demonstrate that the periodic system has not been reduced to physics and cannot be deduced from quantum theory.

Scerri pays attention too to the philosophical choices underlying the construction of the periodic table. The chapter on Dmitry Mendeleev's process of discovery emphasizes that Mendeleev had an abstract 'metaphysical' notion of chemical elements that he clearly distinguished from Antoine Lavoisier's view of elements as simple, concrete substances — a conceptual shift first emphasized some 20 years ago. In addition, Scerri has misunderstood the epistemological status of Mendeleev's abstract notion of the element. Far from reviving a metaphysical notion, Mendeleev did his best to promote a positive, if abstract, notion of the element. Not only did he characterize this invisible entity by an individual quantitative property — its atomic weight — but he defined it by analogy with other basic concepts of chemistry, stating that the distinction between the element and simple substance was like the distinction between atoms and molecules.

Scerri is more original in his detailed account of Mendeleev's famous predictions of unknown elements. He revises the usual success story in pointing out that Mendeleev failed as often as he succeeded. He thus discusses a question first raised by Stephen Brush: whether predictions were a decisive factor in the acceptance of the periodic system. Scerri emphasizes the importance of Mendeleev's ability to fit all the elements into the system.

The core of Scerri's argument is to be found in the chapters dealing with the evolution of the periodic system with regard to changes in atomic theory in the aftermath of Mendeleev's discovery. Here Scerri makes a plea for the autonomy of chemistry. He convincingly argues that the abstract notion of the element was crucial to rescuing the periodic system in the light of the discovery of isotopes. He also rightly notes that Niels Bohr's atomic model relied heavily on spectroscopic data, rather than on theoretical calculations. Against repeated claims that chemistry has been reduced to physics, it is always useful to keep in mind that early quantum physics was based on chemical data.

Finally, in considering a variety of visual representations of the periodic system, Scerri advocates a system known as Charles Janet's left-step table, because it rests on the concept of elements as basic substances, rather than on physical properties.

All practitioners of chemistry, from researchers and teachers to engineers, seem have an opinion about what the periodic table should look like, and many of them continue Mendeleev's work in an attempt to propose better graphic representations. Despite the standard format recommended by the International Union of Pure and Applied Chemistry in 1985, with groups numbered from 1 to 18, new tables are invented every year. In 1973, Edward Mazurs reviewed hundreds of visual representations of the table and distinguished 146 structural types. The periodic system, then, is like a monument, forever inviting new creative designs. ■

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SCIENCE IN CULTURE

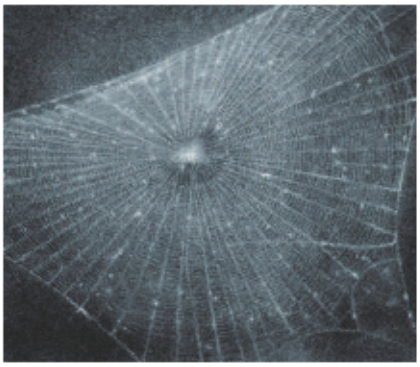
Drawn to nature

Vija Celmins' graphite and charcoal drawings are inspired by the natural world.

Colin Martin

Drawing is central to the work of Latvian-born US artist Vija Celmins. Her haunting, monochrome depictions of limitless expanses of ocean, nocturnal skies and deserts lack a point of reference, such as the horizon, or a depth of field. Usually copied meticulously from photographs she has taken herself, each image takes months to draw. 'Vija Celmins: A Drawings Retrospective', an exhibition originally shown at the Centre Georges Pompidou in Paris and on view at the Hammer Museum in Los Angeles, California, from 28 January (www.hammer.ucla.edu/exhibitions/119), brings together 68 of Celmins' drawings made over a 40-year period.

V. CELMINS/ADAGP, PARIS



V. CELMINS/ADAGP, PARIS

In 1968, Celmins began using photographs of outer space to translate the idea of the night sky into an abstract composition, an approach she then adopted in her ocean drawings. "The sight of the waves miles out, their dutiful and frenetic solitude, their dull indifference to their fate," mused novelist Colm Tóibín in his catalogue essay.

Celmins drew *Untitled (Big Sea #1)* (shown above, left image) in 1969 using graphite on a sheet of paper covered with a light grey acrylic ground, a technique she favours to avoid digging her pencil into paper. By leaving a thin grey border around her images (not shown here), Celmins signals that her subjects are clearly defined objects and not fragmentary images. The subject matter is clearly her photograph, not an actual seascape. "I don't imagine the ocean and try to recreate a memory of it when I'm doing the art," Celmins said in 1992. "I explore a surface through drawing it. The image gets controlled, compressed and transformed."

Over time, Celmins' ocean drawings became denser and she created perspective by using thicker layers of graphite to darken the lower parts of her drawings. Repetition became more significant in her work, and she began producing series of similar images.

In 1983, thinking she had exhausted drawing as her medium, Celmins returned to painting. But she began drawing again in 1994, using a different technique. She applied charcoal by hand directly onto paper, and used erasers to rub through the charcoal to create images by exposing the white surface of the paper.

The subjects of Celmins' latest series of drawings are delicate, light spider webs, shown against dark charcoal backgrounds. *Web #1* (shown above, right) from 1998 conveys the translucent quality of a web in an image that has a sense of discovery and wonder. The series was inspired by a scientific publication, James Henry Emerton's 1902 book *The Common Spiders of the United States*. "If I wasn't an artist, I think I would have liked being a scientist," said Celmins.

Colin Martin is a London-based writer.