandoned high-level passages that could provide an underground route down the Gill.

***Figure 9**: The exit from Giant's Grave Caves, where the stream returns to daylight instead of following an underground course down the length of Penyghent Gill.*

***Figure 10**: Upper Littondale, where the presence of an unknown cave under the valley floor is indicated by a river-bed that is dry except in times of flood.*

Only downstream of Penyghent Gill Main Sink is any long cave system known to exist, as its water resurges five kilometres away at the Litton Risings. However, the sinking stream has been followed underground for less than 100m, and no enterable cave has yet been found at the resurgence. It is reasonable to expect that the underground flow takes a long loop to the north, where it would be joined by flow from the main sinks in the upper part of Littondale, before continuing as a main drain beneath or beside the dale floor [p461]. With about 70m to descend along this course, significant lengths of open streamway probably await discovery, besides long sections of bedding-guided underwater passage. There is also potential for a route via the known passages in Spittle Croft Cave, but the hydrology of this cave is not yet fully understood [p463].

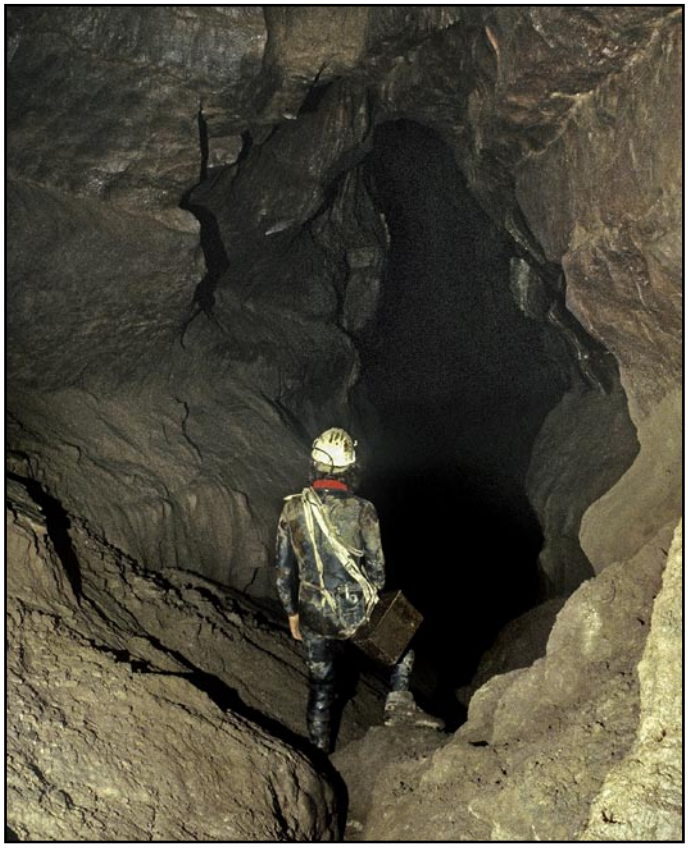

***Figure 11**: One of the large abandoned tunnels in Robinsons' Pot that hint at more extensive old passages lying beneath Darnbrook Fell.*

Round the southern side of Fountains Fell, the prospects for integrated Trans-Craven cave passages are also meagre. It is quite possible that sinks along the shale margin northeast of Dick Close drain beneath the shale cap with down-dip flow into the Brants Gill catchment, though none such has yet been traced. Farther east, Cherry Tree Hole and Robinsons' Pot each have their own catchments to separate risings along Cowside Beck [p471]. Other than some sections of ancient, high-level passage known in Robinsons' Pot, little old cave development has yet been found in the area, and there is no indication of extensive passages that could constitute Trans-Craven links. There is an even more conspicuous lack of known cave under the limestone bench round towards Scoska Cave and Bown Scar Cave [p463]. Historic Way, in Scoska Cave, is a large and very old, abandoned passage that could continue round the fell or beneath the Yoredale cover to originate in the area of Robinsons' Pot and the Darnbrook Cockpits. The Scoska Cave water does not reach Litton Risings with opportunity for continuation farther east. However, the lack of risings downstream of Yew Cogar suggests that modern cave drainage of the limestone north of downstream Cowside might well drain to Litton as a potential low-level Trans-Craven element.

***Figure 12**: The abandoned phreatic tunnel in Sleets Gill Cave once drained extensive caves beneath Hawkswick Clowder and Parson's Pulpit.*

***Figure 13**: Flood flows from Sleets Gill Cave give some indication of the extent of caves beneath the plateau southwest of Littondale.*

Perhaps one of the greatest unknowns in the Dales' karst is the extent of caves beneath the wide, streamless, limestone upland of Parson's Pulpit, High Mark and Hawkswick Clowder. There are large abandoned phreatic tunnels in Sleets Gill Cave and the nearby Dowkabottom Cave, along with fragments of large passage underwater in Foxtrap Cave, in Cote Gill Pot, and forming the southbound Parishioners' Way in Yew Cogar Cave; these are the sparse remnants known to date of significant development in the distant past. In addition, the substantial stream that emerges from Sike Gill Rising and the huge flood flows that can pour from Sleets Gill Cave both indicate the presence of mature stream caves through the area. Streamways in Yew Cogar Cave drain from both sides of Cowside Beck and could perhaps provide a westward link in a Trans-Craven system [p472]. Eastward continuations are less likely, as all known or conceivable passages are truncated in the side of the glaciated dale. Furthermore, a Kingsdale-type cave beneath the floor of Wharfedale is almost certainly precluded by the base of the limestone being breached by the glaciated valley; though no outcrop of the underlying rock is recorded, the presence of basement cobbles within the dale-floor sediments suggests that the limestone is absent beneath some parts of the alluvium (the basement outcrop marked on Figure 3 is conjectural). There is almost certainly a great length of cave passages awaiting discovery beneath this block of limestone, but the chances of those ever being part of a Trans-Craven Cave System appear to be almost nil.

***Figure 15**: Dowkabottom Cave, a fragment of very old passage that would not be known if it had not been breached by surface lowering across Hawkswick Clowder.*

Litton Risings yields underground flows from both sides of Littondale, namely from Penyghent Gill Main Sinks and from Boreham Cave [p461]. There are two adjacent resurgences, and dye-tracing to date has shown only that each is fed by its own separate source, from underwater cave passages that are possibly developed along two separate bedding planes. However, it is more than likely that connections do exist between these two conduits, even if they are active only in flood, so the possibility remains that cave passages extend beneath Littondale to provide a Trans-Craven link.

Boreham Cave has extensive high-level passages that remain unexplored beyond the major boulder chokes reached to date [p464]. Any continuations towards Wharfedale are completely unknown, but the situation bears analogy to Dale Barn Cave with its abandoned and active passages passing beneath Scales Moor. There is almost certainly more cave passage to be found within the limestone beneath Old Cote Moor, but surface stream catchments are very small and many of the caves may be similarly constrained in size.

***Figure 14**: The limestone plateau between Hawkswick Clowder and Littondale that is underlain by the ancient cave passages in Sleets Gill and Dowkabottom caves.*

Crossing Wharfedale appears to be an even greater barrier within any Trans-Craven cave concept. Ideas of an integrated cave system extending up the western side of the dale, crossing within the deeper limestone beneath Langstrothdale and returning back down the eastern side, can gain no support from any of the presently available evidence. The known stream caves are all short [p455], as are the few dye-traced links almost straight down the fell between shale-margin sinks and dale-floor resurgences; there are no large risings yielding water from multiple sinks. Neither is there indication of abandoned high-level passages aligned along the dale, and any sub-floor trunk routes that might have existed along the ancestral valley appear to have been removed by subsequent glacial deepening.

The best prospect for linking caves across Wharfedale could be at Black Keld. A complex of passages behind this powerful rising could include a hidden inlet, not yet found by divers, carrying water from one or more sinks round the southern end of Old Cote Moor. However, this remains for now as speculation, and there is no obvious candidate for a dye injection that could prove the existence of a cave link beneath Wharfedale with a trace to Black Keld.

If Black Keld could be part of a Trans-Craven Cave System, the connections and extensions to the long cave systems of Langcliffe Pot and Mossdale Caverns are both already proven but as yet unexplored [p480]. All the streams in both influent caves can only be followed as far as constrictions that are currently regarded as impassable; at the latter site, these are still perched in the Middle Limestone upstream of unseen routes down through impermeable beds into the underlying Great Scar Limestone. And although open passage continues underwater at the current limit of exploration in Black Keld, just reaching that point requires a major feat of cave diving.

In about 1830 deep mine workings south of Mossdale intersected Grassington Moor Cavern. Miners recorded little more than a pair of walking-size passages, but it was a similar situation in Hudgill Burn Mine Caverns (in the northern Pennines) before cavers gained access and explored 13km of passages in the form of a giant maze [p548]. The miners' entrance on Grassington Moor was the Old Turf Pits shaft, which has collapsed, so prospects for further exploration are remote [p485]. However, it is possible that a maze of cave passages extends through the Middle Limestone and could connect, after much clearance of clastic sediment, with the High Level Mud Caverns in Mossdale, which lie at a lower stratigraphical level in the same limestone bed. Mossdale's main high-level passage trends towards the miners' caves, but is currently known only as far as an intractable choke. Almost midway between the two sites, miners dumped waste into a large rift cavern breached by workings in How Gill Mine. Though highly speculative, such a connection, could add the maze caves into the Trans-Craven System.

Any concepts of further extensions to the Trans-Craven Cave System south of Grassington Moor Cavern become extremely tenuous. Clearly there is abundant limestone along the outcrop, and beneath the grit cover, all reaching round to Greenhow Hill; and this limestone is cavernous. Some significantly long underground flow paths are known; a sink close to Fossil Pot has been traced to Brow Well, south of Grassington, whereas the nearby sink at Gill House has been traced to Black Keld. How Gill Nick swallows a large stream in flood, as do other sinks farther east; all this water probably now re-emerges through mine drains near Hebden, but there must be a natural cave passage draining from it, to either Black Keld or another Wharfedale rising [p479]. Extensive cave development is already known in Stump Cross, and other fragments of old cave passage are scattered through the area, but notions of an integrated cave system to and beyond Grassington cannot be justified.

Recognising that the future will continue to bring ever-greater achievements in Dales caving, the concept of a single, huge, Trans-Craven Cave System extending from Aygill to Fountains Fell does withstand critical appraisal. It can well be justified as a target and incentive for cave explorers. Maybe taking many decades or generations to bring to fruition, it should not be dismissed as fantasy. However, further extensions into Barbondale, Littondale and Wharfedale become progressively more tenuous; for now at least, these should perhaps remain as interesting hypotheses. But all is not lost; great lengths of cave passages clearly await discovery all across the Yorkshire Dales karst, even though they might not contribute to a single, integrated cave system.

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Figure 16*: Mossdale Scar and the largest sink into a major cave system that is still only partly explored, but could, just possibly, though far into the future, become the eastern end of a Trans-Craven Cave System.*