Hungary's

Molnár János

Exploring Budapest's Underwater Caves

Text by Antti Apunen
Photos by Janne Suhonen

Molnár János

Molnár János flows into Lake Malom (above). The water pipe in the bottom of the lake feeds a spa across the street (right)

A rusty tram clatters past us. An uninterrupted line of cars slowly moves along Leó Frankel Street. Businessmen in dark suits hurry to their desks. Women in high heels walk carefully on the cobbled pavement. Between the houses, the ferries on the Danube can be seen, drifting past the Isle of Margaret that divides the town. We are in the middle of the Budapest morning rush hour. Our team attracts attention from passersby. We are carrying a van load of diving bottles and boxes through a narrow iron gate. The stone wall next to the cave is soon covered by diving equipment.

Molnár János is one of the most extraordinary natural cave systems in the world. It is something even most of the city's inhabitants do not know about. The cave stretches out below the metropolis, within the depths of an inactive volcano.

Budapest is known for its spas. Their water originates from the volcanic earth. One of the most well-known springs is Malom (mill) Lake. The name *lake* is a slightly grand definition for a pond that becomes eutrophic in the summer. After a few hundred metres, it flows to the Danube. The lake was already known during the Ancient Roman period—divers have found Roman constructions at the bottom of the pond.

The dry cave of Molnár János begins a few metres above the surface of Lake Malom. Divers enter the cave through a spring, the mouth of which is at a depth of four metres.

Doorway to the unknown

The earliest information about the caves is from 1858. János Molnár, a pharmacist, investigated the dry areas of the cave and analysed the

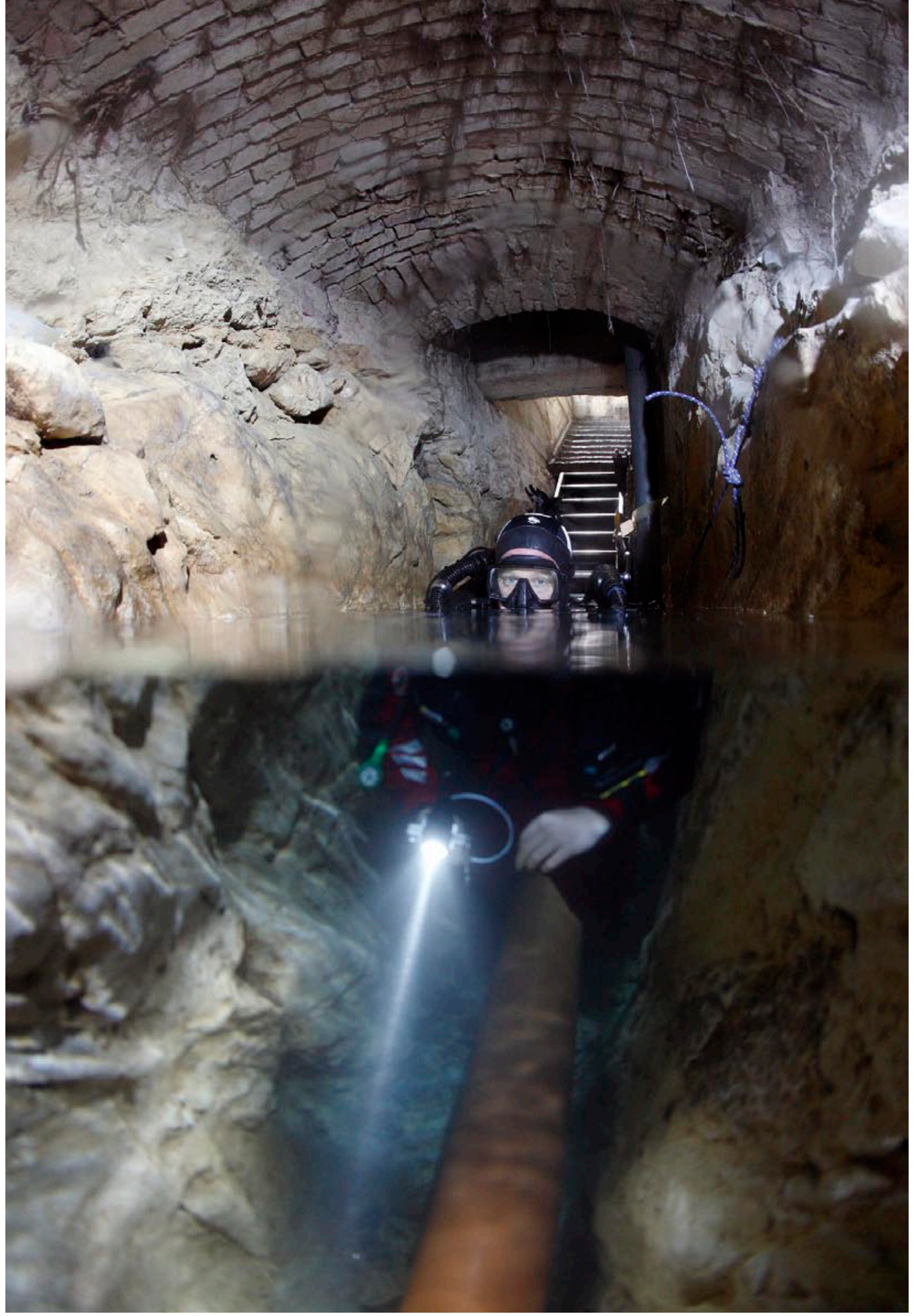
Lake Malom (above) overgrown with aquatic plants. PREVIOUS PAGE: Divers explore Molnár János under Budapest

A few steps down, underneath a hatch (above), waits the entrance to the cave (right)

water of the spring. He examined the healing effects of the water. The cave was first dived in the 1950s. The charting began in the early 1970s. For over 30 years, divers only dived in the old part of the cave, which has 480 metres of tunnels.

Zsolt Gyurka is a local diver who plays a central role in the recent history of Molnár János. Without his perseverance, the largest part of the cave might still not have been found. The old cave was the only known part of the caves until 2002.

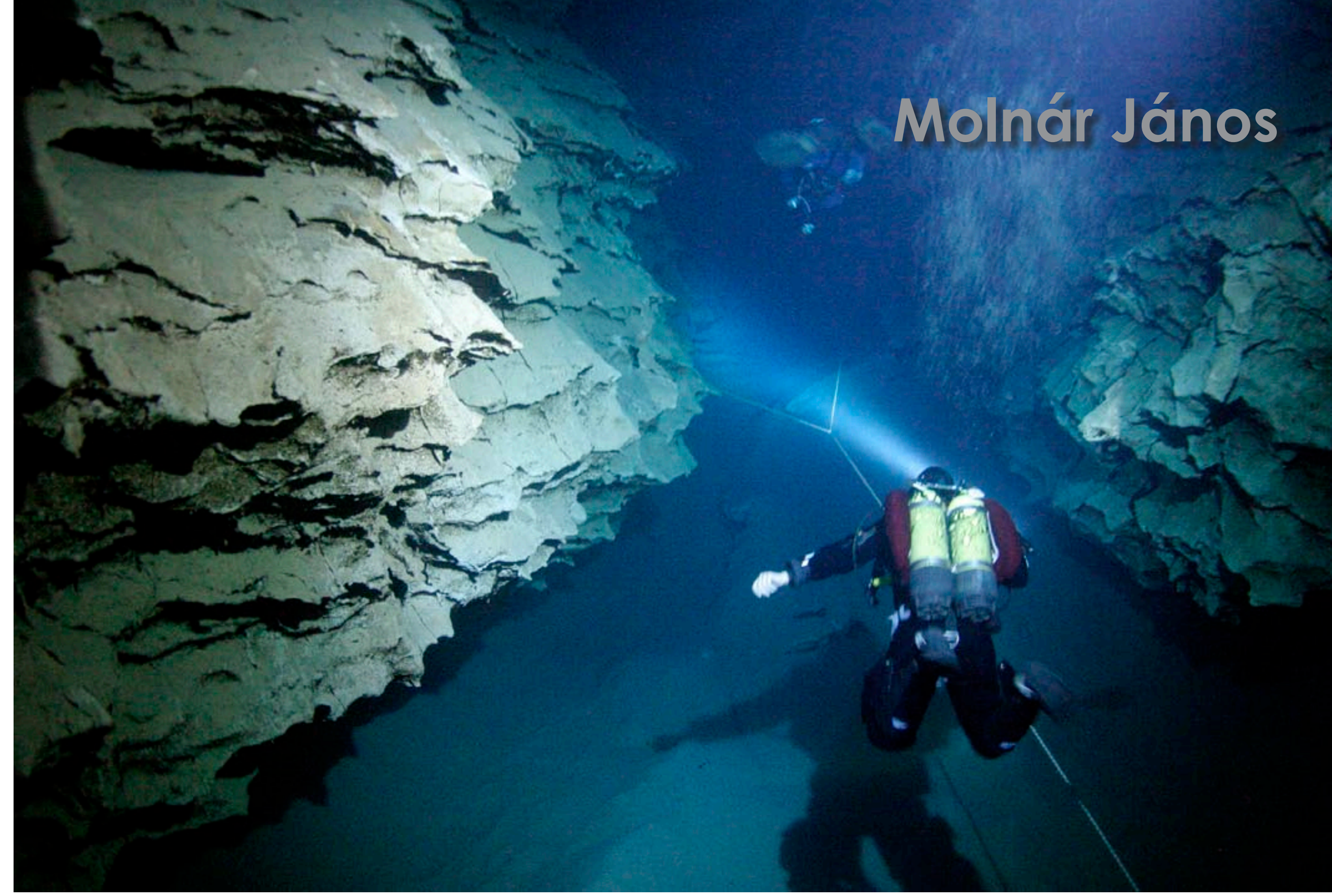
Like many other divers, Zsolt had been diving in the cave for years before he started to pay closer attention to one of the cave's walls. It was warmer than the others, almost hot in fact. There was something interesting behind the wall.

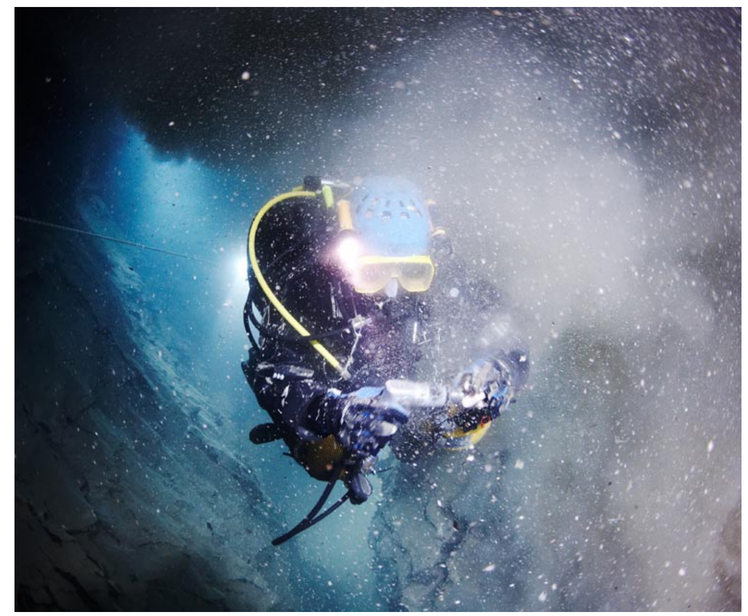


Zsolt began to carry a pneumatic drill with him. He managed to make a hole into the wall so that he could peek through it. There was crystal clear water behind the wall. And there seemed to be a lot of it.

A slow and nerve-racking charting began. Metre by metre Zsolt pulled the guiding line into the cave. He charted one tunnel after another, and today over five kilometres of the cave is known.

The delicate environment presents an even bigger challenge than the distances. Compared to typical limestone caves, it is really difficult and time consuming to attach the guiding lines in Molnár János. It is difficult to attach anything to rock walls that have been softened by acidic water. There are also no rocks in the cave around which lines can be tied. Drilling holes for the bolts destroys visibility in a moment.

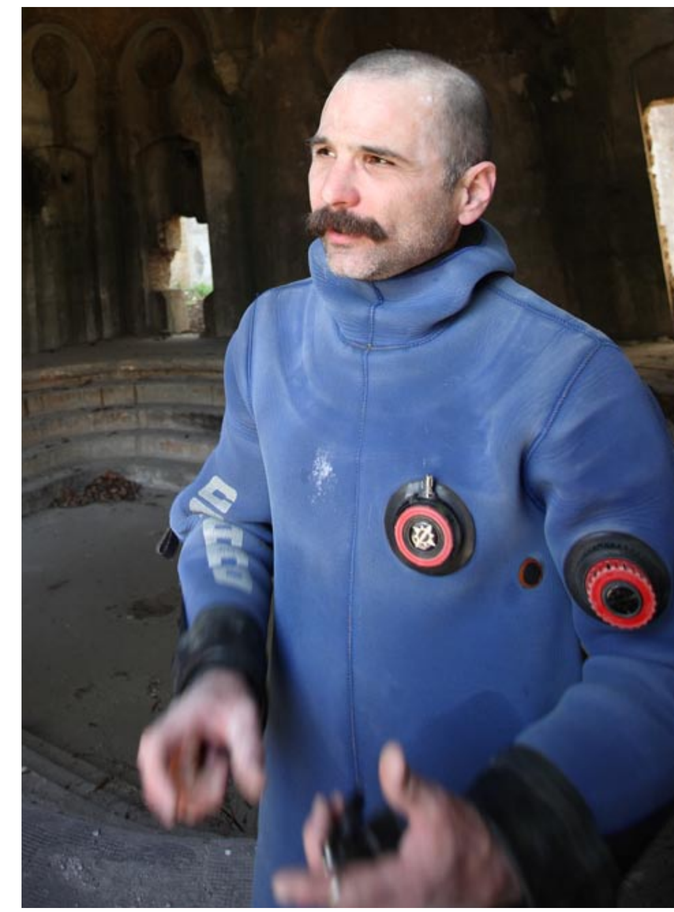




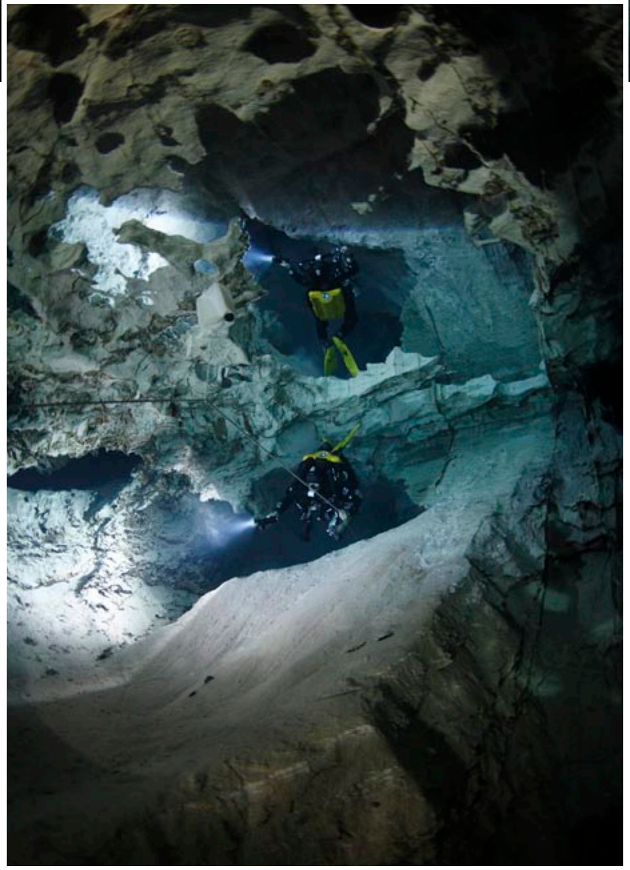
The cave

Today, over five kilometres of the caves have been explored. The biggest charted hall is over 80 metres long and 16-26 metres wide. In this hall alone, there is over 23,000 cubic metres of warm water. If an ordinary kitchen water tap was installed at the bottom, it would take four and a half years to empty it. There are hundreds of these halls in the caves.

Drilling in the surroundings of Molnár



Zsolt Gyurka discovered the entrance to the new part of the cave. He has laid kilometers of line into the cave (left); Divers follow the line into the chambers of Molnár János (top right)



Diver Harri Urho makes his way above the silty slopes (left); After a few days of open circuit diving, the visibility starts to slowly deteriorate (above)

János has revealed that there is a network of many caves crisscrossing between 150 and 250 metres deep underground. The tunnels of Molnár János continue towards the depths, but so far, divers have only reached the depth of 75 metres.

Molnár János would be even more extensive, had the moving earth not cut the tunnels off in many places. The caves almost certainly continue behind places where the fault lines have blocked the way, but they have no entrances.

There are several caves in the surroundings of Molnár János, but most of them are not suitable to dive in. They are either too hot or too confined.

Budapest's limestone earth developed during the warm and humid Eocene period approximately 30-50 million years ago. The first animals like present-day mammals also developed at the same time.

Hungary is bordered by the Carpathian Mountains in the east and the Alps in the north. The rising Alps lifted the Buda mountains with them. The ground plate of the Pannonian plain sank eastwards. The ground cracked along the collision line of the mountains and the plain. Ground displacements can also be seen in many places in Molnár János, where the cave ends, as if it had been cut with a knife.

Caves develop when the earth moves. Water finds its way through even the smallest cracks, and the flow shapes the soft limestone. Acid rain, changes in temperature and gas rising from deep in

Silt has been washed away along the first few hundred meters of passage

the soil speed up erosion.

Acid rain develops when carbon dioxide adheres to rain water. The result is weak carbonic acid, which absorbs into the soil and dissolves limestone. It is the same acid rain that forests, and especially marble and limestone constructions, suffer from.

Caves are like underground rivers that accumulate ground water. The water flows in them and rises to the surface through the same springs that offer a natural entrance for divers.

Unique traits

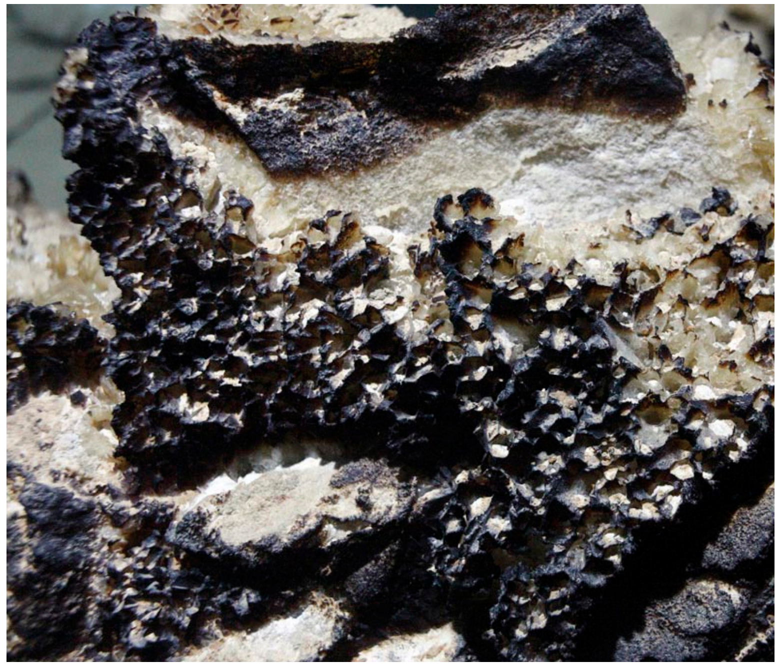
Molnár János differs from all other caves that we have seen. For example, in the caves of Florida, the flow is powerful, and they are more linear in form. A cave often has one big tunnel, from which smaller side passages branch off. In France, the caves are pipe-like tunnels. One tunnel can go on for several kilometres without considerable branches off it.

In France and Florida, the flow of water in the caves increases after rain. The water is quickly filtered through the ground and flows out through the caves. Particularly in France, the water becomes silty after rain. In Molnár János, the filtering is so slow that rain does not affect the currents of the cave. The conditions are stable and predictable.

The gases rising up from the lower earth layers contain hydrogen sulphide, which becomes sulphuric acid when mixed with water. Divers call the water in Molnár János hostile. There is so much sulphuric acid in the water that it erodes material, especially rubber and metal. The metal surfaces of the diving equipment darken within a few days in the water.

Crystal clear water fills huge halls along the way. Water coming up from below the cave is thousands of years old. The walls are decorated with fossils (below left) and crystals (below)

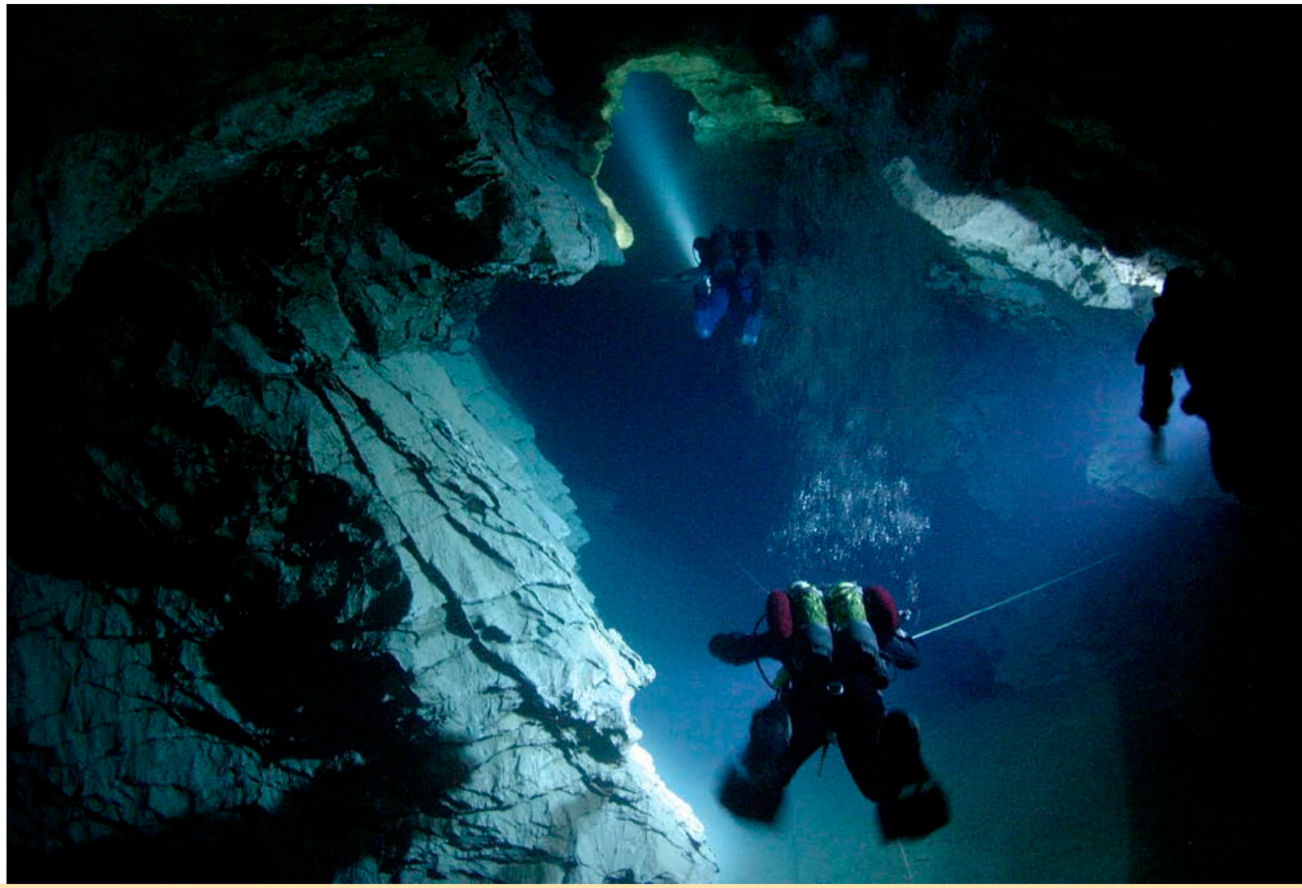
Molnár János

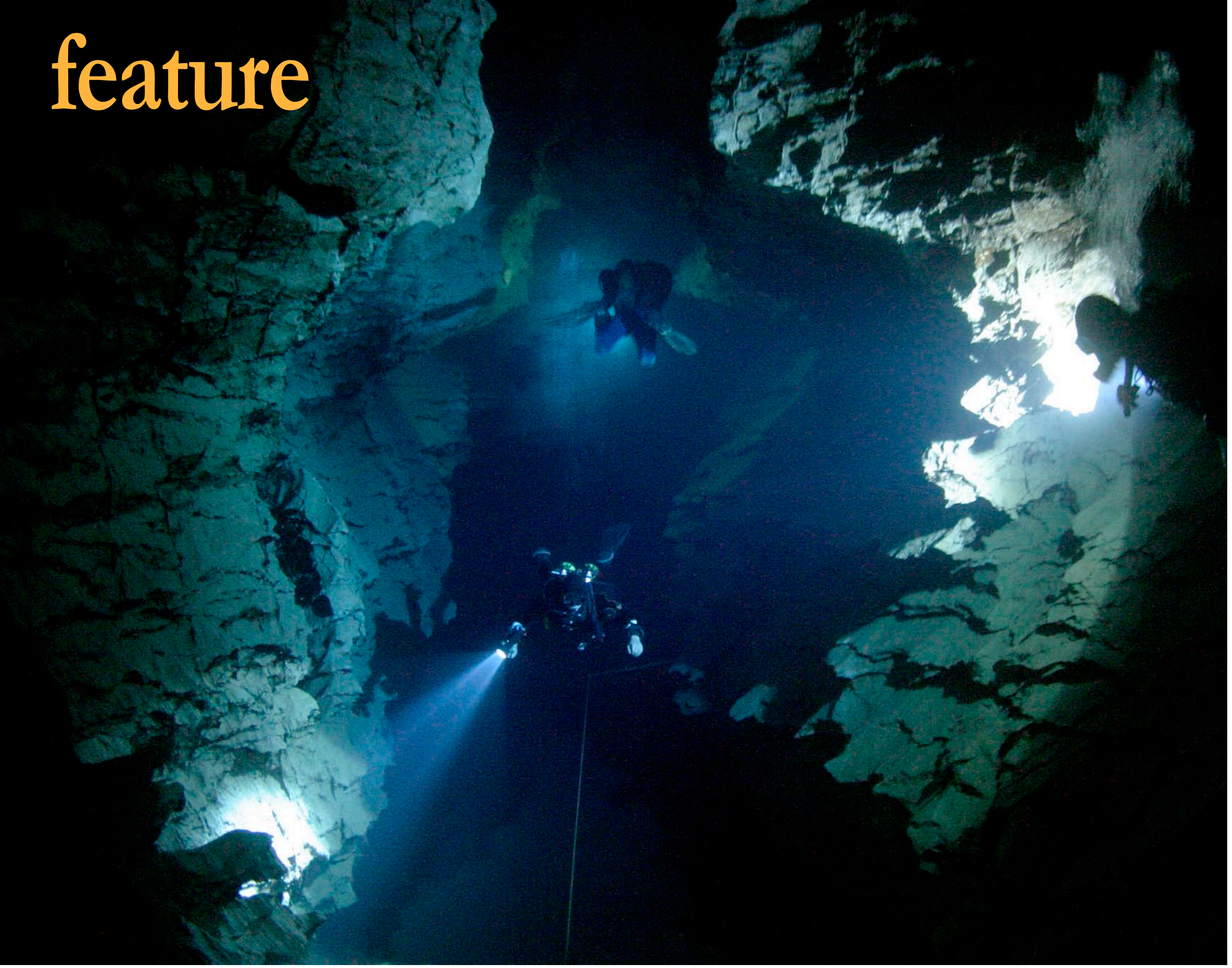


Geological time machine

In Molnár János, new caves are still being formed, but the speed is quite slow in terms of human lifespan. The humidity exuding from the Earth's surface gets mixed with the rising ground water that has rained down thousands of years ago. According to radiocarbon dating, the ground water in Molnár János is over 5,000 years old.

Unlike the new part of the cave, the old tunnel has been a popular place to dive. The short tunnel has been known for decades, and it is easy to dive in. The rock has become smooth in the narrow gaps. Also, the silt that used to cover the walls has gradually worked loose. That is why one can see the details in the limestone rock near the mouth of the cave. Fossils can be seen in the





Molnár János

Different crystals (left and below) are a result of changes in water acidity and composition of surface water and deep volcanic water meeting inside the cave; Divers enter a chamber in Molnár János (far left); Marine fossils in the cave formed when the area was under the sea millions of years ago (bottom)

The crystals reveal the presence of various minerals, such as manganese, calcium carbonate and barium

walls, things like a tooth of a prehistoric shark.

The fossils in Molnár János originate from the time when the area was sea bed. The ground layer where the cave is located mainly consists of red algae, echinoids, coral fragments, bivalves, decapods and bryozoans. The mystery of Molnár János is what hides underneath the many metres of silt sand.

The most magnificent details are the crystals on the walls of the cave that are formed from orthoclase and barium sulphate. Orthoclase develops when silicate and calcium carbonate are crystallised in water. The particles of soft limestone have crumbled down to the bottom of the cave and become silt. Gradually harder fossils emerge from deep inside the rock. They stick out of the wall for a while until the limestone surrounding them erodes and the fossils sink to the bottom.

In Molnár János, the water flows very slowly. In the deeper part of the caves, the silt sand that has run down from the upper levels covers most of the bottom, hiding its contours. The currents are so weak that they cannot carry the silt out of the cave. Only the stair-like walls remain, which the silt has settled on.

Molnár János is the only cave in the area where hot volcanic water is mixed with the cooler surface water flowing from the Buda Mountains. The temperature of the warmer, volcanic water is normally 27°C. There are no hot springs in the deeper parts of the caves. There, the temperature of the water is 20°C.

The hot currents of Molnár János sustain plenty of bacteria, which colour the walls of the cave red. They eat sulphate, which is abundant in the volcanic water. In the oceans near the tectonic plates, there are similar hot springs through which hydrogen and hydrogen sulphides erupt.

One can see the history in Molnár János at a glance. Crumbled crystal pillars reveal how the crystals have formed over the course of the centuries, like the rings in a tree trunk. Even small changes in the acidity of the water can clearly be seen in the crystals.

In the uppermost layer of the caves, there are black barium crystals covered with manganese oxide. They reveal a geological change. The crystals are several centimetres long and have accumulated on the surface of the lower layers as carpets, as if lots of black building blocks had been thrown on the surface.

In some places, the manganese oxide forms a black film on the surface of the rock. The velvety layer is like soot. Diving in the manganese oxide rooms is an extraordinary experience, as the black colour absorbs the light and covers the details of the walls.

Under the layers of manganese oxide and barium sulphate, there is calcspar, or calcite—a form of calcium carbonate often found in chalky ground, limestone ground or marble. In the caves, there are many areas of crystal

In deeper parts of the cave, the mud banks may collapse without much notice

that have formed from crystallised calcspar.

The last to develop in the cave were the bacteria that are fed by hot currents from the depths of the earth. Bacteria reduce the acidity of the water.

Traditionally, interest in caves had more to do with geological history, but now researchers are interested in the bacteria living in conditions that were not supposed to support life. They offer medical science new alternatives for developing treatments.

NASA uses bacteria when it models life on other planets. In the last few years, it has been found that bacteria manage to survive in complete darkness and in temperatures of several hundred degrees. Light is not necessary for them, and their diet is still as primitive as when evolution began. Even radioactive radiation, which splits human DNA fast, does not affect them.

I can only imagine how much even just one leaking sewer could damage Molnár János. The water in the caves has been preserved like the frozen water in the core of a glacier. Human influence does not reach here, yet. The water in which we swim pre-dates our chronology.

A dive into Molnár János

I pulled myself carefully along the projections of the walls and the line, trying not to stir the silt with my fins in the narrow gaps, as it would impair visibility immediately. I could hear only the random clinks of the stages against each other and the sound of my own breathing.

I detached my backup gas bottles and pushed them in front of me in order to get through a restriction. I pulled with both hands and wiggled when the box of my photographing light got stuck between stones. I found the right position and glided through the gap.

We continued for a hundred metres along the narrow tunnel. The walls were a few centimetres from my face. The narrow tunnel opened into a big hall. In front of me, there were stone blocks as big as houses. We made our way past them and followed

THIS PAGE: Cave wall colors vary from shining white to velvety black where manganese oxide lines the walls; Water temperature is 20°C, with no current

Molnár János

Molnár János

The walls may look like stone, but in many places will turn to silt by mere touch. Acidic water has softened the limestone walls to crumbling point; Divers float in formation passing shelves formed by erosion of layered limestone (top left)

the guiding line along the most suitable diving route. The rock in front of me looked as if it was only waiting for the touch of my finger to go hurtling down the slope.

The water in front of me was starting to ripple. On the thermocline, the karst water that filters from the surface mixes with the hot currents rising from the depths.

Visibility was momentarily lost, as we dived through the mixing layer of cold and warm water. A hot wave hit us in the face. The temperature rose to 27°C. The warm water rose from the depths of the Earth. Colours changed suddenly. The bacteria that thrive in warm water coloured the walls a rusty red.

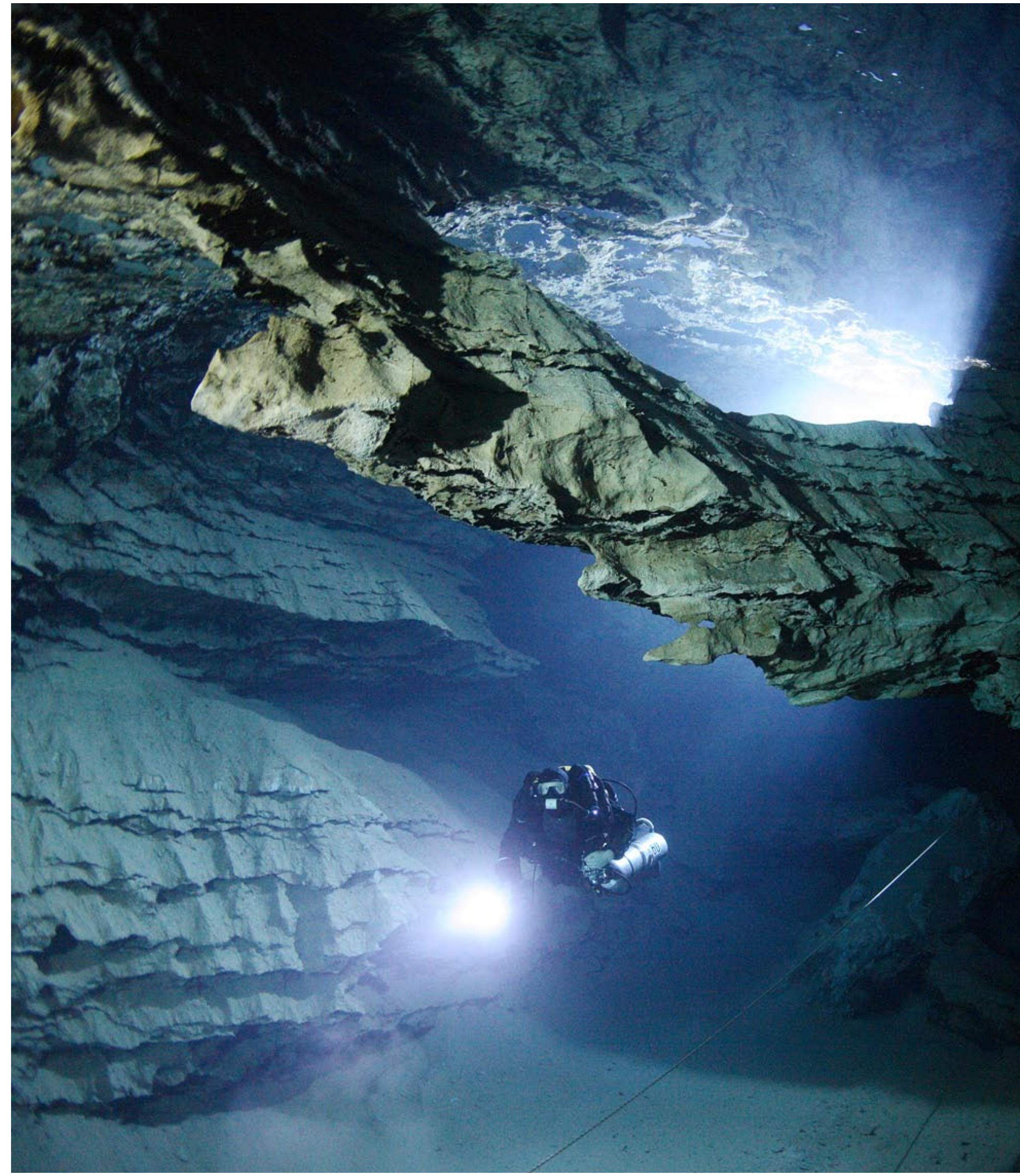
The surface of the water was dimly visible above us. There was a big hall called the carbon dioxide chamber, which reaches several metres above the surface of the water. It was the biggest space above water in Molnár János.

We went beneath the surface again. There were hundreds of fossils in the vertical wall. At first glance, the wall looked like solid rock, but when I pressed it with my finger it gave away. My finger sank into the limestone like a hot knife through butter.

This is what makes diving in the narrow parts of Molnár János so difficult. It is difficult to find a hard rock surface; if you touch the walls, they crumble down in a cloud of silt.

We descended deeper into the cave. The water welling up from the hot springs hit the cold layer again in front of us. I sighed with relief, as the cool water rushed to my face.

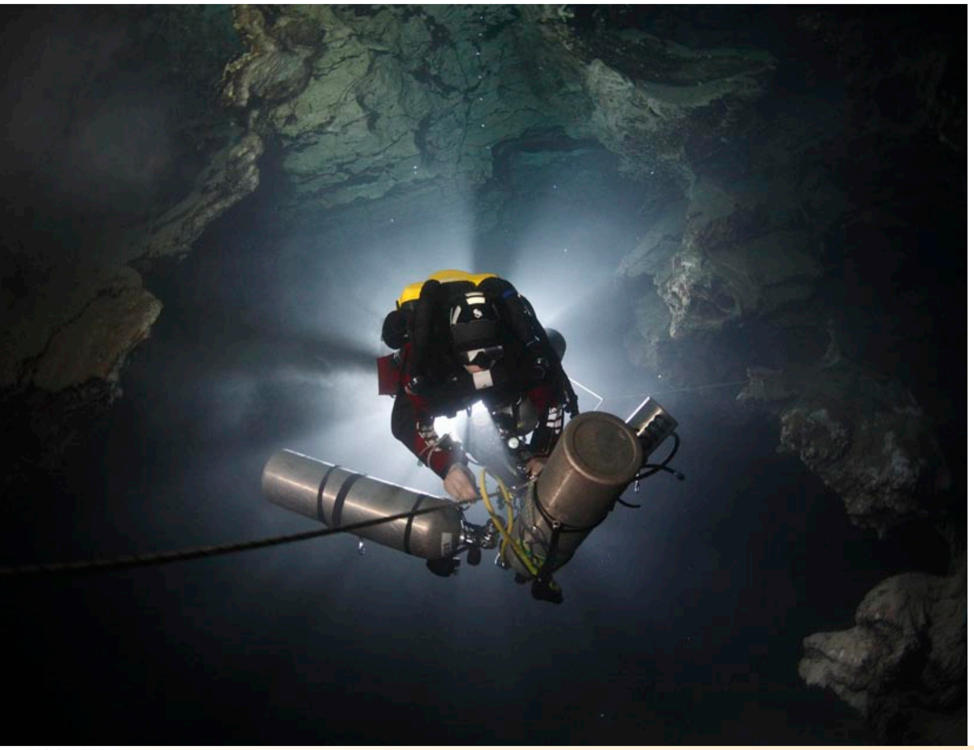
The dry suit is an excellent invention for the ice cold waters of the north. Here, it protects during the long and deep dives,



Astonishing formations are preserved as the flow inside the cave is really slow

Molnár János

The floor has collapsed, but there is no access to the space just a few meters below us. We can only guess what we would find there



but it is anything but pleasant in a hot bath.

We continued deeper into the depths of the Earth. In the deep parts of the cave, there were no hot springs or bacteria. The red walls of the big hall changed to a more even grey. Our gas-discharge lamps made the scenery surreal and blue. The water was gin clear.

The narrow tunnel at the beginning of the dive changed to great cathedral-like halls, which could reach tens of metres high. In the walls, there were stair-like shelves covered in silt, which had fallen from above. The shelves had formed when the softer parts of the layered limestone eroded away. The hard layers have resisted water the longest. These 'stairs' are a typical sight in Molnár János.

Formations

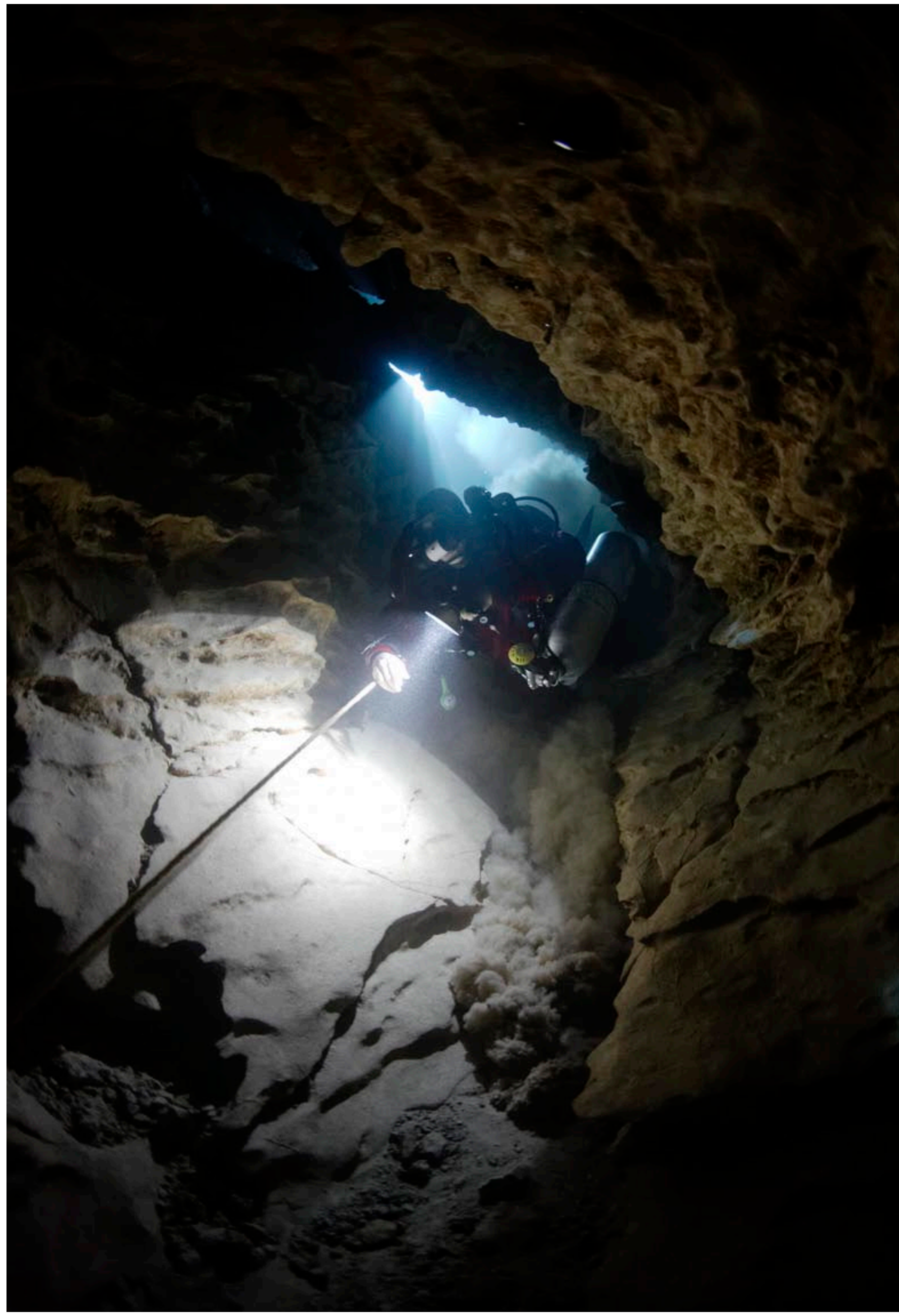
Contrary to, for example, the natural caves in Mexico, there are no visible stalactite formations in Molnár János. Of course, the silt layer covering the bottom of the cave could be hiding almost anything under it, but it is quite likely that the sulphuric and carbonic acid have eroded any possible formations away.

The most distant parts of the cave have been visited only a few times, if at all. When there is no current, nothing takes the silt away or detaches the loose substance from the walls.

The acidic water has eroded the stone unevenly. The walls and ceiling are covered in plates a few millimetres thick that are only held in place by silt and the pressure of the water. They are so weakly attached that the touch of an ascending, expanding air bubble is enough to detach plates as big as a car bonnet from the ceiling.

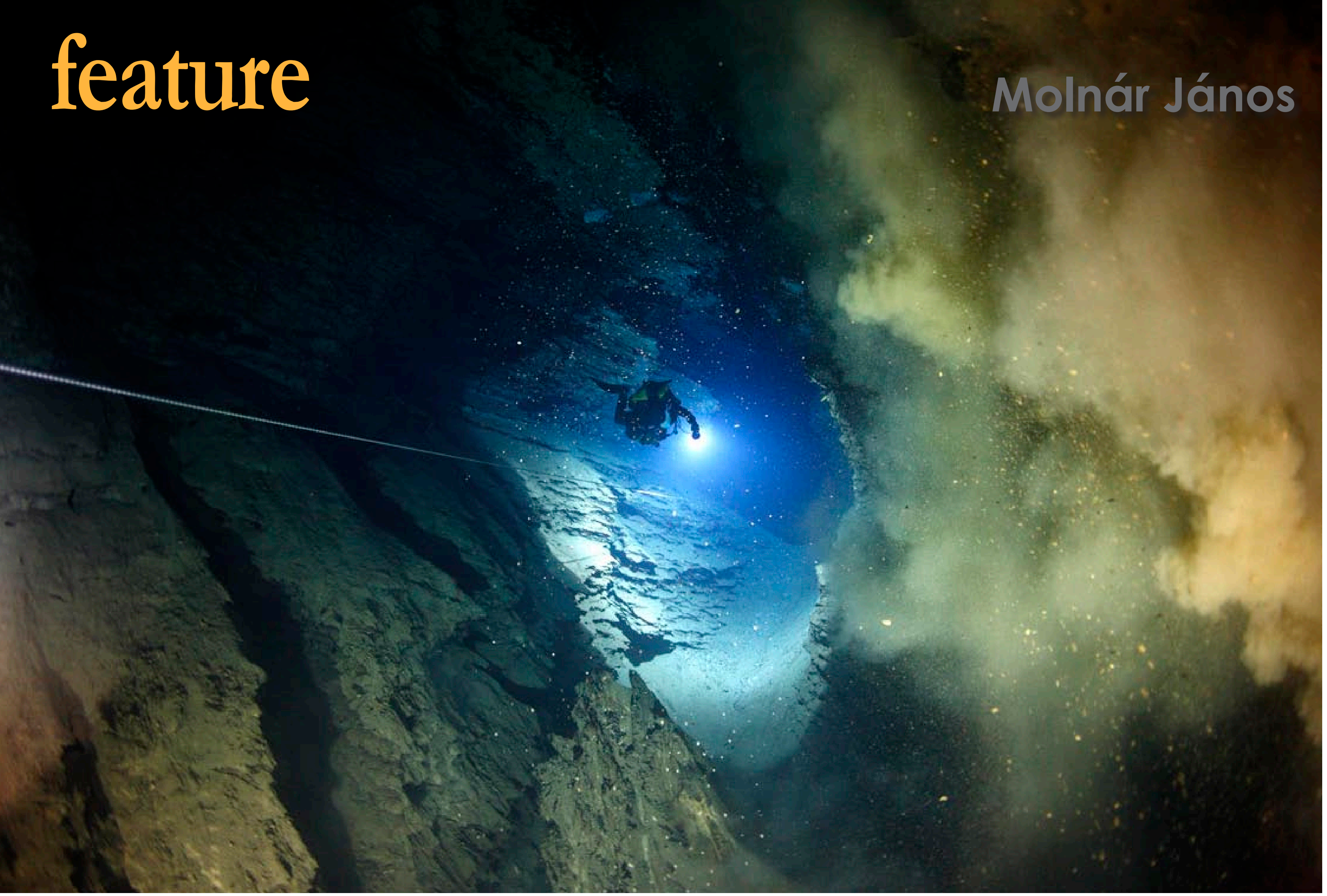
We descended to the depth of 30 metres. Although everyone pulled themselves as carefully as they could through a gap in front of us, a foggy cloud arose in front of it. I dived into the cloud and felt the direction of the line with my hands. On the other side of the gap, I found myself in clear water once again. The walls were lined with a velvety carpet, which absorbed all light. It was as if I had dived into a completely new, separate cave. The manganese oxide that clung to the surface of the limestone looked like coal.

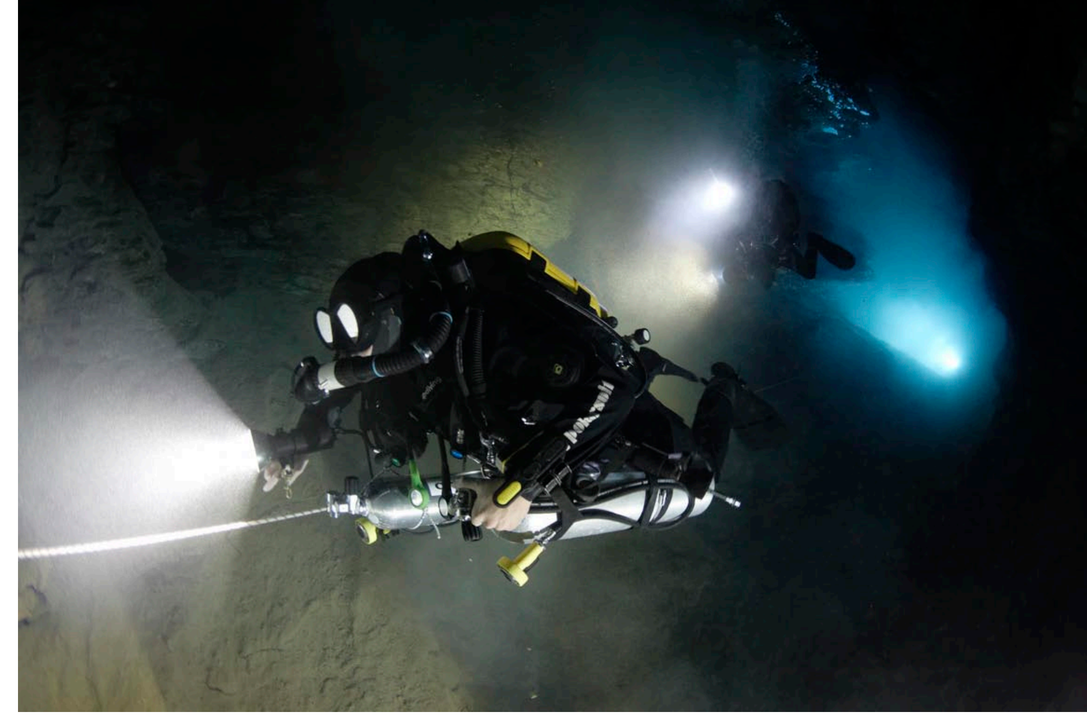
The bubbles hit the ceiling. The air formed hundreds of mercury-like bubbles, which reflected the rays of light around the black room. We were in the middle of



Sturdy lines offer a way home if a mudslide destroys visibility

Molnár János





Rarely visited parts of the cave are hard to photograph. Even a small amount of bubbles will release plenty of silt, ruining the otherwise excellent visibility

Location of Budapest on maps (left)

a fireworks display, as the rays of light jumped from one wall to another.

We swam through a few big halls and descended to 35 metres. I squeezed through the narrow gap. I found myself in a space, which was approximately one metre high. The backup gas bottles hanging by my chest touched the silt on the bottom of the cave, and the casing of my diving equipment scratched the ceiling. I pulled myself forward with my fingers. I was not moving my fins, as to do so would further stir up the powdery bottom.

I turned back. The exhaled bubbles in front of me hit the ceiling and exploded as if in a slow motion film. An enormous silt cloud swallowed me up. I could no longer see the light of my lamp, which was only tens of centimetres from me. I was in complete darkness.

The acidic water has also softened the surface of the walls and ceiling so much that a hand would sink into them without feeling the hard surface, which can lead one forward. The forms of the cave did not have clear lines, so it would take an eternity to grope one's way out along the uneven walls. As the exit passage was not even a metre in diameter, finding it in a room with walls like cotton wool was a nightmarish thought.

I squeezed myself through the narrow exit passage once more and, as if by magic, the scenery changed. The silt cloud was left behind me, and I as in clear water again.

We continued our dive toward the furthest charted point of Molnár János. We were a kilometre from the mouth of the cave, at a depth of 22 metres. A shaft that fell vertically into the Earth began at the end of the hall. We descended the shaft to a depth of 50 metres. We had reached the furthest point. The tunnel ended at a wall. The other, bigger branch of the tunnel had been less charted, but the cave continued there at a depth of 70 metres.

We motioned upwards with our thumbs to signal that it was time to turn back. We headed for the exit. The walls disappeared in the darkness, and the long, narrow beams of our diving lamps lit the way forward. We rose up the shaft slowly. The majestic walls fell back into darkness.

We swam back along the same route. Visibility was not as good as it was when we came. The air bubbles and touching the bottom in narrow gaps had detached silt, which had spread like a grey veil in the water. It would be weeks before the water was clear again.

A few hours had passed since we started the dive. I switched off my lamp and lifted my head above the surface. Daylight and the sounds of the city flooded the tunnel through the hatch. At best, we had been only 50 metres below the city. In my mind, I went over the journey in the depths below the city. We moved around, block after block, inside the rock. Most of the people walking on the pavement probably had no idea that there was a cave system full of water below their feet.

We climbed up the steel stairs into the bright daylight. A tram clattered past us again. In the heat of the midday sun, drowsy people seemed to wake up again for a moment when they saw us with our diving suits and equipment by the side of the road. ■

Having visited caves and seas all over the world, writer Antti Apunen and photographer Janne Suhonen, both based in Helsinki, Finland, have co-published a book, Divers of the Dark, *and several articles on diving. Visit:* ***Diversofthedark.com***

Monár János is located on Leo Frankel's Street in Budapest