J. BALOG/EXTREME ICE SURVEY

James Balog has developed new photographic equipment to monitor changes in glaciers such as the Ilulissat in Greenland.

Q&A James Balog

Archivist of ice

For six years, photographer James Balog has trained his lens on ice, capturing time-lapse images that have helped scientists to study how glaciers and ice sheets respond to climate conditions. With the documentary Chasing Ice *soon to debut in US cinemas, Balog talks about the loss of landscapes.*

ILLUSTRATION: N. HIGGINS
PHOTO: J. ORLOWSKI/EXTREME ICE SURVEY

Why are you interested in frozen landscapes?
When I was six years old, I had to walk home from school in a heavy snowstorm. It was a great contest between myself and nature. As a young man, I started ice climbing and mountaineering in the White Mountains in New Hampshire. When I looked at photographs of glaciers in Alaska I knew I wanted to spend time there.

When did you start photographing glaciers in time lapse?
After being blown away by the glacial retreat I saw while shooting a *National Geographic* cover story, 'The big thaw', in 2006. The next year I created the Extreme Ice Survey, deploying time-lapse cameras to monitor retreating ice in the Arctic and mountain areas, some so remote that our team was probably the first to visit them. Temperatures could reach −40 °C and the winds 150 miles per hour. We had to tackle deep snow, torrential rain and falling rocks. Off-the-shelf gear wasn't robust enough, and it took six months of experimenting to come up with a reliable time-lapse system. Right now, we have 27 such cameras at 18 glaciers in Alaska, Greenland, Iceland, the Rocky Mountains and at Mount Everest. Shooting every half-hour of daylight year-round, each one generates 8,500 frames per year. The footage provides scientists with information on the mechanics of glacial melting and gives the public evidence of how rapidly Earth's climate is changing.

What is the most dramatic moment you've caught?
Every year there are calving events in which ice falls off glaciers into the sea. The rate of ice loss in Greenland has doubled during the past 20 years, and this summer we've seen unprecedented rates of surface melting. We expected the Ilulissat Glacier on the west coast of Greenland to have a massive discharge of ice, so in summer 2008 two of my team members stood watch for weeks. They caught the biggest calving event ever recorded on film. It was as if the entire lower tip of Manhattan had broken off and fallen into the ocean, like an urban skyline toppling, with skyscraper-sized blocks of ice submerging and resurfacing.

What's the aim of the Extreme Ice Survey?
The problem of climate change is perception. Human brains and our economic system favour the status quo. We aim to collect powerful visual evidence so that people can understand what's really happening.

Portraits of Vanishing Glaciers
Rizzoli International: 2012. 288 pp. £29.95

Chasing Ice
Jeff Orlowski: 2012

When satellites capture retreating glaciers from hundreds of kilometres away, the images may be beautiful but they're removed from human experience. We live on the ground. Retreating glaciers are where you can see climate change as it happens.

What have scientists learned from your images?
In 2006, on the Greenland Ice Sheet, I met glaciologists who said that glaciers are big lumbering things that respond to climate change on a scale of decades or centuries. We have learned that glaciers respond hourly to atmospheric conditions. Our visuals also suggest that subglacial floods may trigger some of the bigger calving events. We have nearly a million pictures in the archive now, although there's a lot of analysis yet to do.

How do you fund the ice survey?
A significant part of our initial funding was from the Expedition Council at *National Geographic*. Nikon gave us hardware. By partnering with scientists, we got help from the US National Science Foundation and NASA. But most of the funding over the past five years has been from private donors. It has been an absurdly difficult project to run without 'big science' government-scale funding and logistical support.

Do you have a science background?
For my master's in geomorphology, I researched Colorado's Big Thompson River flash flood of 1976. But I would not presume to call myself a scientist. When I was finishing my thesis, I remember looking at a stack of manila punchcards and deciding that I'd rather see the world through a camera than through data analysis. The data are incredibly important, but my calling is to understand the world through art.

What next?
The underlying theme of my work is the collision between human needs and nature. I'd like to do more with energy, in part because my grandfather died in a Pennsylvania coalmine collapse. We worked in the Gulf of Mexico after the Deepwater Horizon oil spill and are documenting changes in forest cover in the Rockies. And I am trying to make the ice survey financially stable so that the cameras can keep going for a long time. I feel a tremendous obligation to preserve a pictorial memory of these vanishing landscapes for the people of the future.

INTERVIEW BY JASCHA HOFFMAN

PHYSICS

Modelling Feynman

Daniel Cressey marvels at a gleaming depiction of the subatomic by the world's leading information designer.

All Possible Photons: The Conceptual and Cognitive Art of Feynman Diagrams
ET Modern, New York.
Until spring 2013; official opening 15 September.

Before the explosion in 'infographics' describing everything from cocktail mixology to US health-care spending, there was Edward Tufte.

Tufte, a statistician, is perhaps the world's most celebrated information designer. In *All Possible Photons* at his Manhattan gallery, ET Modern, Tufte has unleashed his love of artistic explanation in a series of sculptures instantly recognizable to anyone with a passing knowledge of particle physics. Minimalist 'graphics' consisting of stainless-steel tubing formed into straight and undulating lines, Tufte's rendering of Feynman diagrams transforms recondite scientific notation into abstract, glinting art. Tufte also plans to show versions more than five metres high at his sculpture park in Woodbury, Connecticut.

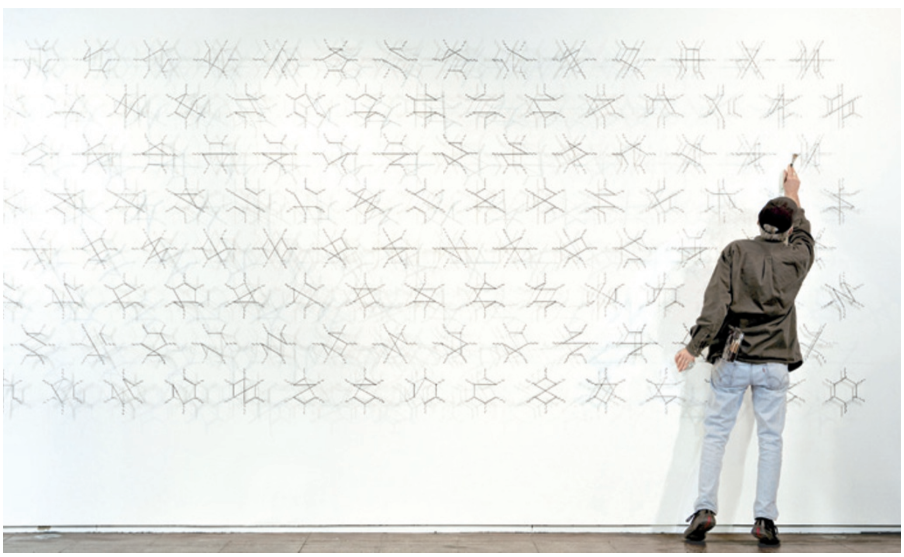
US physicist Richard Feynman created elegant traceries of lines, dots and arrows to describe and predict how subatomic particles interact. Feynman was not unaware of his diagrams' aesthetic appeal, and famously drove a van painted with a selection of them.

Tufte's matt or polished steel sculptures, mounted on the walls, are shorn of explanations as well as much of the detail that makes them scientifically useful, such as arrows and labels. Some are large and dominate their wall space. The most powerful artwork on display is the collection of 120 smaller pieces that give the show its name — a cluster representing all possible space and time paths of a particular interaction of photons. These form what Tufte calls "a complete enumeration of everything that could happen" in that instance.

This isn't the first time Tufte has ventured into Feynman territory. The diagrams feature as models of good design in Tufte's book *Beautiful Evidence* (Graphics, 2006). They are also referenced in one of his enormous *Rocket Science* sculptures of fantastical space probes attached to giant bazooka-style launchers. In the *Airstream Interplanetary Explorer* (2011), the probe is an iconic silvery Airstream caravan adorned with Feynman diagrams. Tufte's contention is that because subatomic particles everywhere in the Universe behave as shown by Feynman diagrams, these could work as communiqués to other worlds. As he has put it, "Better the cosmopolitan verbs of Nature's laws on spacecraft than the local proper nouns of national flags, earthly Gods and Goddesses, and government agency logos."

By focusing on the diagrams alone, the sculptures in *All Possible Photons* bring home the power of Feynman's achievement. There is beauty in his diagrams, but the real deal is what they can potentially describe — which is everything. ■

Daniel Cressey *is a reporter for* Nature.



A. SEVERNY

Edward Tufte adjusts his *All Possible 6-Photon Scattering (120 Space-Time Feynman Diagrams)* (2012).