The periodic table of the elements: all life, clever and ugly, is found here

A new book celebrates the unruly tale of the periodic table and man's war over the elements. By Sam Kean.

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Shell Age of Energy: aiming for a new agenda Photo: AFP/GETTY
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The periodic table – that set of boxes you remember hanging on the wall of your chemistry class – is many things. It's an invaluable tool for organising the building blocks of the universe. Its columns and rows are a microcosm of the history of science. And it's also a storybook, containing all the wonderful and clever and ugly aspects of being human.

From simple hydrogen at the top left to the man-made impossibilities at the bottom that can only be conjured into existence for fractions of a second, the periodic table describes every single known element: the chemical substances that, separately or combined, make up everything we can see or sense around us. We eat and breathe the periodic table; people bet and lose huge sums on it; it poisons people; it spawns wars.

Some elements have been important since the early days of civilisation: humans have always lusted after gold, while iron helped remake societies. The elements also found more humble uses: Ancient Egyptians lined their eyes with cosmetics made from antimony, and the Romans relied on mouldable lead pipes to deliver water into their homes.

However, simply relying on the elements we found around us was never enough. For thousands of years, alchemists – up to and including Isaac Newton – attempted to unearth new elements, and study their properties, under all kinds of unusual conditions. Hennig Brand, a German alchemist, was the first to succeed for centuries, when in 1669 he boiled down urine to discover phosphorus. But it was not until the late 1700s that our knowledge of the elements really took off, as chemists developed new ways to purify and isolate elements. Such research was, in terms of the technology of the time, incredibly cutting-edge. Sir Humphry Davy, one of the most successful at this pursuit, has been compared to a big-game hunter, wowing the public by bagging sodium, magnesium, boron, chlorine and more.

The discovery of dozens of elements brought new challenges for scientists. Biology had the Tree of Life, which linked the various species and phyla – but did anything similar exist to organise the elements? Or were they inherently chaotic, a jumble of substances that could be arranged equally well by any old trait?

The answer, of course, was that there was a pattern – and it's embodied in the periodic table. This is a brilliant tool because it provides a natural way to order the elements: each one has its fixed spot (based on its "atomic number"), and elements with similar characteristics appear in the same column on the table.

In fact, scientists discovered so many new elements with so many similarities that six separate people came up with the idea of the table independently in the mid-1800s, listing elements based on how they behaved and reacted with each other.

So why do most people today only know about one of those six, Dmitri Mendeleev – a Russian chemist who published his first table in 1869, years after his rivals? His biography helped. The youngest of 14 children, Mendeleev was orphaned as a teenager and grew up into a long-bearded radical (and bigamist). He published his first periodic table only because he fell behind his publisher's deadline, and needed a concise way to summarise his knowledge of the elements – and even then, he had to ignore a job inspecting local cheese factories to finish the book.

Mendeleev was, however, brilliant. Although he came late to the periodic table, he incorporated the most elements into his version, and used it to predict the existence of substances, such as gallium and germanium, that had not yet been discovered. In a way, his work is similar to Darwin's on evolution: neither man did all the work, but they did the most, and they did it more elegantly than others.

After Mendeleev, a number of scientists helped fill in and refine the periodic table. These included Marie and Pierre Curie in Paris, who studied radioactivity and discovered a glow-in-the-dark element, radium, that spawned a legitimate craze. There was also Ernest Rutherford, who figured out the structure of atoms and discovered how one element can "transmutate" into another – the dream of the alchemists finally come true.

Perhaps even more talented than Rutherford was his student at the University of Manchester, Henry Moseley. Before Moseley, scientists knew that the periodic table worked, but couldn't understand why the elements sat in the spots they did – especially because some (like cobalt and

nickel) didn't line up exactly by weight, and had to be switched around to fit in columns with similar elements. Moseley ended the confusion by linking an element's spot to its positive charge. (In modern terms, we'd say that as you move left to right on the table, each new element acquires one more positively charged proton in its nucleus.) The elegance and depth of his experiments were remarkable for a 25-year-old, but Moseley had little time to enjoy his success: he died two years later at Gallipoli. A colleague claimed that his death alone ensured that the war would go down as "one of the most hideous and most irreparable crimes in history".

Moseley's death, however, was not the only interaction between warfare and the periodic table. During the First World War, the metal molybdenum, when sprinkled into steel, vastly improved the stresses and temperatures that German howitzers could handle. Its cousin, tungsten, played a similar role for the Nazis.

More recently, demand for the element tantalum – a component of mobile phone circuits – intensified a horrific civil war in the Congo. Congo controls 60 per cent of the world's tantalum supply, and the spike in demand for mobiles in the late 1990s enriched those who ran guns and funded militias. Phone-makers have since found new sources of tantalum, but a large fraction of the war's 5 million deaths can be laid at its door.

Other element-driven crises may await us. The discovery of trillions of dollars of elemental wealth in Afghanistan, if not properly managed, may further destabilise that country. Many agricultural scientists fret that the world supply of phosphorus – essential in fertilisers – has started to decline, and there's no ready substitute.

There's also the issue of energy supplies, as scientists worldwide try to eliminate the use of carbon. Some see promise in lithium batteries, others in hydrogen fuels. Many alternative energies rely on "rare earths" (elements 57 to 71), to be found in catalytic converters, superconductors, solar panels, wind turbines, energy-efficient light bulbs and the engine of a Toyota Prius. All of these technologies have drawbacks – which is why, if the periodic table was a betting board, you'd find stacks of chips all over it.

Scientists added the latest element – number 117, called "ununseptium" – earlier this year. But creating new elements nowadays is very difficult, given that the heaviest can only be created – in incredibly small quantities – by manipulating fragile nuclear material, and disintegrate in milliseconds. So, in one sense, we may be nearing the end of the periodic table. Yet its wonders remain inexhaustible. We're constantly learning new things about old elements. Nothing short of the explosion of our sun billions of years from now – and the vaporisation of the Earth that will follow – will wipe it from our consciousness. And even then, the 92 natural elements that make up our solar system will likely drift across the universe, and become fodder for new planets, new life forms and stories we can't even imagine.

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'The Disappearing Spoon' by Sam Kean, published by Little, Brown, is available from Telegraph Books for £16.99 plus £1.25 p&p. Call 0844 871 1515, 0844 871 1515

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