

# NewScientist

---

**NEW SCIENTIST LIVE USE CODE  
SUBS10 FOR 10% OFF TICKETS**



# How a janitor wowed Darwin by solving the ice age mystery

Self-educated ice sage James Croll cracked the conundrum of why Earth periodically freezes over. He was feted in his time, so why did the world forget him?



**A genius who worked out the choreography of glaciers, James Croll was not a people person**  
J. Campbell Irons

By **Fred Pearce**

HE WAS the janitor who unlocked the secret of how ice ages happen. The sickly son of a poor Scottish farmer, James Croll left school at 13 and became an itinerant labourer and failed salesman. But decades of private reading and an astonishing capacity for original thought saw him soar to scientific stardom. Croll became the father of climate-change research, and corresponded as an equal with the science heavyweights of the day, including Charles Darwin, Lord Kelvin, Arctic explorer Fridtjof Nansen and geologist Charles Lyell. Yet you have probably never heard of him.

His star waned, and his insights about the cosmological causes of the great glaciations sank from view, until revived half a century later by Serbian mathematician Milutin Milankovitch,



modern age?

Croll was born in 1821 and raised on a smallholding on moorland in rural east Scotland, land he worked from a young age. His sporadic schooling ended at 13, but by then he had stumbled across a copy of *The Penny Magazine*, the *New Scientist* of its day. He became hooked on science. By 14, he was reading the great science texts of the time. “At first I became bewildered, but soon the beauty and simplicity of the conceptions filled me with delight and astonishment,” he later wrote in an autobiographical sketch. “I studied pneumatics, hydrostatics, light, heat, electricity and magnetism. I obtained assistance from no one.”

His head was full of ideas, but Croll had no qualifications and no money. At 16, he was a travelling millwright, sleeping in rat-infested barns. Later he became a joiner, before a damaged elbow left him unable to do manual work. He was also, as his step-nephew James Campbell Irons wrote in a biographical appreciation, “heavy and ungainly” as well as “modest, shy, dry and with an almost speechless manner”.

Not surprisingly, then, Croll also failed as a tea merchant and an insurance salesman, and went bankrupt as the landlord of a temperance hotel in a town of 3500 people and 16 taverns. By luck, he eventually found himself a neighbour of the head of Anderson’s University, the forerunner of Strathclyde University. Croll became its caretaker. There, duties done, he would hole up in the library, pursuing the great scientific issues of the day. One of those was the cause of the ice ages.

Geologists had deduced that large parts of Europe had been repeatedly covered in ice, but nobody knew what caused this waxing and waning. There were some theories rooted in astronomical phenomena, but it was Croll’s untutored, free-ranging mind that would crack the conundrum.

By painstaking calculation, he showed that over more than a million years, the glaciations appeared to coincide with the periodic extremes of what astronomers call eccentricity. This variation in the elliptical shape of Earth’s orbit around the sun has only a tiny effect on the total amount of solar radiation reaching the planet. In his greatest insight, Croll proposed that it was enough to trigger substantial indirect cooling of the Arctic – in particular by the diversion of the Gulf Stream, reducing heat reaching the pole. As more ice formed, more sunlight was reflected, causing more cooling. Such amplifying feedbacks underpin estimates of the impact of human-made climate change today.

His ideas were published in 1864 in the *Philosophical Magazine*, a top UK science journal of the day. The paper was attributed to “James Croll, Anderson’s University”. Whether the editors knew Croll was a janitor is not recorded, but soon it didn’t matter. As Croll put it, “the paper excited a considerable amount of attention”.

He was soon corresponding with the great and the good of science. Darwin wrote: “I have never, I think, in my life, been so deeply interested by any geological discussion.” Croll’s paper had, he said, “cleared so much mist from before my eyes”.

In 1867, Croll became secretary of the Scottish Geological Survey in Edinburgh. It allowed him time, despite growing bouts of poor health, to produce a book on his thinking. Published in 1875, *Climate and Time* appeared to seal his reputation as one of the era’s great scientists. Within months, he had an honorary degree from the University of St Andrews, and fellowships



Thomas Günther/Plainpicture

at the Royal Society in London and the New York Academy of Sciences.

Croll published more groundbreaking research: on how glaciers moved, the causes of ocean circulation, and the thickness of Antarctic ice – at a time when scarcely anyone had even set foot on the continent. He also persuaded Darwin that rivers were important agents of erosion.

The high waters of Croll's fame retreated as he became ever more reclusive. Turning down an invitation to lecture at the British Association (today the British Science Association), he wrote: "I dislike all such public displays... there is a cold materialistic atmosphere around scientific men in general that I don't like. I mix but little with them."

His health worsening, he retired in 1880, aged 59. Prime ministers William Gladstone and Lord Salisbury both rebuffed pleas from Darwin, Lord Kelvin and others to give Croll a full civil-service pension. He ended up penurious in rented lodgings in Perth, just streets away from where he bought his first *Penny Magazine*. He died a decade later. He was buried in what is now an abandoned churchyard in Cargill. A worn gravestone lists 14 of his forebears, with Croll and his wife Isabella mentioned last, in the smallest letters, as space on the stone ran out.

## **"An astonishing capacity for original thought saw him soar to scientific stardom"**

One obituary called him "among the foremost, if not the first [investigator] of the physical cause of climatic change". But by then, the salons of science had tired of this testy recluse. Soon, his name and his theories were largely forgotten.

Only in the 1930s were they revived by Milankovitch, who corrected some inaccuracies in what he called Croll's "most remarkable" work. Even so, when ocean-sediment cores taken in the



In the past decade, a handful of Scottish academics have tried to rescue Croll's name. There is now a memorial to him outside the Royal Scottish Geographical Society in Perth.

Croll's fall is usually painted as the result of Victorian sniffiness at the untutored working class. Maybe so. But what is remarkable, says Andrew Dlugolecki at the University of East Anglia, UK, is how much respect he did receive in his heyday, despite his lack of formal qualifications. "Leading scientists corresponded with Croll as an equal. That would probably be impossible nowadays, given the huge emphasis placed on papers in the scientific literature," says Dlugolecki.

And what journal today would publish a paper, whatever its merits, from a janitor with no formal education? *New Scientist* asked *Nature* whether its editors could think of such an upstart in their recent archives. They could not.

*This article appeared in print under the headline "Caretaker who solved the ice age mystery"*

**Fred Pearce** is a consultant for *New Scientist*

Magazine issue 3192, published 25 August 2018