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THE MAGIC MIRROR: LEGENDS, LIMNOLOGY, AND NUCLEAR POWER ON LAKE STECHLIN

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On the horizon of the small German village of Neuglobsow, the chimney of the Rheinsberg nuclear power plant rises above the surrounding beech and pine trees. It stretches to the sky, twice the height of the forest beneath it—a solitary concrete monument in a picturesque landscape. Beneath the tower and the trees, there is water: glass-clear and shining blue; cold and immensely deep. Lake Stechlin is a mirror. Named from the old Slavic word for glass, *steklo*, it reflects the forest, the smokestack, the landscape around it—and other, more global phenomena too.

The IGB LakeLab. © 2018 Volker Crone. All rights reserved. Courtesy of the Leibniz Institute for Freshwater Ecology (IGB).

A silver fish striped with pink flits in its depths. A crayfish crawls over the open shells of mussels. A black-necked bird streaks overhead. Neon algae spin their way around the branches of a fallen tree. And clouds move in reflection across the water's surface. Stechlin is both the largest and deepest lake in the area, remarkable for its clarity. On good days, you can see ten metres into its turquoise depths, at times to the very bottom.

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Lake Stechlin.

"Everything is silence here," wrote the German realist author Theodor Fontane, who made the lake famous as the setting of his 1898 novel, *Der Stechlin*. "Not a single boat leaves its wake and no bird may be heard to sing . . . Yet from time to time at this very spot things do get lively."[1] Fontane drew on local histories and legends for his fictional Stechlin, which would in turn shape the cultural understanding of the real lake—and the scientific legacies that followed.

. . .

It is 1755, and three thousand kilometres away in Lisbon an earthquake is raging. It is November, All Saints Day, mid-morning. Fissures erupt in the centre of the city, and thousands are killed. Inexplicably, just as the earthquake strikes in Portugal, the lake water at Stechlin roils and erupts in geysers.

This a local legend, documented by historian Friedrich Wilhelm August Bratring in his 1799 account of the region.[2] A century later, Fontane took this story further: during far-off quakes and volcanic eruptions, he wrote, Stechlin gives rise to an enormous red rooster that flaps his wings above the waves, that crows over the solitude of the lake. Fontane also drew on local tales from Karl Haase's 1887 book of regional legends, in which a hubristic fisherman called Minack casts his net over Stechlin in a storm, only to be pulled into the water and drowned by the rooster.[3]

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Art installation on Lake Stechlin.

These tales, for Fontane, had a literary function. Depicting social and political upheaval in nineteenth-century Prussian society, Fontane used the lake as a metaphor for the cultural transformations in his story about aristocrats living on its shore. But Fontane's novel would impact the lake's actual future: the rumour of Stechlin's powers—a kind of limnological divination made famous by Fontane—would linger and transmute in the decades that followed. In the present story, however, there is no rooster and there are no aristocrats—just a lab and a nuclear reactor.

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In 2017, two years after my first visit to Stechlin, I take up a post as writer-in-residence at the Leibniz Institute for Freshwater Ecology (IGB) in the village of Neuglobsow. The IGB sits on the lake's eastern shore, a complex of wood-clad buildings set around the village's old fisherman's hut, where the mythical Minack may once have been found. I am here to write about the lake's significance in literary history and limnological research and spend days at a time shadowing the lab's researchers, interviewing them about their work. Swimming out to the lake's centre, I think about why this place is so captivating to me. From my little office, I trace the lake through the archives.

I find Stechlin in the pages of a limnology journal, *Archiv für Hydrobiologie*, a major text in freshwater science. In 1935, the editor August Thienemann recounts the tale of a quasi-scientific article published in a newspaper. In the article, a local mining engineer proposed construction of a research centre at Stechlin, intending to study the lake's eruptions and their geological link to far-off earthquakes. He argued that German researchers should pay closer attention to Stechlin, that it could be used as a naturally occurring "pre-seismograph" to warn of disasters in Europe. The article, Thienemann recounts, caused outrage in the scientific community, in part for its enrolment

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of local legends and not least because limnologists had long taken an interest in the lake for its size and clarity.[4]

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But the legends nonetheless captivated scientists. In the same 1935 volume of *Archiv für Hydrobiologie*, Lotte Möller, a limnologist from Berlin, argues that isolated oscillations in the water as described by Fontane and Bratring were possibly just a result of wind circulation and other meteorological phenomena.[5] And today, Fontane is still everywhere in Neuglobsow—red roosters are painted onto shutters, affixed to rooftops, in framed pictures in the IGB's lunchroom. On quiet afternoons, when the village-bakery truck rolls by, the laboratory's staff gather for Kaffee und Kuchen, divvying up cups of coffee and slices of custard cake under the cockerel's watchful eye. The scientists I speak to all know the lake's legend by heart and aren't shy about discussing it. I find myself enthralled that limnologists should ever have needed to refute a tale that, for Fontane, so clearly functioned as a metaphor.

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On a crisp autumn day, I am invited to join the lab's researchers on a visit to the nearby nuclear power plant. It is being decommissioned, and part of that process involves educating any interested parties on the work the plant carried out and the process of dismantling it. We meet at the IGB's lab and carpool through the forest to Rheinsberg. From the potholed parking lot, a man ushers us into a classroom to learn about the site's history and its future.

Inside Rheinsberg nuclear power plant. © Jessica Lee.

When it opened in 1966, Rheinsberg was the first nuclear power plant built on German soil. Plans for the project began in the early 1950s, when East German engineers and scientists assessed the region's suitability for a project that would herald a modern, technologically advanced GDR. The plant was a construction of Cold War beauty in a sylvan landscape, complete with tiled pillars and pea-green control panels overflowing with dials and buttons. A canal was dug between Stechlin and the neighbouring lake Nehmitz, so that water could be drawn up from Lake Nehmitz, through the nuclear reactor to cool it, and then flow onward into Stechlin—before flowing back through the canal again. As West Germany's first nuclear plant came online just five years before, the plant was a statement of technological mastery for the GDR.

Rheinsberg operated for 23 years—longer than the 20 it was built to function for—storing its nuclear waste in containers on-site and pouring the reactor's cooling waters into an area on Stechlin's western shore near the canal. And then, after the fall of the Berlin Wall in 1989 and Germany's reunification a year later, the plant finally stopped operating amidst safety concerns and began the process of decommissioning.

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Lake Stechlin and Rheinsberg nuclear power plant, with Lake Nehmitz in the foreground. © EWN - Entsorgungswerk für Nuklearanlagen GmbH.

During our visit, we are led through the buildings still standing. Though the plant no longer produces power, it is by no means "closed": of the original 670 workers, over one hundred remain, carrying out the slow process of dismantling the building and its contents, waiting out the half-life of radioactive contaminants found across the site. One building is entirely encased in tarps, sealed so that not even dust from its demolition can escape. The reactor and core components of the plant have already been removed and stored in a facility near the Baltic Sea, but the work at Rheinsberg, our guide explains, will continue for another decade at least, far exceeding the time the plant actually operated.

As our tour is comprised largely of freshwater ecologists, the conversation centres on the plant's impact on Lake Stechlin. During Rheinsberg's operations, some 400,000 cubic metres of water circulated through the cooling system daily, heating up to ten degrees Celsius before flowing out into Stechlin. Combined with the workings of climate change, the lake as a whole warmed by 1.5 degrees Celsius over a matter of decades.[6] Even this seemingly small transformation would have profound effects.

> *The power plant created a perfect experiment in a time of global warming. The glut of nutrients and heat flowing into the lake's west bay transformed communities of microphytes, invertebrates, and other organisms.*

Besides attracting locals who would swim and luxuriate in the warm outflow, the power plant created a perfect experiment in a time of global warming. Over decades of research through the

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Limnological Laboratory Stechlin (the predecessor institute to the IGB), scientists collected an enormous dataset on the lake's changes. The warmer water reduced ice cover on the lake, and the glut of nutrients and heat flowing into the lake's west bay transformed communities of microphytes, invertebrates, and other organisms. While underwater plants had previously thrived as sunlight travelled deep into the water, the knock-on increase in plankton, algae, and bacteria greatly reduced the lake's clarity, diminishing plant cover. Some species, unused to the newly warm and nutrient-rich conditions, disappeared altogether. As a group of East German scientists wrote in 1985, "the organismic society was thrown into disorder."[7] The impact of this warming continues to be felt: researchers surmise that the glut of nutrients that amassed in the heat perhaps remains in the sediment and is now slowly flowing into the lake.[8]

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Out in the lake's centre floats a year-round companion: the IGB's LakeLab. It is arguably the most ambitious research station of its kind, far larger than most freshwater ones. It is a series of 24 "mesocosms": nine-metre diameter enclosures that run to the lake's floor, fastened together and connected by walkways, appearing from above like a piece of honeycomb floating on the water's surface. The LakeLab allows Stechlin to be studied under strict controls and to be used as a mirror for wider environmental trends. Two-and-a-half centuries after Bratring reported bizarre movements in tandem with the Lisbon quake, scientists today are looking for signs of climate change.

> *Two-and-a-half centuries after Bratring reported bizarre movements in tandem with the Lisbon quake, scientists today are looking for signs of climate change.*

They do so in a variety of ways. The site hosts one major experiment a year, and the experiments often build on one another: 2014's experiment replicated the impact of 2011's large summer storm, Otto, which allowed scientists to observe how cyanobacterial (blue-green algae) blooms are encouraged by churning waters. In 2015, they studied "brownification" of the lake: how increased rain and storms can add carbon, phosphorous, and other nutrients to the water, reducing its clarity. The following year, they studied the effects of light pollution—from sky glow to moonlight—on the lake's zooplankton, examining the ways changing clarity and light-penetration changes the behaviour of organisms.[9]

During my time at the lab, I help out with maintenance tasks that keep the mesocosms running. The outboard motor of our boat rips into the silence. Matthias, one of the IGB technicians, is at the helm. Motorboats generally aren't allowed on the lake, but an exception is made for a few local fishermen and the IGB's researchers. It's a short journey, just a minute until we dock against a floating walkway.

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The LakeLab, with Rheinsberg in the distance. © Jessica Lee.

We spend the morning laying fish fences around the perimeter of the mesocosms, lengths of plastic webbing circling each enclosure. The larger perch in the lake, Matthias tells me, have a habit of hunting smaller fish inside the seclusion of the lab—which can cause problems for the experiments. I crouch on the narrow ring surrounding each enclosure, fastening zip ties around the mesh and metal framing, repeating the process every metre. Once we finish, before boating back to the lunchroom—haunted as it is by its painting of the red rooster and the tale of the drowned fisherman Minack—Matthias pulls out a fishing rod. He casts it into the space between enclosures, and for a moment we stand watching in silence, Stechlin's mirror-glass reflecting in the midday light.

. . .

It's hard to know whether scientists would have so focussed on Stechlin if it weren't for the fictional geysers or the nuclear plant. Fontane's influence pervades not just the place itself but also the understanding of it: books on lake science emerging from the lab never fail to mention the myths. A fifty-year anniversary publication from the IGB opens with a retelling of the legends.[10] One 2010 study went so far as to argue that the story of the rooster could be explained by an outbreak of *Planktothrix rubescens*, a red-hued alga.[11]

When I interviewed the researchers, I spoke with one of the IGB's lead scientists, Rita Adrian. I asked about the idea of the lake as a mirror and the way the legends have shaped the lake, and our conversation moved on to earlier notions of Stechlin as a warning system for global disaster. She explained that her preference was to describe Stechlin as a "sentinel." "2008 was pretty much the first time when people sat together and discussed the idea," she told me. "Sentinels are guards who

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detect something—the term comes from the military. We could also say 'indicators' . . . But sentinels suit global climate change."

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Aside from the localised warming from the nuclear plant, lakes in this region have warmed at a rate of 0.34 degrees Celsius per decade in the past 30 years, roughly twice the rate of air and surface temperatures. In a month-to-month study of Central European lakes since 1961, every month showed warming.[12] Water is slow to heat and cool, so this is a drastic change—and a worrying one.

Stechlin's depth and clarity mean that it is more susceptible to warming, and more likely to see a reduction of ice cover in winter. In turn, a reduction of ice can have the knock-on effect of warming the lake sooner in spring and summer, shifting the timing of seasonal mixing. In lakes worldwide, climate change doesn't simply mean warmer water, but entirely transformed ecosystems. Fontane's red rooster crowed warning; the wasting away of ice crackles with the same intensity. From the Lisbon quake until now, Stechlin has been held as a mirror to the world around it. Today, it really is portending disaster.

Notes

[1] Theodor Fontane, *The Stechlin*, trans. William L. Zwiebel (Rochester: Camden House, 1995), 1.

[2] Friedrich W. A. Bratring, *Die Grafschaft Ruppin in historischer, statistischer, und geographischer Hinsicht* (Berlin: G. Hahn, 1799), 22.

[3] Karl Eduard Haase, *Volkstümliches aus der Grafschaft Ruppin und Umgegend* (Neuruppin: R. Petrenz, 1887), 46–49.

[4] August Thienemann, "Der Stechlin-See als Präseismograph," *Archiv für Hydrobiologie* 29 (1935): 346–47.

[5] Lotte Möller, "Stechlin-See und Sakrower See: Ein Beitrag zur Charakteristik eutropher und oligotropher Seetypen," *Archiv für Hydrobiologie* 29 (1935): 137–56.

[6] Leibniz Institute for Freshwater Ecology (IGB), *Fünfzig Jahre Gewässerforschung am Stechlinsee* (Berlin: IGB, 2009), 5.

[7] Rainer Koschel, Georg Mothes, and Siegfried Jost Casper, "The Nuclear Power Plant and Its Role in the Life of Lake Stechlin," in *Lake Stechlin: A Temperature Oligotrophic Lake*, ed. S. Jost Casper (Dordrecht: Dr W. Junk Publishers, 1985), 419–32.

[8] "Lake Stechlin," Leibniz Institute for Freshwater Ecology (IGB), accessed 19 October 2023, https://www.igb-berlin.de/en/lake-stechlin.

[9] See the following publications for results: Darren P. Giling, Jens C. Nejstgaard, Stella A. Berger, Hans-Peter Grossart, Georgiy Kirillin, Armin Penske, Maren Lentz, Peter Casper, Jörg Sareyka, and Mark O. Gessner, "Thermocline Deepening Boosts Ecosystem Metabolism: Evidence from a Large-Scale Lake Enclosure Experiment Simulating a Summer Storm," *Global Change Biology* 23, no. 4 (2017): 1448–62, https://doi.org/10.1111/gcb.13512; Nicolas Clercin, Brigitte Vinçon Leite, Igor Ogashawara, Christine Kiel, Sabine Wollrab, Stella Berger, and Jens Nejstgaard, *Using UV-Fluorescence Fingerprints to Assess Lake Browning Effects: A Mesocosm Experiment in Lake Stechlin, Germany* (Berlin: International Society of Limnology, 2022); Andreas Jechow, Franz Hölker, Zoltán Kolláth, Mark O. Gessner, Christopher C. M. Kyba, "Evaluating the Summer Night Sky Brightness at a Research Field Site on Lake Stechlin in Northeastern Germany," *Journal of Quantitative Spectroscopy and Radiative Transfer* 181 (2016): 24–32, https://doi.org/10.1016/j.jqsrt.2016.02.005.

[10] IGB, *Fünfzig Jahre Gewässerforschung am Stechlinsee*, 4.

[11] Judit Padisak, Éva Hajnal, Lothar Krienitz, József Laknar, and Viktória Üeveges "Rarity, Ecological Memory, Rate of Flora Change in Phytoplankton—and the Mystery of the Red Cock," *Hydrobiologia* 653 (2010): 45–64, https://doi.org/10.1007/s10750-010-0344-2.

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[12] R. Iestyn Woolway, Martin T. Dokulil, Wlodzimierz Marszelewski, Martin Schmid, Damien Bouffard, and Christopher J. Merchant, "Warming of Central European Lakes and Their Response to the 1980s Climate Regime Shift," *Climatic Change* 142 (2017): 505–20, https://doi.org/10.1007/s10584-017-1966-4.

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