THE ELEMENTS

A VISUAL JOURNEY AROUND THE PERIODIC TABLE

BY HUGH ALDERSEY-WILLIAMS INCLUDING AN INTERVIEW WITH GRAPHIC DESIGNER DAVID SMITH

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THE ELEMENTS:

A VISUAL JOURNEY AROUND THE PERIODIC TABLE

This essay is published in association with the touring exhibition: **ELEMENTS: THE BEAUTY OF CHEMISTRY**, created by Science Gallery, Trinity College Dublin on the occasion of the Tercentenary of the School of Chemistry at Trinity College Dublin.

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The exhibition, launching in the International Year of Chemistry, is curated by David Grayson, Daniel O'Donovan, Hugh Aldersey-Williams and Michael John Gorman, and is a partnership between Science Gallery, Trinity College Dublin and the BergamoScienza festival, with the assistance of researcher Brigid Lanigan and advisor Silvia Giordani.

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To explore the **ELEMENTS** exhibition visit **www.sciencegallery.com/elements**

CONTENTS_

THe PEriOdic Table Does Not ExiSt_

THE RAW MATERIALS OF EVERYTHING

Let's get one thing straight from the start. The periodic table does not exist. The chemical elements exist, but the periodic table of the elements that we are all taught about at school, in ways more or less inspired, is no more than a representational convenience.

The chemical elements do have a natural sequence. What makes one different from another is the number of protons in the nucleus of its atoms. Starting with the lightest of them, hydrogen, which has a single proton, each subsequent element (helium, lithium, beryllium and so on) contains one more proton. This continues all the way up to the more than one hundred elements we know today. This fundamental fact allows us to rank the elements according to their atomic weight. It places them in a linear order, but it does no more than that. This alone does not lead us to the familiar two-dimensional grid of squares that we call the periodic table, which is in the end simply a brilliant visual aid, with less truth about it than the average map.

'**ELEMENTS**: THE BEAUTY OF CHEMISTRY' explores both the iconic nature of the periodic table and the attraction and utility of the elements that lie behind it.

The periodic table is the invention of the Russian chemist Dmitrii Mendeleev. In the 1860s, Mendeleev was writing a textbook for his students at St Petersburg University. Aware of the growing number of chemical elements that had recently been discovered, he wished to bring some order to what was fast becoming an unruly jumble. The story goes that he sat down at his desk with the names of all the known elements written out on cards in front of him, and began to shuffle them around as in a game of patience. He knew it was important to keep in mind their natural order by atomic weight. But he also started to group them according to their chemical similarities. Corrosion-resistant metals such as gold and silver went together. Pungent-smelling elements like chlorine, bromine and iodine did too. In this way, he began to assemble a two-dimensional array.

IT IS MENDELEEV'S TABLE THAT HAS SURVIVED AS THE ONE THAT MAKES THE GREATEST SENSE OF THE CHEMISTRY OF THE ELEMENTS.

But not everything made sense. In some areas, there seemed to be too few elements. Mendeleev's stroke of genius was to dare to leave gaps in his table for elements

that hadn't yet been discovered. This supremely confident gesture was the key to Mendeleev's triumph. From 1869, when his table was first published in his long-awaited textbook, until his death in 1911, he had the unique pleasure of hearing the news from time to time that a chemist in Germany or France or Sweden had found a new element to fill one of these gaps.

Many people think of Mendeleev's periodic table as a scientific discovery, rather than an invention. Yet it was and remains simply one table among many candidates. It has two dimensions because of the necessary constraint of putting it down on paper so that it could appear in a textbook.

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THE ELEMENTS HAVE ALWAYS BEEN FASHIONED, TRADED, EXCHANGED, ADMIRED AND WORSHIPPED.

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During the mid-nineteenth century there were quite a few competing tables of the elements. Many scientists had noted strange relations among the elements, but had usually come unstuck by attaching too much importance to the numbers that appeared to govern these relations. These tables have fallen into obscurity. Others are still devised from time to time even today, including ones that use more than two dimensions.

It is Mendeleev's table that has survived as the one that makes the greatest sense of the chemistry of the elements. In its 142 years, it has required only one major modification – the addition of an extra column on the right to accommodate the chemical group of elements known as the noble gases, which were unexpectedly discovered around the turn of the twentieth century. Even the heavy, radioactive elements discovered since the Second World War have slipped obediently into place in Mendeleev's design. Small wonder, then, that this table has become a graphic icon. We remember it, happily or not, from the schoolroom. But it now adorns coffee mugs, tee-shirts and shower curtains, where chemical knowledge is absolutely not required. It is exploited by renowned contemporary artists such as Damien Hirst and Simon Patterson. It prompts questions for quizzes and titles for books. It has inspired innumerable variations on the internet where there are periodic tables of biscuits and swearwords and much else besides. If there's one thing we love more than a system of order, it seems, it's making a mockery of that system.

There would be no need for a periodic table at all if we didn't know that there is something truly special about the elements, that these are forms of matter which demand to be collected, organised and presented as some kind of complete system.

The idea that the material world is not merely made up of matter, but of particular types of matter, is very old. From the idea that all matter might be made up of versions of a single basic material, perhaps

water, the Greek philosopher Empedocles developed the notion that there were four elements, adding earth, air and fire to water. Aristotle added his authority to this concept such that it persisted for 2,000 years. As a theory of matter, it was sufficiently robust that it appeared with minor variations in most ancient philosophies. It slotted in to a fourfold view of the world that also included the cardinal directions and the agricultural seasons.

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IT IS THE ELEMENTS THAT GOVERN OUR LIVES, NOT THE PERIODIC TABLE.

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The four elements comprised different combinations of four 'principles': heat, cold, wet and dry. And they corresponded neatly with the four bodily humours that dominated medical understanding for most of this period.

With the birth of modern chemistry, however, it began to be understood that this scheme was no longer sufficient to explain the full variety of matter. For example, it was clear that metals, while they were extracted from the earth, were not themselves earth. The air we breathe was obviously not the same as the fumes of volcanoes or the gas that bubbles out of swamps.

In the late eighteenth century the French chemist Antoine Lavoisier was engaged in assaying his country's mineral waters. This investigation led him to a highly significant sequence of discoveries. Different waters contained different solid salts, and from these salts it was sometimes possible to extract different metals. Water itself was also separable into two gases with distinct properties, hydrogen and oxygen, and so even water could no longer be regarded as an element. In the year of the French Revolution, 1789, Lavoisier drew up a list of 'simple substances' that included these newly discovered gases, as well as twenty-one other substances now confirmed as elements, and eight more substances with distinctive chemical behaviour that he was sure contained new elements that would be obtained in their pure state just as soon as a suitable technique was found for converting them.

Mendeleev's table, assembled eighty years later, counted sixty-three named elements (and four gaps). Today, there are 112 named elements. In June 2011, scientists at the Joint Institute of Nuclear Research confirmed the existence of two new arrivals, numbers 114 and 116, which now await official naming.

In many cases, what we know now as an element in the scientific sense has long held importance or fascination simply as a material. The elements have always been fashioned, traded, exchanged, admired and worshipped. This is true of the few elements known in the ancient world: antimony, arsenic, carbon, copper, iron, gold, lead, mercury, silver, sulphur, tin. And, though we don't always realise the fact, it continues to be true of those elements discovered since.

118

It is the elements that govern our lives, not the periodic table. The periodic table is helpful to chemists – though not consulted by them as often as you might think – and greatly relied upon by bad chemistry teachers, who seize upon it as something for their students to memorise. But behind the hieroglyphics of the chemical symbols there are these real substances – useful or obscure, vital or dangerous, beautiful or obnoxious.

It is these substances that we celebrate above all in **ELEMENTS**: THE BEAUTY OF CHEMISTRY. The involvement of the elements in our lives is reflected in our window feature, 'Element of the Day', which will have put the spotlight on more than half of all the elements in the periodic table during the run of the exhibition. Meanwhile, one gallery is given over to 'Portraits' of a selection of the elements, chosen as some of those we know not so much from school lessons in chemistry but more deeply through our culture.

IT IS ALSO ASSOCIATED WITH IMMORTALITY, WHICH COMES FROM THE ELEMENT'S FUNDAMENTAL PROPERTY THAT IT IS VIRTUALLY IMMUNE TO CHEMICAL ATTACK – IT IS FOUND (IF YOU'RE LUCKY) IN ITS NATIVE STATE AND IT LASTS FOREVER.

Many of the elements carry with them a rich symbolism. This symbolism arises, as it must, ultimately from these elements' unchanging physical and chemical properties. This applies, of course, to the elements we have known for thousands of years. To take perhaps the most obvious example, gold has long been associated with riches, as the story of King Midas reminds us. Investors still flee to gold when other propositions seem too risky. Yet this need not be the case. It is our cultural decision that we hold gold in such esteem. Why gold? The element is seen as valuable both because it is rare and because it is unique in appearance, being the only yellow metal. It is also associated with immortality, which comes from the element's

GOLD, Au
SIREN, MARC QUINN
PHOTO:MARC QUINN STUDIO

fundamental property that it is virtually immune to chemical attack – it is found (if you're lucky) in its native state and it lasts forever. From these two qualities – its rare appearance and its permanence – come further associations with kings and gods. The alchemical symbol for gold is a circle. This represents the yellow sun, but also symbolises perfection and completeness. (The symbol for silver, neatly enough, is a half-circle, depicting the moon, and indicating the imperfection that becomes apparent when the white metal tarnishes to black.) The meanings we have conferred on gold are now deeply embedded and almost universally shared around the world, so that it is the automatic choice for wedding rings (symbolising the permanence of marriage) and national reserves of wealth. Sometimes, just the word is enough to signify value, as when 'luxury' products as banal as chocolate and toilet paper are branded 'gold'.

When artists work with gold today, they do so knowing all about this cultural baggage. A piece such as Marc Quinn's 'Siren' – a life-size sculpture of the model Kate Moss made in 2008 for a temporary exhibition at the British Museum – raises questions about the popular worship of celebrities precisely because it triggers our memory of more ancient gold representations of deities and potentates such as the Buddha and Tutankhamun. Yet an element need not be highly valued in monetary terms to earn its place in our culture.

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AN ELEMENT NEED NOT BE HIGHLY VALUED IN MONETARY TERMS TO EARN ITS PLACE IN OUR CULTURE.

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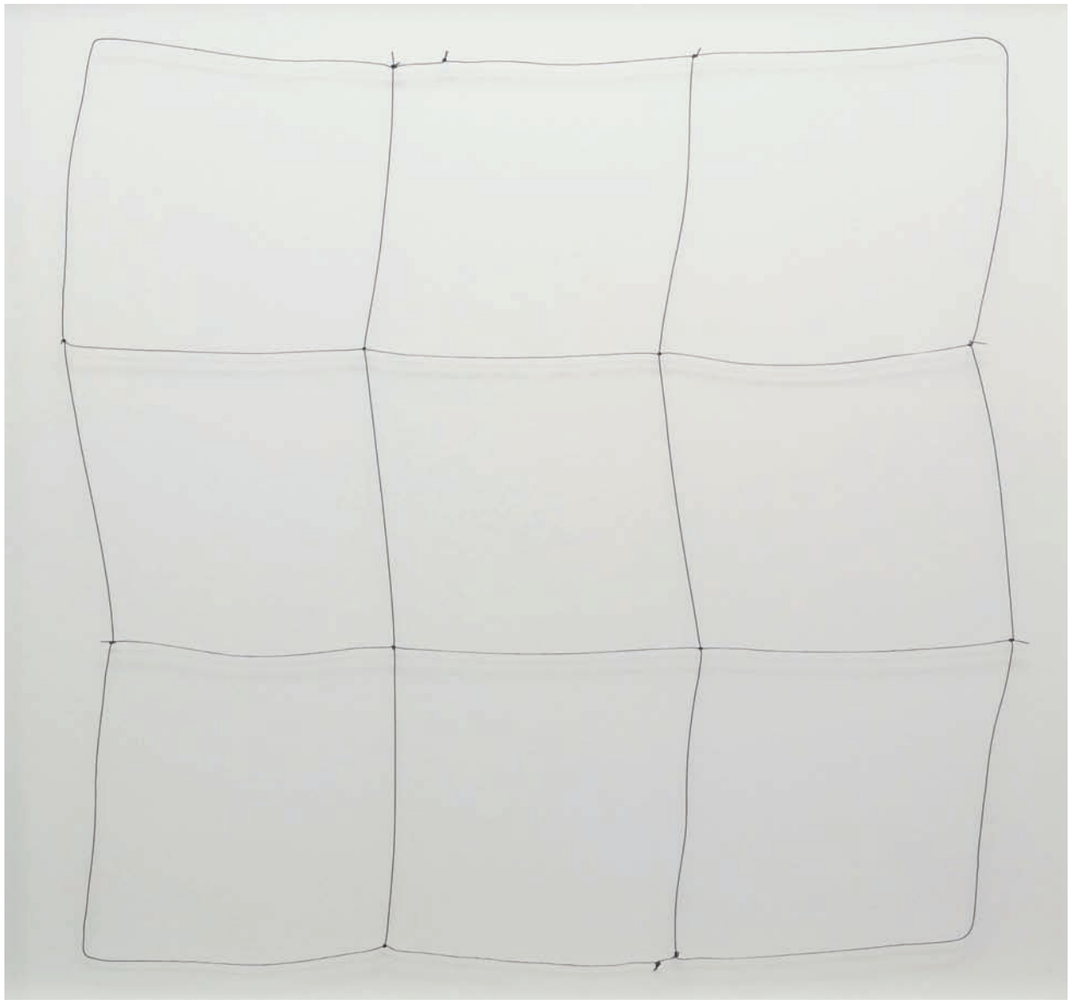
Of all the metals, lead lies at the opposite extreme. It is the base metal which the alchemists strove to transmute into precious gold. The yellow oxide that forms as a crust on the surface of the metal as it melts was thought to be a promising sign of this change.



LEAD, Pb
BULLET DRAWING 2011, CORNELIA PARKER

COPPER, Cu
UNTITLED S.158, RUTH ASAWA
PHOTO: LAURENCE CUNEO

But it is for its own qualities that we ought to appreciate lead. It is heavy and soft, which makes it easy to work, and it has a tendency to develop a protective coating of white, which dulls its shine but effectively prevents it from corroding away. This suits it to many uses – for roofs and drains, for sarcophagi and casings for relics. Dublin's Christ Church Cathedral keeps the heart of Saint Laurence O'Toole in a plump leaden casing itself shaped like a stylized heart, one of many such preserved remains.

Because of its density, lead is linked with death and fate in many customs. The Romans used dice made of lead. In parts of Central Europe, they pour molten lead in order to tell fortunes from the shapes it makes when it solidifies. Lead is never more fateful than when it comes in the form of a bullet. By drawing the lead from a bullet into a thread the artist Cornelia Parker connects this fate with the thread of fate in Classical mythology.

Copper is poised somewhere between gold and lead in our affections. Like gold, it has a unique appearance, beautiful to some, the only red metal. Some New World cultures even value copper more highly than gold, not so much because of its colour as for its brassy smell, produced by reaction with oils left by human touch.

However, it is for its utility that copper has been mainly prized, and continues to be so today. It is highly conductive of both electricity and heat, and more important still, may be drawn into the fine wires by which our energy and communications are carried. It is this property of the element that inspires the woven copper sculptures of Ruth Asawa.

CALCIUM, Ca
HUMAN TARSUS
PHOTO: RUŽA LEKO

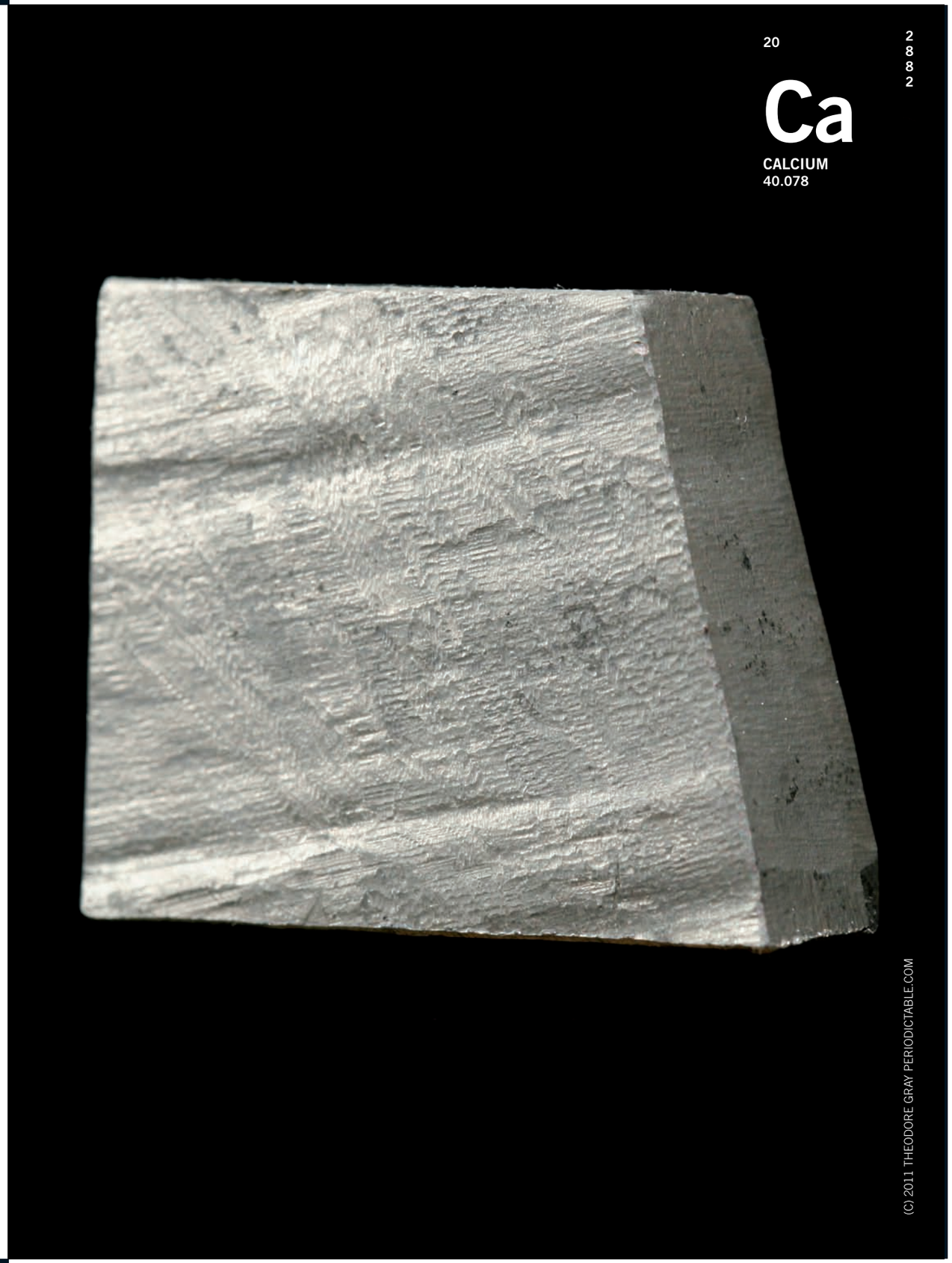
As the only liquid metal, mercury is more obviously special. Yet this enchanting element is fast being excluded from our daily lives because it is also very poisonous. From 2009, it has been forbidden under European Union law to sell traditional mercury thermometers and barometers, while Scandinavian countries have banned the use of mercury amalgam dental fillings.

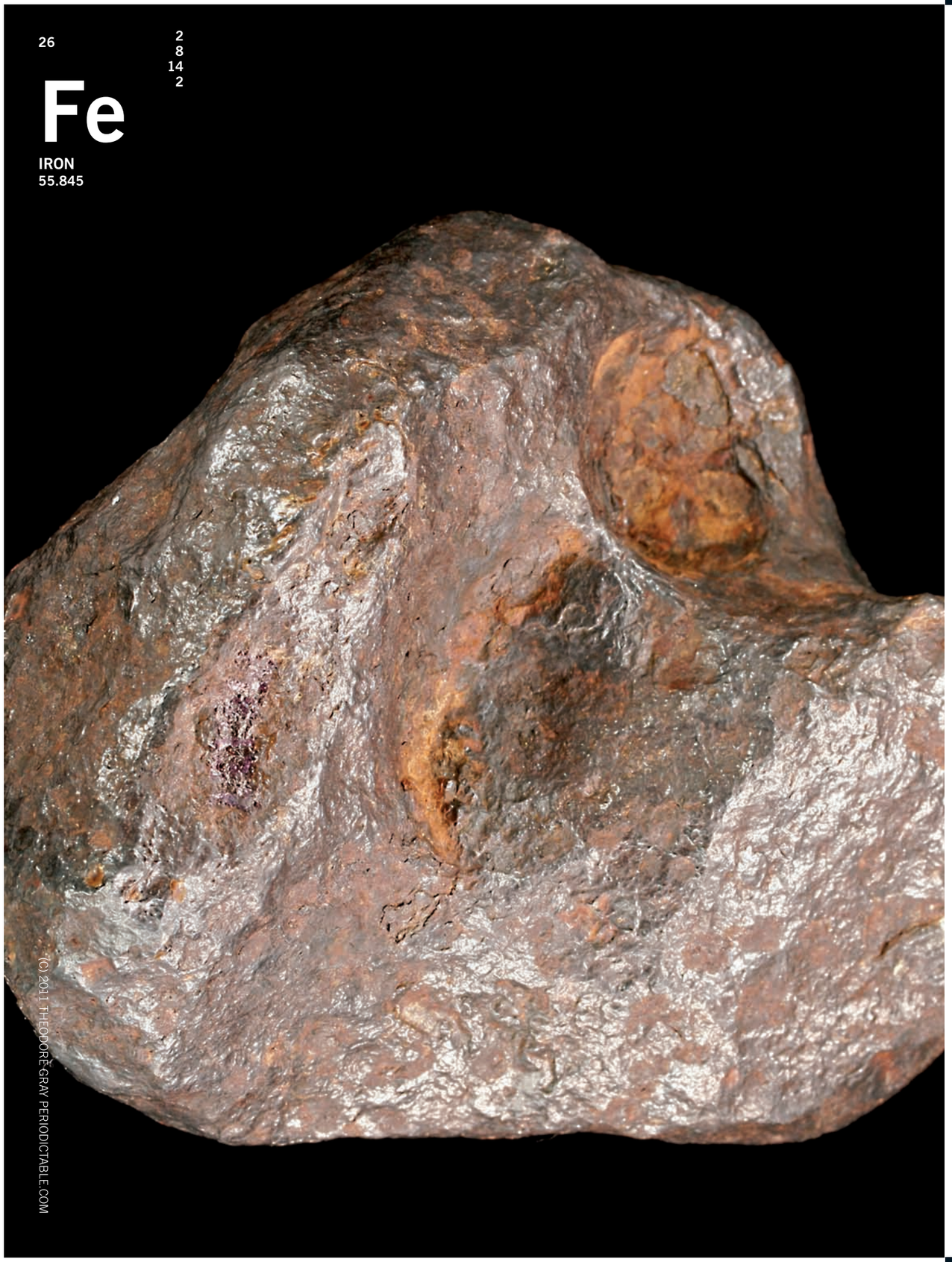
It's becoming hard to believe that mercury in fact has a distinguished medical, religious and artistic history. It was notoriously prescribed in the treatment of syphilis and other diseases and, surprisingly perhaps, is still used in some leukaemia treatments. The belief that this unique metal has special powers is very old. Bowls of mercury have been found in Egyptian tombs dating back to 1500 BCE. It was thought to prolong both life and afterlife both here and also in Chinese culture because its liquid nature is suggestive of life, hence the element's alternative name of quicksilver. Santería, an Afro-Caribbean religion, requires mercury to be scattered around the home to dispel evil spirits – not a practice that would be encouraged by today's health and safety legislation. Just as dangerous were the pools of mercury once favoured as garden ornaments in Moorish Spain, where visitors could dabble their fingers in the liquid metal and send sunbeams reflecting round the courtyards. The safe way to celebrate mercury today is perhaps to follow the example of the artist Anish Kapoor, whose Cloud Gate, a massive sculpture in Chicago's Millennium Park was inspired by the appearance of a droplet of mercury but is in fact made of polished stainless steel.

Many more of the elements we know best not in their uncombined or elemental form but as compounds in chemical combination with other elements. When we worry about our sodium intake or anti-oxidants it is not the pure elements sodium and oxygen that we have in mind but their chemical compounds that enter and emerge from our bodies.

Most of the elements have some role in human biology. Quite a few play a major part, but many others are taken up in trace amounts, and often their exact biochemical function remains poorly understood.

Two such major elements features in the 'Portraits' – carbon and calcium. Both are chemically locked in to the cycles of life. After oxygen, carbon is the most abundant element in the human body,





a principal constituent of our tissue and our DNA. We obtain it in the form of food and lose it in the carbon dioxide in our breath. To convert this biological carbon into elemental carbon takes nature millions of year. Today, that process can be artificially accelerated such that some people now request that their remains be preserved not as bones or ashes but with their body carbon converted into diamond.

Calcium is involved in another natural cycle that connects the animal and mineral worlds. The chalk layers of the earth are the remains of shelly sea creatures, while our own bones depend for their strength on calcium in food courses that draw on these deposits. As it happens, both elements have long been vital in human culture too. As charcoal and chalk, carbon and calcium were the raw materials for the first black and white marks we made in the world. Our similes for black and white – black as coal, black as soot, bone white, alabaster white – still refer to these elements.

Iron likewise has both biological and cultural importance. Combined in the haemoglobin molecule, it is the element that colours our blood red. This has made it the symbol of war, the element of mars. Since the Industrial Revolution, however, iron has been more visible as a symbol of human technological achievement – the material of ships and bridges and the railways.

COMBINED IN THE HAEMOGLOBIN MOLECULE, IT IS THE ELEMENT THAT COLOURS OUR BLOOD RED THIS HAS MADE IT THE SYMBOL OF WAR, THE ELEMENT OF MARS.

The work of the sculptor Antony Gormley – who has in the past used his own blood as a medium – references all these meanings. His famous Angel of the North – a heroic winged human form twenty metres tall, in Gateshead, England – lionizes the men who once built great ships in the area. It is a past-tense work because the iron is not shiny and new,

IRON, Fe
MEME CXV, ANTONY GORMLEY
PHOTO: STEPHEN WHITE, LONDON

ARSENIC, As
WALLPAPER SAMPLE, WILLIAM MORRIS

but rusted, closer to the blood of men. In his new work with iron, the Meme series of 2007–11, one of which is included in **ELEMENTS**: THE BEAUTY OF CHEMISTRY, Gormley continues this exploration. The miniature human figures that make up the series are abstracted in a number of rectangular blocks. Some of the figures stand upright, but when one is crouched, as is the piece shown here, it is easily read first as a mere heap of scrap iron.

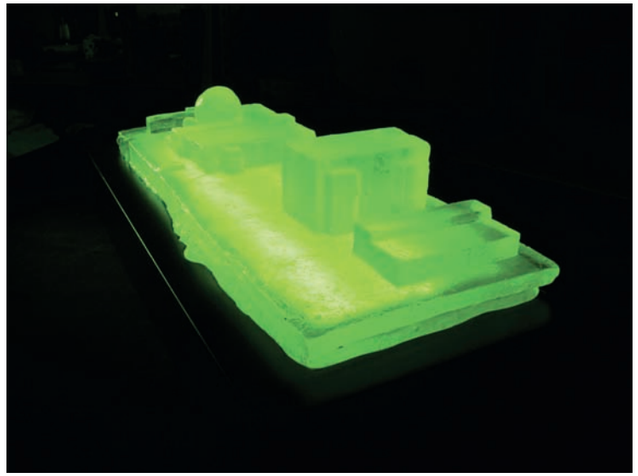
Like the blood and rust of iron, several other elements are also known to us chiefly through their colourful compounds. In the exhibition we focus on two – cobalt, which gives us the distinctive rich blue of ceramics and glass, and arsenic, whose bright green compounds once made them highly popular among decorative artists. Even such champions of natural dyes as the Arts and Crafts pioneer William Morris could not resist the appeal of arsenic for his wallpaper patterns. Arsenic is of course better known to us now as a poison. The form of the element used to kill vermin was a white oxide, also used by murderers and suicides. When it began to be suspected that the green salts used in wallpapers and home decor were poisonous as well, a dispute broke out between medical campaigners and the manufacturers. Eventually, Morris and others were obliged to find safer dyes.

When stimulated by an electrical discharge, the elements may be made to emit light. This light has a characteristic set of colours for each element, like a personal signature, and is called an atomic spectrum. The spectrum of hydrogen has many colours, which we see as white light. This is the origin of the light of the sun. But some elements produce spectra where one colour predominates. The elements sodium and neon loom large in film and literature because of their distinctive spectral colours of yellow and red respectively, which in turn gain specific meanings.

Ever since it began to be used for street lighting in the 1930s, sodium light has been taken as a sign of not always happy urban sophistication. Jean-Paul Sartre, Tom Wolfe and J. M. Coetzee are among the varied writers who have exploited it in this way. The poet John Betjeman was an early critic, ranting against the ‘yellow vomit’ thrown out by the new concrete ‘gallows overhead’. Neon is one of the group of elements known as the noble gases.

These gases – also including argon, krypton and xenon – fill the gas discharge tubes used to make illuminated advertising signs. This light also provides a visual shorthand, especially in stories set in the American West. Neon light is superficially warm and welcoming, but it has a sinister undercurrent, instantly sensed when we see a flickering 'motel' sign in a horror movie.

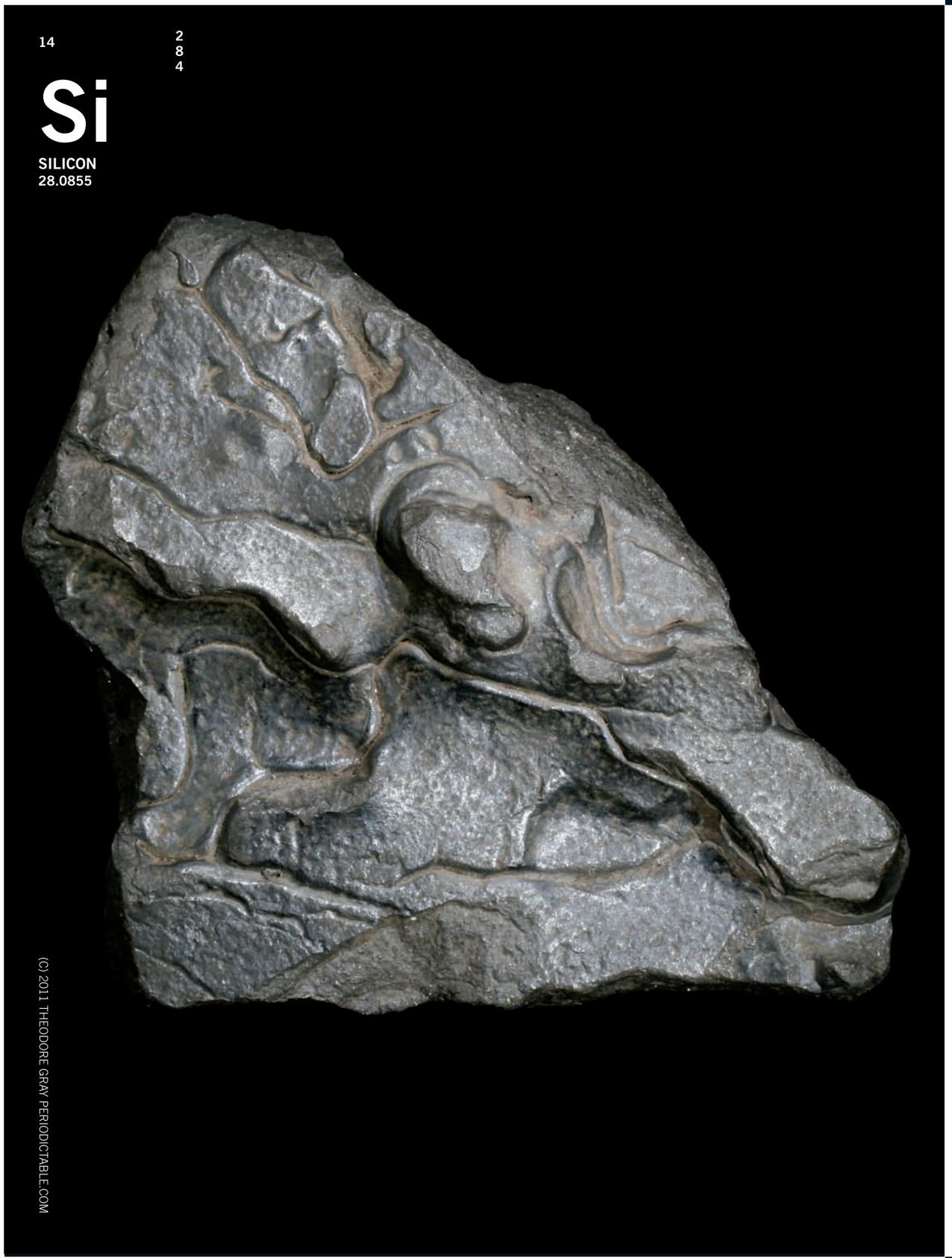
Many artists have chosen neon as their medium. By exploiting its iconic familiarity for their own more mysterious messages, they question the mindless consumerism for which it usually stands. Neon, the element, has made its mark in this way so effectively that 'neon' is now a byword for this kind of communication. Yet, as Sarah Blood's illuminated sign using argon gas in this exhibition reminds us, not all 'neon' is actually neon.



URANIUM, U
SIZEWELL, KATE WILLIAMS
PHOTO: KATE WILLIAMS

URANIUM AND PLUTONIUM, FOR EXAMPLE, ARE ELEMENTS MOST OF US WILL NEVER SEE, YET WE KNOW THEIR NAMES AND WHAT THEY PORTEND.

Some of the elements go still further, exerting an influence over our lives in more metaphorical ways. Uranium and plutonium, for example,



are elements most of us will never see, yet we know their names and what they portend. Kate Williams's ominously glowing model of a nuclear power station cast in uranium glass reminds us prettily of these new fears. These elements are our new touchstones of evil, a role perhaps taken over from the devil's traditional element of sulphur, which features repeatedly (as brimstone) in the more apocalyptic passages of the Bible. Silicon is another element we see rarely even though we talk about it a lot.

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THE PRIME EXAMPLE OF AN ELEMENT THAT ROSE TO POPULAR CULTURAL FAVOUR HAS TO BE RADIUM.

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Silicon has become our byword for electronic high technology. Surprisingly, for an element first isolated nearly 200 years ago, it entered daily usage only recently, when the trade magazine Microelectronic News coined the phrase Silicon Valley in 1971. The label stuck, although unlike many other elementally inspired place names in the United States (from Boron, California, to Sulphur, Oklahoma) it does not actually appear on maps. Nevertheless, it has spawned many hopeful imitators, including, inevitably, Ireland's own Silicon Bog. The prime example of an element that rose to (and then fell from) popular

SILICON, Si
UNPRINTED INTEL SILICON WAFERS
PHOTO: RUŽA LEKO

RADIUM, Ra
ARTEFACT FROM THE RADIUM CRAZE
PHOTO: RUŽA LEKO

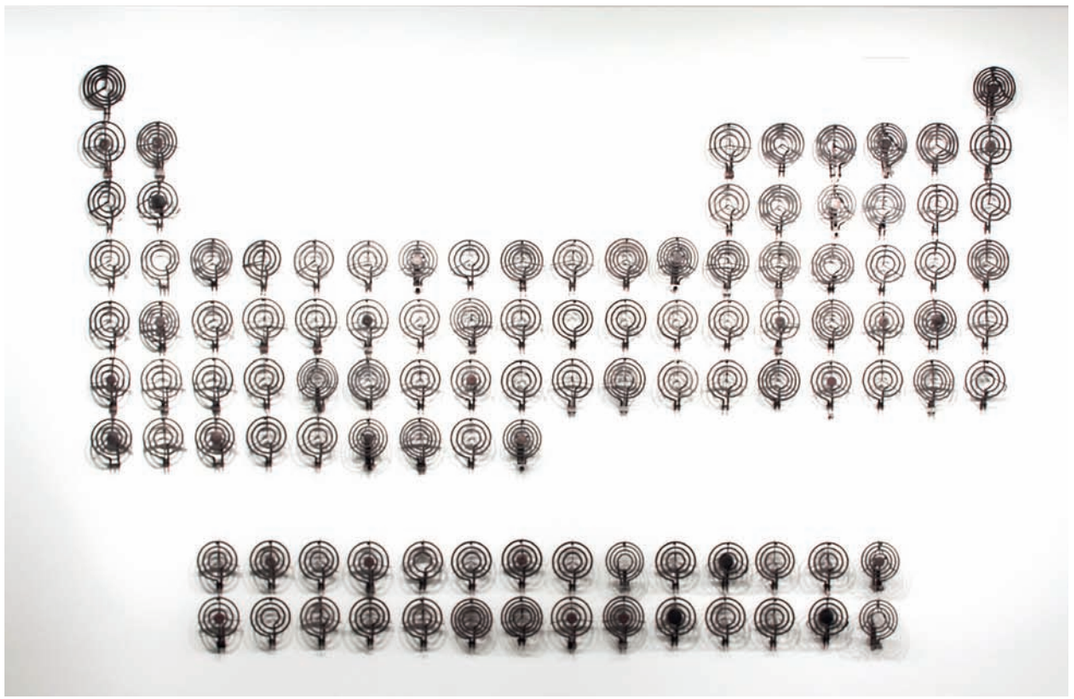
cultural favour in this way, though, has to be radium. Discovered in 1898 by Marie and Pierre Curie, radioactive radium was soon found to be useful in the treatment of cancer.

The buzz around this 'miracle cure' grew to such an intensity that before long people were selling not only radium bathwater preparations, radium toothpaste and radium contraceptives, but also items such as 'radium' beer and razor blades where the chemical element itself was never actually present. The word alone was enough. Radium had become a brand. Only once it was realised that radium actually posed a very serious danger to health did this allure gradually fade.

Our readiness to be persuaded that a particular novel element has value beyond its value as a commodity has not faded, however. Somehow we know that a platinum credit card is more covetable than a gold one, even though neither element is present in them. We know we are expected to be impressed by a car or a computer branded 'Titanium'.

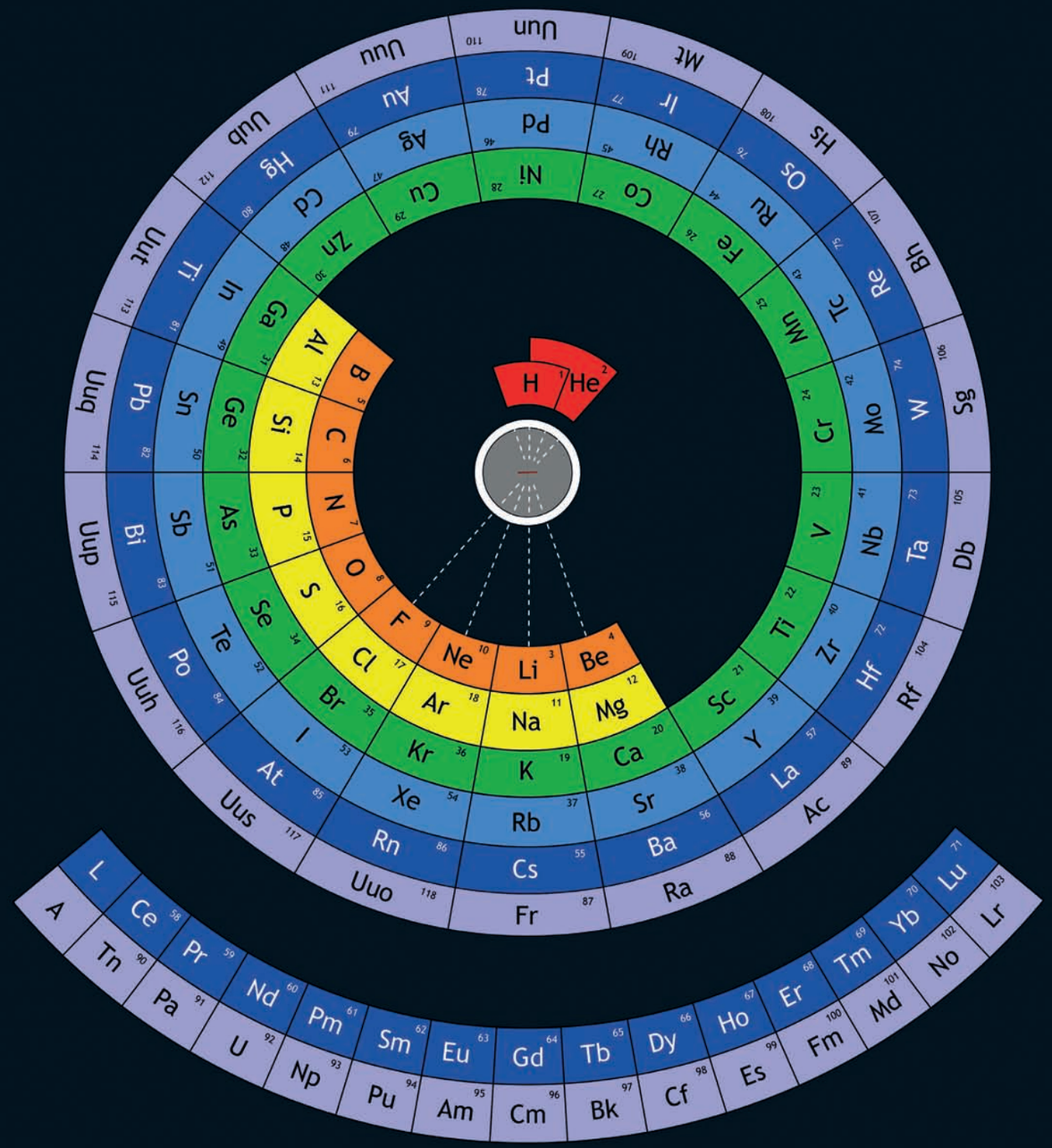
This, today, is the power of the elements. More and more of the elements are increasingly essential in material ways – once obscure elements such as samarium now used in the powerful magnets of our mobile devices, and a fluorescent salt of europium even incorporated as a security feature into our euro banknotes, for example. But they are also present in our art and literature, language and metaphor. The elements, it is clear, belong not behind laboratory doors, but to us all.

HUGH ALDERSEY-WILLIAMS



I DON'T THINK YOU UNDERSTAND THE WAY I FEEL ABOUT THE STOVE, DAVID CLARKE

PHOTO: DAVID CLARKE



The circular form of the periodic table was designed by Mohammed Abubakr, ECE, GRIET, Hyderabad, India

MICHEL JOHN GORMAN [Mjg] IN CONVERSATION WITH DAVID SMITH [Ds]

MICHAEL JOHN GORMAN

Michael John Gorman is the Founding Director of Science Gallery (www.sciencegallery.com) an innovative cultural space bridging art and science at Trinity College Dublin. He has curated and co-curated fourteen exhibitions relating to the intersection between art and science. Michael John is also Coordinator of the StudioLab project, a major European project bridging art and science involving hybrid spaces throughout Europe including Science Gallery, Le Laboratoire, Royal College of Art, Ars Electronica FutureLab and Medialab Prado, and an Adjunct Professor in Engineering and Computer Science at Trinity College Dublin. His publications include Buckminster Fuller: Designing for Mobility (Skira/Rizzoli, 2005), A Mysterious Masterpiece: The World of the Linder Gallery, with Lawrence Weschler and others Alias 2009, and many articles on aspects of the relationship between art and science in journals including Leonardo, Nature and Science.

DAVID SMITH

David Smith is the Programme Leader of the BA(Hons) Visual Communications at the Institute of Art, Design and Technology in Dun Laoghaire. He is principal designer and creative director of Atelier David Smith and one of a select group of current Irish based practitioners that have an established international reputation. In 2010 David was the first Irish designer inducted into Alliance Graphique Internationale (AGI), an elite international club of the world's leading graphic designers and artists in a professional collaboration of common interest and achievement. Its members have been collectively responsible for the identity design of most of the world's top corporations and institutions as well as for countless examples of globally known packaging, publications, illustration and posters.

Mjg_

From a design point of view, what works and what doesn't work with the traditional Mendeleev Periodic Table?

Ds_

On the most basic of levels, any assessment of design has to ask is the design fit for purpose – ie. is it usable and comprehensible to its audience and user group. Mendeleev's basic design is a sequence of horizontal and vertical fields ordered chronologically in accordance with their atomic number (horizontal) and their chemical properties (vertical). This ordering principle defines the visual form and the resulting gridded design is extensible, modular and easy to use for the large majority of users.

From a design point of view the basic treatment clearly works and is more than fit for purpose. I would need to have a far greater understanding of chemistry and/or the needs of the advanced user to identify "what doesn't work" – the fact that Mendeleev's basic design remains in constant usage and is the most instantly recognisable of the hundreds of designs in existence indicates that, for this designer at least, identifying "what doesn't work" could end up being a pointless task considering the overweighing merits of the original.

Mjg_

What makes Mendeleev's periodic table so iconic? Is it design, simplicity of information or just all the information completed into one document?

Ds_

Otto Neurath – the Austrian philosopher and designer of the ISOTYPE system – likened the information designer to a "transformer"[1] – one who transformed (designed) data into a visual or graphical representation of its essential meaning for a particular user. This "transformation" of making the complex simple is one of the most demanding of tasks a designer faces. Our natural compulsion to over embellish, enhance or "beautify", can often affect the quality and clarity of any design.

As a chemist, Mendeleev approached his task with scientific rigour and his design is appropriately more concerned with function than aesthetic quality. The irony is that the application of his logic and the systematic ordering of the elements contributes to a very robust and beautifully simple "table of elements". The final design effectively orders a significant amount of complex information in a comprehensible and simple way. The information within each field of the grid is a discrete numeric and typographic mnemonic that is both precise and functional.

Its status as a design icon can be based on my previous remark that it remains in constant usage. The basic design uses very few graphic elements (text and line) and is no less effective in black and white than its fully illustrated alternatives.

1 The transformer: principles of making Isotype charts, Marie Neurath and Robin Kinross, 2009, Hyphen Press, London, UK

Mjg_

How successful do you think the alternative periodic table designs are? Can you improve on the original?

Ds_

There are certainly more visually engaging, more informative, colourful and elaborate designs in existence. Amongst my favourites are the helicoidal series or "chemical galaxies" that re-present the information on various spiral forms. Robert Harrison's design is particularly notable (spiralperiodictable.com). Amongst the most elaborate and visually rich are Theodore Gray's designs that capture and present a phenomenal level of information. Scientifically rigorous, Gray's designs exploit the full gamut of reproduction technologies in print (for posters, books and card decks) and on screen (for smartphones and tablet devices such as the iPad).

However, despite their visual appeal many of the alternative designs in use have not necessarily improved on the fundamental organising principles of Mendeleev's original.

Mjg_

How come the periodic table is so well recognised and why do you think it has spawned so many iterations (periodic table of fonts, design, swearing)?

Ds_

If we accept that we read best what we read most[2], the high recognition factor or familiarity with the gridded structure is simply due to the fact that Mendeleev's design is the most commonly used representation of the periodic table. If over time chemists, academics and educators had adopted an alternative we might now be discussing a design with a different form and not a tabular representation of the elements. The fact that there are so many spurious imitations in existence is probably down to the simplicity of the ordering system used, the ease of reproduction of the gridded system and plain old laziness – I'm not sure that counterfeiters would have been so quick to appropriate complex and elaborate spiral forms.

In acknowledging the "genius" of the original design American critic and designer William Drenttel was far more critical of these "faux representations" when he said — "the Periodic Table, like other areas of science, is often just a genre that's ripe for appropriation, offering an easy visual metaphor and a ready source for imagery… [it's] the indiscriminate appropriation of scientific imagery for the making of cool things."[3]

2 Zuzana Licko, Interview with Rudy Van der Lans, Emigré #15, 1990, Emigré Publishing, California, US.
3 Culture is not always Popular, William Drenttel Doyle in conversation with Jessica Hefland, AIGA National Design Conference: The Power of Design, 2003

Mjg_

Would you say that the periodic table is the ultimate information graphic?

Ds_

I'm afraid I would be biased towards Harry Beck's design for the London Underground map in any vote for the "ultimate information graphic". Both Mendeleev's and Beck's designs have qualitative similarities in their functionality, clarity and efficient use of information. Beck's design, however, was so ground-breaking in its departure from using geographical maps as the basis for wayfinding. The principles of his simplified design with its universally familiar system of lines, colours and transit points continues to define and inform how transport maps are designed today from New York to Berlin.

Mjg_

Is the periodic table design similar or different from the latest trends in information graphics?

Ds_

If you look at pure information design I think there is very little difference as there is an economy of means in use and the focus is on the effective and clear representation of the core data. However, there is a vast difference between Mendeleev's efficient and obvious design and the current trend for "making information beautiful" with its tendency to over elaborate and decorate statistical information.

Mjg_

The periodic table is referenced in a number of art forms and interpreted by artists (Damien Hirst, Simon Patterson) but does it actually help people to understand chemistry and the elements?

Ds_

I would find it difficult to advocate using Hirst's representations of the periodic table as a teaching tool. I don't recognise his "designs" as being assistive in the retention or comprehension of the information. His extensive interpretation of the chemical elements, at least from a graphic perspective, reached it's apogee when he "branded and designed" everything for his restaurant venture Pharmacy. The design for Pharmacy was the final act in a long term collaboration with designer and typographer Jonathan Barnbrook that started with Hirst's first monograph I Want To Spend the Rest of My Life Everywhere, with Everyone, One to One, Always, Forever. Whilst one could argue that due to his profile and the extent of his "interpretation" of the chemical elements he contributes to an increased awareness of the subject I would agree with William Drenttel and liken his graphic interpretations as "the indiscriminate appropriation of scientific imagery for the making of cool things." [4]

There is no reason why the same argument should not apply to Simon Patterson. However, as an aide memoire maybe his interpretations deserve more consideration. Patterson is probably most notable for his adaptation of the London Underground map The Great Bear, but his interpretation of the periodic table Rhodes Reason and subsequent repurposing as a

4 ibid

book Rex Reason (solid gaseous liquid synthetic) – a playful commentary on popular culture – may actually have potential in the classroom. The fact that Rex Reason takes the form of a book makes his "design" clear and accessible, with each page dedicated to an "element". However it is the reinterpretation of the elements as film stars – Au [gold] or Audrey Hepburn, Na [sodium] or Kim Novak, and the beautifully obvious Yb [ytterbium] or Yul Brynner – that for any brave, or celebrity obsessed science teacher, could potentially see Rex Reason and its playful mnemonics, become the teaching aid of choice!

Mjg_

If you were to design a periodic table where would you start?

Ds_

I would have to start by asking why do we need a new design and who is it for? Then I would need to make an informed decision about what possible improvements could be made for any particular user before considering any changes to the original. There are so many in existence that their cumulative tweaks and changes would most likely leave very little area for improvement.

There is no question that Mendeleev's original design will tempt designers to reinterpret it for specific audiences or require more substantive iterations as, and when new elements are discovered but apart from minor iterations it is hard to see the need for a radical change to his fundamental design.

The best opportunity probably lies in the rethinking and repurposing of the original table for different media platforms. Improving and enhancing how students and other end-users engage with the chemical elements and how to best assimilate the information, but it's fair to say Theodore Gray is already way ahead of me in this area!

ACKNOWLEDGMENTS_

Au

GOLD,

Exhibit courtesy of GoldCore and Galantas Irish Gold

Photo courtesy of Marc Quinn Studio

Pb

LEAD, BULLET DRAWING' 2011, CORNELIA PARKER, UK

Courtesy of the artist and Frith Street Gallery, London, UK

Cu

COPPER, UNTITLED S.158 RUTH ASAWA, JAPAN/USA

Courtesy of the artist and Rena Bransten Gallery, San Francisco, CA, USA
Photo: Laurence Cuneo

Hg

MERCURY,

Courtesy of Chemistry Department, Trinity College Dublin, IRL

C

CARBON, LIFEGEM MEMORIAL DIAMOND, USA

Exhibit courtesy of LifeGem, USA

Ca

CALCIUM, HUMAN TARSUS

Courtesy of The Anatomy Department, Trinity College Dublin, IRL
Photo: Ruža Leko

Fe

IRON, MEME CXV, ANTONY GORMLEY, UK

Courtesy of the artist and White Cube Gallery, UK
Photo: Stephen White

Co

COBALT, BLUE GLASS BOTTLES PRIVATE COLLECTION

As

ARSENIC, WALLPAPER SAMPLES, WILLIAM MORRIS, UK

Courtesy of the William Morris Society and Prof. Andrew A. Meharg, University of Aberdeen, UK

Na

SODIUM, STREET LAMP

Courtesy of Simon Cornwell, UK

Ar

ARGON, THIS IS NOT A NEON SIGN, SARAH BLOOD, UK

Exhibit courtesy of the artist.

U

URANIUM, SIZEWELL, KATE WILLIAMS, UK

Courtesy of the artist

Si

SILICON, UNPRINTED INTEL SILICON WAFERS

Courtesy of INTEL, Ireland
Photo: Ruža Leko

Ra

RADIUM, ARTEFACTS FROM THE RADIUM CRAZE, PRIVATE COLLECTION

Photo: Ruža Leko

Pt

PLATINUM,

Exhibit courtesy of the National Physical Laboratory, UK

HUGH ALDERSEY-WILLIAMS

Hugh Aldersey-Williams is a writer and curator with interests in science, architecture and design. He is the author of a number of popular science books, including The Most Beautiful Molecule, about the Nobel Prize-winning discovery of buckminsterfullerene. He has curated exhibitions and events at the Victoria and Albert Museum and the Wellcome Collection in London on topics ranging from zoomorphic architecture to the sense of touch and personal identity. His new book is the best-selling Periodic Tales: The Curious Lives of the Elements, on which the exhibition **ELEMENTS**: THE BEAUTY OF CHEMISTRY is loosely based.

THANK YOU...

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DESIGNED BY RUŽA LEKO

ABOUT SCIENCE GALLERY

Situated at the dynamic boundary between Ireland's leading research university, Trinity College Dublin, and a busy urban centre, Science Gallery is a new kind of hybrid space, bringing artists, scientists, designers and engineers into creative and critical dialogue through exhibitions, events and public experiments. Since opening in February 2008, more than 750,000 people have been engaged with Science Gallery's exhibitions, events and public experiments exploring themes ranging from the science of fashion to contagious laughter, crocheted coral reefs to living tissue as art. Follow our journey on Twitter @ScienceGallery or find out more on www.sciencegallery.com or www.youtube.com/sciencegallery

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