Cave and Karst Science Explained

Charlie Self explains issues 36(1) and 36(2) of our national cave science journal.

In issue 36(1), there are three papers. At first glance, all three are 'hardcore' science, with little to interest the recreational caver other than the description of karst areas in other countries. But perhaps there is a readership for these abstracts after all. It occurs to me that hydrologists may not always bother to read papers on speleobiology and vice versa. So my contribution is this: I'll read the papers, so you don't have to!

Periodic Breakthrough Curve of Tracer Dye in the Gelodareh Spring, Zagros, Iran

Haji Karimi and Javad Ashjari

This paper concerns the hydrology of a spring near the site of a dam currently under construction in western Iran. The right abutment of the dam is being built on thinly bedded limestone that potentially contains karst caves.

An example of a mainly vadose passage in Jegerhullet, a combination cave. Photo: Trevor Faulkner.

Dye was pumped into a borehole near the dam site over a period of 24 days, and boreholes and springs downstream of the dam were monitored for the next three months. The dye appeared strongly at one borehole and at one of the springs, but the breakthrough curve of the spring (a plot of dye concentration against time) was unusual: it showed the dye arriving in a series of pulses. The authors conclude that near the dam site there is diffuse water flow into the limestone, but nearer the spring there is conduit flow through a cave with a siphon.

This is a well written and nicely presented paper, but I was left unsure just how seriously water might leak into the limestone once the dam is completed. Like many cavers, I have an interest in the pathways followed by underground water, but I would not call myself a hydrologist. For publication in a general cave science journal, I felt that the referees (or the editors) should have asked the authors to make their conclusion a bit clearer for non-specialist readers like myself.

Relationships Between Cave Dimensions and Local Catchment Areas in Central Scandinavia: Implications for Speleogenesis

Trevor Faulkner

Faulkner has been studying caves in the isolated marble outcrops of central Scandinavia since 1972 and has been to most of them. This large paper separates the more than 800 caves, virtually all of which he has visited, into three morphological types. Mostly vadose caves consist of a single active streamway, relict caves are phreatic remnants, combination caves have both relict and active passages.

So far, so good. To bring the paper down to a manageable size, the author has introduced an abbreviated terminology: e.g., XS/CA translates as "mean cave passage cross-sectional area divided by the cave's catchment area". There are many of these abbreviations, which make this a strenuous read! I was constantly referring back to the two tables of abbreviations.

This is an extremely complex study, with far too many parameters for a simple overview. However, the author demonstrates that only the mostly vadose caves are attuned to the present (Holocene) climate and topography. Relict caves are shown to have formed beneath ice-dammed lakes during the last retreat of the ice caps. The upper phreatic passages of combination caves also formed during this deglaciation period, while their vadose parts developed under present conditions.

These Scandinavian caves are generally short, shallow, simple, and geologically very young. To a cave exploration enthusiast, this would be a problem. To a cave scientist, this is an asset. Simple caves with many examples allow fundamental principles to be deduced; in more complex systems, basic patterns are masked by later processes. The merit of Trevor's research is that the marble karst of central Scandinavia may hold the key to our understanding of speleogenesis in all the glaciated caving regions of the world.

Glaciokarst of Western Orjen, Montenegro

Uros Stepisnik, Mateja Ferk, Blaz Kodelja, Goran Medenjak, Andrej Mihevc, Karel Natek and Manja Zebre

Orjen in the southern Dinaric mountains is a massif made almost entirely of limestone and dolomite. It also has the highest annual precipitation in Europe. The study area is a very fine glaciokarstic landscape, with the traces of four Pleistocene valley glaciers. The authors are able to show that the area had well-developed karst before glaciation began, contrary to previous opinion.

Extensive lateral-terminal moraines remain largely intact because most glacial meltwater drained vertically into the karst, as does the current rainwater drainage. All four valleys have outwash fans of material from sporadic floods, caused during glacial melting by the build-up of lakes behind the moraines. The lateral moraines are so well preserved on the Orjen massif that it was possible to use two separate methods to determine the equilibrium line altitude (where ice accumulation and ice ablation were equal) for the maximum extent of the former glaciers.

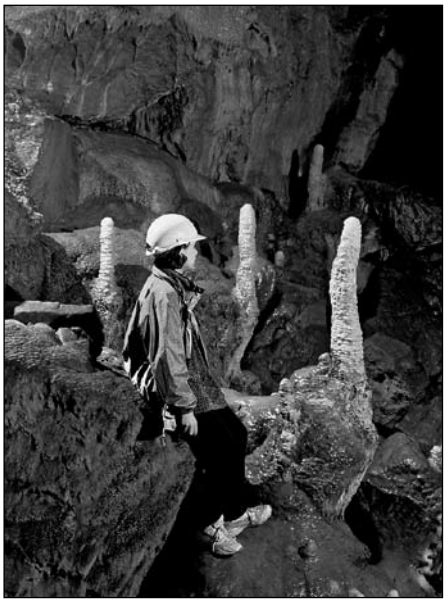
The paper is clearly presented, easy to read and has colour photographs which extend to the front and back covers of this issue of C&KS.

Issue 36(2) of Cave and Karst Science contains two main papers and four shorter reports. All are of general interest to the scientifically inclined British caver.

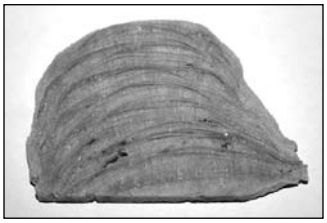
The Dripwaters and Speleothems of Poole's Cavern: A Review of Recent and Ongoing Research

Adam Hartland, Ian Fairchild, Jamie Lead, David Dominguez-Villar, Andy Baker, John Gunn, Mohammed Baalousha and Yon Ju-Nam

Have you ever wondered why stalactites grow so fast in old cellars and under railway bridges? They grow at about 100 times the rate of those in normal karst caves. The reason is because of a different growth mechanism: the calcium doesn't come from limestone but from "lime" (calcium oxide) that is one of the ingredi-



Poached Egg Chamber, Poole's Cavern, Buxton. Photo: Paul Deakin.



These photos show two examples of hyperalkaline calcite deposition. Left: A partially flooded tunnel in Buxton, Derbyshire that was abandoned in 1964. Photo: John Gunn. Above: Re-growth (approx. 4cm tall) of a poached-egg stalagmite in Poole's Cavern. The re-growth formed over the period 1997-2008 and was then sectioned and polished. Photo: A Hartland.

ents of cement. This combines directly with carbon dioxide from the air to form calcite.

This next paragraph has been written specifically for geeks and builders. Strictly speaking, the drip water is picking up 'slaked lime' (calcium hydroxide) which makes it quite strongly alkaline. This explains why a small cut on a finger stings so much if you are working with lime mortar.

So, what about Poole's Cavern? It is a normal karst cave in Derbyshire, with the remains of old lime kilns on the hillside above. The land is contaminated with patches of lime waste, which affects the groundwater entering the cave. Some of the drips in the cave are uncontaminated and produce normal stalactites and stalagmites. Others are hyperalkaline and produce the fast-growing stalagmites for which Poole's Cavern is famous. Many of these stalagmites are of the 'poached egg' type, with bright orange tips due to the inclusion of organic matter from the topsoil, carried in the drip water as colloidal-sized particles.

The importance of Poole's Cavern for cave scientists is that the topsoil and vegetation are essentially the same over this part of the hillside. This allows a direct comparison between normal and contaminated drips and also the calcite that is deposited from them. Organic matter colloids are more stable in strongly alkaline conditions and significant quantities are incorporated into the fast-growing stalagmites. This gives them their colour, fluorescence and their tendency to bind trace elements such as copper and nickel.

It is extraordinary and quite cheering that early 19th century industrial pollution has made the cave both more beautiful and scientifically more interesting. The research continues.

George Elliot Barton (1898–1978): Talented Explorer of Stump Cross Caverns — & Beyond — in the 1920s

Stephen Craven

George Barton was an Australian who served in the first world war, then took the opportunity to have a university education in England. In the early 1920s, he became interested in cave exploration and worked with some of the most famous names of that time in England, continental Europe and also in Brazil. A chamber bears his name in Stump Cross Caverns in Yorkshire. His caving career was spectacular but brief, and he left no personal record of his exploits.

Reflections on Fengcong & Fenglin

Mick Day and Wei Huang

Tony Waltham

In a recent issue of C&KS, Tony Waltham proposed that the Chinese terms fengcong and fenglin should replace 'cone karst' and 'tower karst' as descriptions of tropical karst terrains. I reviewed this paper in the first C&KS Explained and predicted that other karst scientists would adopt the new terminology, since these Chinese terms have genetic implications.

Day and Huang support Waltham's proposal but suggest that the 'cockpit karst' of countries like Jamaica is a closer equivalent to fengcong than 'cone karst'. The discussion then moves to the genetic relationship between fengcong and fenglin and other specialist areas of tropical karst geomorphology. Waltham's short report continues this discussion.

What is immediately apparent is that it is not the shape of the residual hills that matters, but the processes that are happening between them. This is why a new genetic terminology must necessarily supersede our old familiar English names. But there is a problem. Fengcong is actually pronounced 'fungtsung', so I will not be surprised when either the spelling or pronunciation of these terms is Anglicized.

Are All Caves Ecotones?

Max Moseley

This is the second main paper in this issue of C&KS, but what is an ecotone? The author is careful to make a very detailed explanation of this concept. Put simply, an ecotone is a transition zone between two adjacent ecological systems. Phrased another way, it is the narrow band of overlap between different environments and their communities of life. Ecotones are therefore rich in species diversity because they have characteristics derived from both sides, plus some species which have evolved to exploit the transition zone.

In this paper, Max suggests that caves are transition zones between the surface, on the one hand, and the host rock fissure system on the other. This means that the real subterranean community consists of the small creepy-crawlies (and similar sized water-living beasties) that live primarily in cracks in the bedrock, only occasionally and perhaps accidentally venturing into a cave.

This gives a profoundly different view of cave biology. We should no longer think of 'cave life', with each cave being seen as a separate isolated habitat. Instead we have 'life in caves', an ecotone between above-ground and true underground animal communities. Such a radical change of viewpoint could potentially resolve some of the outstanding questions on the ecology, evolution and conservation management of cave-associated faunas.

An Interim Report on Wigpool Cave: a Syncline-Guided, Palaeo Drainage Cave in the Forest of Dean Limestone Basin, UK

Chris Bowen

The Forest of Dean is geologically an enclosed basin containing Carboniferous limestone. An early phase of cave development (possibly during the Triassic period) formed extensive networks of interconnected caverns, rather than through drainage caves. These caverns eventually

George Elliot Barton (left) and others in Stump Cross Caverns, August 1922.

filled with clastic sediments (mud and sand) and high-grade iron ore derived from coal-bearing rocks in the centre of the basin. These are the Forest of Dean 'iron mines', which now are mostly empty after 2000 years of mining activity.

Exploration in the lowermost level of Wigpool Iron-ore Mine has led to the discovery of a rare example of a through drainage cave. Such caves were only able to form towards the close of the Triassic cave-forming period. Wigpool Cave has at least five levels, which are interconnected vertically, and an end-to-end length of about 225m (measured from the Grade 2 survey in the report). Unfortunately, the access route to the cave has remained flooded since 2005, hence the need to offer only an 'interim' report on this small but interesting cave. ■

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