Light fantastic

What makes mysterious glowing orbs appear over a Norwegian valley? We might be about to figure it out, says Caroline Williams

"IT IS a very nice evening in the Norwegian mountains, there is a clear sky and the stars are around us. Everything is cold, it's a fantastic view and then out of nowhere – pow! It ignites." Bjorn Gitle Hauge pauses and shakes his head in disbelief. "When you've seen it you can't forget it. You wonder, how can this happen?"

Hauge, an electrical engineer at Østfold University College in Halden, Norway, is recalling his first encounter, seven years ago, with the Hessdalen phenomenon: strange, hovering, flashing balls of light that have been appearing in a valley in central Norway for at least a century.

Sometimes the lights are as big as cars and can float around for up to 2 hours. Other times they zip down the valley before suddenly fading away. Then there are the blue and white flashes that come and go in the blink of an eye, and daytime sightings that look like metallic objects in the sky. It is little wonder that when they started appearing up to 20 times a week in the early 1980s, UFOlogists hailed the Hessdalen valley as a portal to other worlds and flocked there to celebrate.

But for an international team that has been studying the mysterious lights since then, the valley harbours something much more exciting than flying saucers. If they can work out what it is about the place that powers such incredible light displays, it may not only help explain mysterious lights in other parts of the world, but also open up the possibility of storing energy in a radical way. It is a big if, but the team will be heading back to Hessdalen in the summer to test out a bunch of theories on what is generating the lights. Armed with clues from recent lab studies, plus a bank of new instruments and sensors, they could find that this is the year it all starts to make sense.

Hessdalen might have been just another UFO fad if it weren't for Erling Strand, a computer engineer also at Østfold University College. In 1982, he was among the hordes who made the 400-kilometre trip north from Oslo to see the lights that the Norwegian press were calling UFOs. Unlike everyone else, though, he didn't have spaceships on his mind. "I thought: a strange light hovering around in nature – what is the physics behind that?" he says. He soon found that no one had an explanation. "I got the impression that scientists didn't want to involve themselves, and I think the word 'UFO' was the main reason," he says.

Frustrated, he gathered a few friends, borrowed some equipment and, with advice from a handful of sympathetic Norwegian physicists, in 1983 he launched Project Hessdalen. It was the first attempt to study the lights scientifically. On the group's first visit to the valley the following summer they saw 188 lights, 53 of which they were confident couldn't be explained as illumination from buildings, vehicles or planes. They filmed the lights, fired lasers at them, plotted their movements using radar and carried out a battery of tests, all of which led them to conclude that this was undoubtedly a genuine phenomenon. Yet they gleaned few clues as to its cause. Measurements of radioactivity and seismic activity, both of which could be a potential power source for the lights, drew blanks, although the researchers did see a small fluctuation in the area's magnetic field before some sightings.

TOP: SAM CHIVERS; RIGHT: LEIF V GULLSTAD

Then, as abruptly as they had begun, the lights disappeared and the project ground to a halt. Not until 1993, when Strand paid a visit to the valley, did the team discover that locals had been seeing the lights all along, but had kept mum after being ridiculed by the press.

Strand sprang back into action, organising a conference in Hessdalen in 1994. Many of the delegates had an interest in other mysterious atmospheric phenomena such as ball lightning and St Elmo's fire, and were intrigued by the valley's potential as a natural lab. The meeting spawned a fresh effort to measure the lights' size, shape and speed ›

BJØRN GITLE HAUGE/ØSTFOLD UNIVERSITY COLLEGE, NORWAY

Does the geology of the valley at Hessdalen form a natural battery?

using radar, and added spectral analysis to the toolkit as a way to find out what elements the lights were made of. The delegates also resolved to search for electrical, magnetic and geological anomalies that might explain why Hessdalen was such a hotspot.

A small group of Italian, Norwegian and French researchers have been back to the valley each September since 2000, all working on the mystery as a sideline to their usual research. Their measurements show the Hessdalen lights make no sound and seem to be fairly cool – they don't burn the ground or trees on contact, at least. There is evidence, however, that they sterilise the ground if they land, killing soil microbes. Strand once saw a light land on the snow, and while the snow didn't melt, it left a mark and analysis showed that there were no microbes in the snow at this spot, although the levels were normal some 15 metres away.

Another surprise is that even when no lights are visible, something seems to be happening in the air above the valley. Data from radar reveals strong echoes from unseen entities (*Acta Astronautica*, vol 67, p 1443).

Most of the researchers feel that these clues point to some kind of plasma as the culprit. When a gas ionises, it forms a cloud of ions and electrons – plasma – that release energy in the form of light when they recombine. Among other things, plasmas are known to kill bacteria, and in the right conditions can be cool enough to touch (*Journal of Applied Physics*, vol 45, p 165205). And plasmas don't have to emit visible light – sometimes they glow in the infrared or ultraviolet part of the spectrum.

Problem solved? Not so fast: plasmas are very difficult to make. According to Michael Coppins, a plasma physicist at Imperial College London, you need to raise

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temperatures to around 10,000 °C to ionise a gas, and that requires a lot of energy.

But glowing balls of light do occur naturally on Earth, and in 2012 a team of scientists captured one at its birth. Jianyong Cen and his colleagues at the Northwest Normal University in Lanzhou, China, were studying a storm at a remote site in the north-west of the country when they lucked out: their instruments recorded a bolt of lightning hitting the ground not far away, generating a 5-metre-wide glowing orb of ball lightning that hovered for over a second. Spectral analysis suggested that the orb contained silicon, iron and calcium. Intriguingly, the spectrum of the Hessdalen lights also reveals the presence of silicon and iron, plus scandium, a common element in the region and one which happens to be easily ionised.

This seems to suggest that the Hessdalen phenomenon is ball lightning. In Hessdalen the lights aren't linked to thunderstorms, however – they can pop up out of nowhere on sunny evenings. "There must be an energy source somewhere that has the power of a lightning strike," says Hauge. "What can electrify and drive a ball of light as big as a car for several hours?"

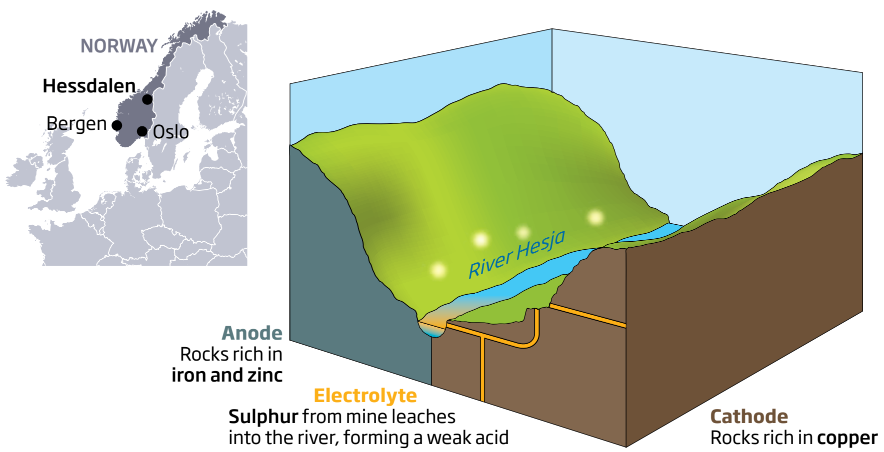
Perhaps there is something about the valley's shape, microclimate or geology that allows it to generate a huge electric charge. One idea, says Hauge, is that strong winds could whip up static electricity on the mountains. Other research has shown that wind-blown snow or sand can generate a static charge. "In Hessdalen we have iron in the mountaintops and we have extreme winter conditions with very high wind speed," says Hauge. "Maybe these winds build up charge."

Another idea is that the lights are powered by radioactivity – specifically, the decay of radon in the atmosphere. This was put forward by Gerson Paiva and Carlton Taft of the Brazilian Center for Physics Research in Rio de Janeiro, who have created ball lightning and plasmas in the lab. In 2010 they suggested that the Hessdalen lights are made up of "dusty plasma" – one containing ionised dust particles. Paiva and Taft have used radon decay to make dusty plasmas and believe that something similar could occur in Hessdalen. (*Journal of Atmospheric and Solar-Terrestrial Physics*, vol 72, p 1200).

Coppins accepts that radioactive decay could generate some kind of plasma. Unfortunately, every search for radioactivity in Hessdalen since the very first field experiments in 1984 has failed to find evidence of it; indeed background radioactivity is lower in the valley than in the surrounding area. Even so, Hauge is searching for radon as a priority this year, and is placing radon detectors in an area where a large light was seen. He admits that the team has found no large radon-emitting rocks in the area, but points to nearby mines that are now filled with water. Could big radon bubbles be erupting from deep in the ground, picking up dust from the water's surface as they enter the air? "The bubble comes up and… whoosh!" he says.

Natural-born battery

Floating balls of light have been seen in the Hessdalen valley, Norway, for centuries. The valley's unusual geology may be responsible, turning it into a giant battery that powers the lights



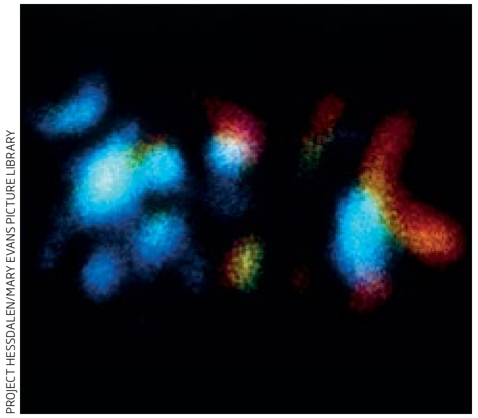
Land of two halves

The other main strand of research later this year will be led by Jader Monari of the Institute of Radio Astronomy in Medicina, Italy, who has been studying the spectrum of the lights and electrical anomalies in the valley since 1996. This year, though, he will turn his attention to the valley's unique geology in search of evidence of a novel source of energy.

In 2011 Monari and his team analysed rock samples from Hessdalen and found that it is a valley of two halves: the rocks on one side of the Hesja river are rich in zinc and iron, those on the other are rich in copper. Then, during the 2012 mission someone mentioned an abandoned sulphur mine in the valley. "For me it was news," says Monari. "We found zinc and iron on one side and copper on the other. If there is sulphur in the water in the middle, it makes a perfect battery."

Monari suspects that the iron and zinc form the anode of this natural battery, the copper makes the cathode, and sulphuric acid leached out of the mine turns the river into an electrolyte. This, he says, could explain a strange electric field anomaly that they measured in 2010.

To test the idea, he and his colleague Romano Serra from the University of Bologna, Italy, set up a pair of rocks from opposite sides of the valley as electrodes, and dunked them in river sediment to mimic a battery. They found that a current flowed between the two. "It was possible to light a lamp," says Monari.



PROJECT HESSDALEN/MARY EVANS PICTURE LIBRARY

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In the past, sightings of the lights peaked at about 20 a week

Monari suggests that this unique geology contributes to the lights in two ways. First, it supplies bubbles of ionised gas, formed when sulphurous fumes react with the humid air of the valley. Second, it forms electromagnetic field lines in the valley that could move the bubble around. "This electrical field creates a path that could be the 'main road' of the lights inside the valley," he says.

> **"The unpredictable climate once trapped the researchers in a snowstorm in August"**

This seems to fit with the evidence. If the ion bubbles are a cold plasma that hasn't been energised enough to emit visible light, it is possible that they would float around the valley invisibly, revealed only by radar pulses bouncing off them.

It could also explain how the lights seem to move, says Monari. Ion bubbles can shift and change shape, so a moving light could simply be a lit part of the cloud shifting as its overall shape alters. A light may even seem to flash as parts of the cloud are briefly excited.

Hauge suggests the energy needed to make the cloud glow could come from a build up of charge. This would also account for the mysterious daytime sightings of metallic objects in the sky. "People see it and think it is metallic but it isn't – it is a very dense cloud that is starting to emit light," says Hauge.

About the only thing the natural battery idea doesn't explain is what might be supplying the charge to energise the plasma enough to emit visible light. In recent years, though, the researchers have noticed that the lights are particularly impressive during auroral displays. A flurry of lights in 2007 came just 30 minutes after a fantastic aurora borealis, says Hauge, and three years ago Italian researchers filmed the lights under a green auroral sky. "And an aurora borealis means an ionised atmosphere – more charge," says Hauge.

With so many new clues to go on, everyone involved in the project is itching to get back to the mountains. It won't be easy, of course. The unpredictable arctic climate once trapped the researchers in a snowstorm in August, and two years ago a bank of cameras blew off a mountain and smashed. However, Hauge has been working on equipment that will allow the team to image the whole valley at once, rather than a tenth at a time, as in the past. He won't go into details apart from revealing its name – the "Eagle Eye" – but is clearly excited by the possibilities. "I can see everything at once and correlate it with radar," he says. "I am hoping to get this equipment up there this year."

There's just a chance we could be close to solving this mystery. If so, the lights might soon prove to be more than just a pretty display. Understanding the process that powers these curious lights might offer a way to recreate them anywhere, anytime. "I think that this could be a new mechanism for storing energy," says Hauge. "If we have some kind of installation that could pick up charged particles and lock them inside, then you can store energy."

This is all hypothetical, and Strand, the initiator of the Hessdalen project, is cautious. "I think the theories we have now are based on too few hard facts. It can damage the research," he warns. The most important thing they can do, he says, is collect data until they are sure they know what they are dealing with.

Whether the strange lights turn out to offer us a source of clean energy, or just some weird physics that lights up the valley, one thing is certain: the truth is hovering out there in Hessdalen. And this band of detectives won't give up till they find it. No aliens required. ■

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