Observations

Jim Pattison and Murray Robertson

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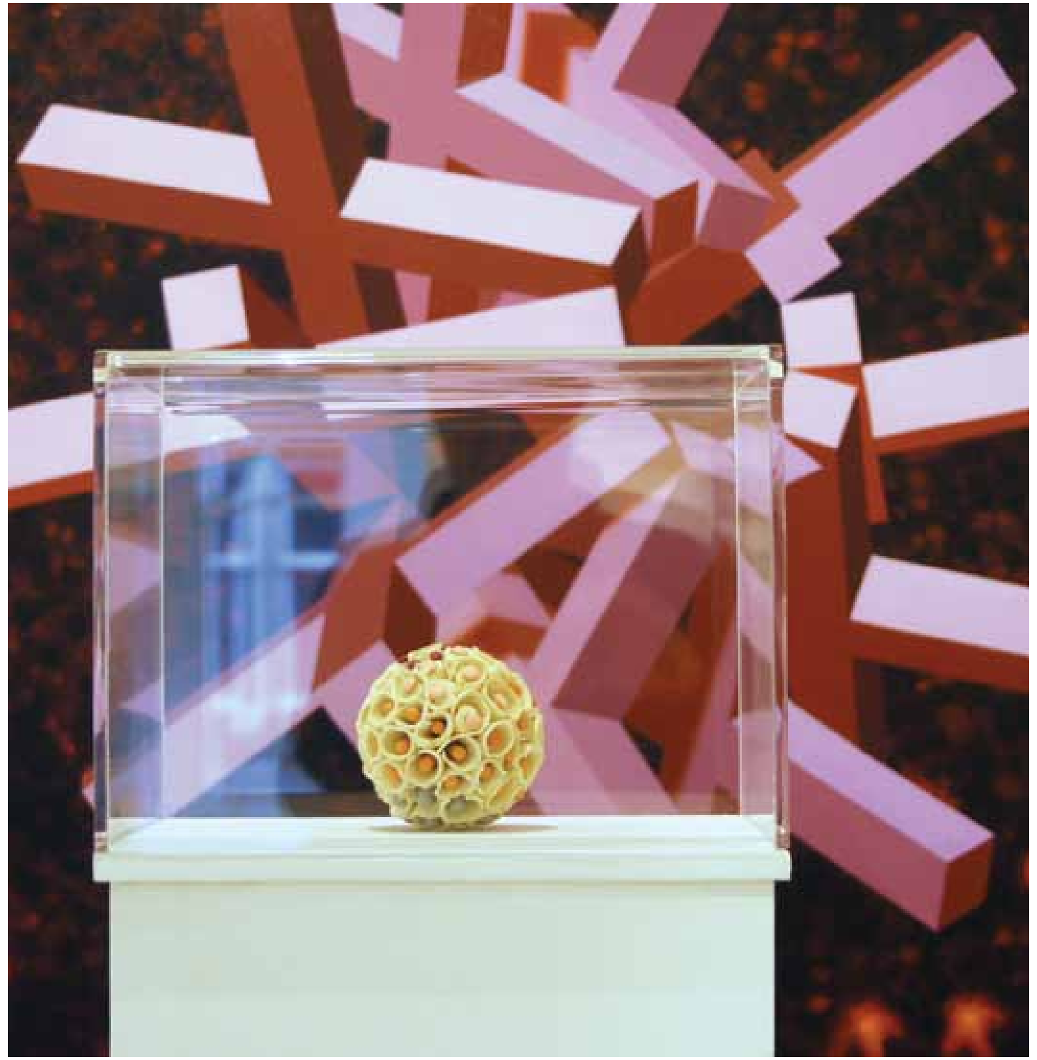
Glasgow Print Studio Gallery



The most beautiful thing we can experience is the mysterious. It is the source of all true art and all science. So the unknown, the mysterious, is where art and science meet.
Albert Einstein

Observations On

What we can experience, or perceive, or know must of course depend upon what there is to experience, or perceive, or know, but it must also depend upon the apparatus that we have for experiencing, perceiving, and knowing. For us to be able to experience anything at all it has to be such as can be coped with by the apparatus we have. That is not to say that nothing else can exist, but it does mean that nothing else can be experienced, perceived or known by us. (Bryan Magee, *Men of Ideas*, 1982)

The etymological root of the word "theory" lies in the Greek term theoria: "a looking at, things looked at". (The word theatre derives from theatron; literally, "a place for viewing".) Similarly, the word speculation derives from the Latin specere, "to look at, view". When we read these words - when we look at them - we do not necessarily know what lies behind them, the origins of their meaning. We use them without pause: they are simply given. The same holds true, for most of us and for most of the time, for our understanding of our bodies and the world in which we exist. How many of us understand the lymphatic system, or the composition of polyurethane, or the rudiments of quantum mechanics? How many of us know how to fix our computer when it crashes? In most instances we leave of all this stuff to others: "Could you possibly take a look at this for me?"

Looking, thinking, and knowing are tightly bound together. They operate, however, as a self-regulating system in which none has precedence, either conceptually or temporally. This means that looking does not necessarily come before knowing, nor does looking necessarily limit knowing. By the same token, knowing does not always precede thinking, and thinking may sometimes contradict knowing. The relations between these three terms are constantly shifting. I know that a certain group of phenomena exhibit shared characteristics. This leads me to extrapolate that there may be other phenomena that potentially belong to this category, although this remains pure speculation. I have not actually seen any of these phenomena because they exist beyond the limits of my own perceptual apparatus, and beyond the reach of the instruments available to me (e.g. microscopes and telescopes). I would not know what they look like, and I would have to invent or imagine ways to represent them, find new means to endow them with form and visual presence.

To make matters even more interesting, looking, thinking, and knowing are all tangled up with something akin to desire. We want to know, see and think certain things: certain things are satisfying to know, see and think (whereas others are disappointing and frustrating). We need to know, see and think certain things. In other words, looking, knowing and thinking are not entirely objective. In fact, at this point it may be worth making a distinction between looking and seeing. Two people may look at the same object or event and see very different things. One might see a picturesque landscape, whereas another might see a scene of rural economic neglect. Watching dramatic footage on the evening news bulletin, one might see a struggle for independence; the other might see a lawless riot. Confronting a rhinoceros for the first time in 1515, Albrecht Dürer was floored. In order to depict this extraordinary creature he was forced to picture it in terms of things that he was already familiar with. To modern eyes, Dürer's rendition of the rhinoceros looks uncannily like an armoured warhorse. Seeing, then, is inseparable from what we know, what we want, and what we may think.

Seeing is also, of course, linked to questions of faith and trust: seeing is believing, according to the old truism. It is far easier to invest our trust in something that we can see. If we cannot see something we might even be tempted to suppose that it does not exist. If, for whatever reason, we are unable to see the thing itself, then we will happily settle for a representation of that thing - a photograph, a painting, a drawing, for example. It is even probably true to say that today we are far more exposed to representations of things than to the things themselves. Most of us have never met Barak Obama in the flesh, but we have seen him often enough on our TV screens and in our newspapers to be pretty certain that he exists. Such is the current pervasiveness of representations that it has led some theorists to claim that representations no longer mirror or reflect reality: they have become reality. According to the French philosopher Jean Baudrillard, for example, the Gulf War did not actually take place, it was simply an effect produced by electronic images on computer terminals. The combatants did not engage with each other in ways that we might understand as conventional warfare: they fought it out in the virtual realm of digital images and abstract representations.

Thus, by virtue of their entanglement with seeing, thinking and knowing are also often subject to irrational and subjective influences. Recent research, in fact, has suggested that fingerprint identification in forensic investigations is not always as objective and reliable as we have been led to believe because it is open to influence (and consequent misidentification) from contextual factors. If fingerprint analysts are fed certain pieces of information before beginning their task, it will often produce skewed results, leading to more than 1,000 mistakes per year in the USA according to one source. Nevertheless, sight retains a capacity for objectivity, and is central to our understanding of the world. According to Marshall McLuhan, sight is a "cool" medium: it is relatively detached and assessing, and it more precise than the other senses. If, for example, we want to know exactly how hot something is, touch alone cannot provide us with accurate information. However, with the invention of the thermometer we can turn heat into something visible, something precisely calibrated for the eyes to read. Human ingenuity has also produced speedometers to translate the experience of velocity into something measurable by the eyes, whist scales, decibel meters, clocks and rulers perform a similar functions for the experiences of weight, sound, time, and distance.

The effect of examples such those noted above is to elevate sight above the other senses in terms of the ability to present the world to us as something measurable and quantifiable. However, in order to prioritise sight, it must be somehow detached from the other sense. (The thermometer, for example, removes the sense of touch from the assessment of heat.) Rather than interacting with each other in a kind of co-operative system, the senses are increasingly understood to function as specialised tools. There is a distinct and 'proper' area of activity for each of the senses, and there should be as little cross-interference between these designated areas as possible. The condition known as synaesthesia, in which sensory impressions from one 'area' are registered and experienced in a different 'area' - such as when music is experienced visually - is thus understood as an abnormality. Thus it is not entirely surprising to find that during the heyday of Modernism in western art (stretching from roughly 1860 to 1960) an influential strand of art increasingly detached itself from tactile experience in order to position itself as a purely optical phenomenon, addressing itself to the eye alone - a process that culminated in the Op Art movement of the 1960s, whose primary purpose was to produce images that excited and confused the viewer's optical experience.

This process whereby the human senses become ever more subject to the processes of specialisation may be understood as part of a wider historical development. The ways in which knowledge and experience are organised and compartmentalised today are the result of specific historical conditions. It used to be the case, for example, that the study of geometry was pursued as a branch of philosophy. Thus an Italian Renaissance artist, such as Piero della Francesca, could claim an intellectually elevated status for his work - and thus for his profession - by virtue of his ability to employ the geometric principles of mathematical perspective. Three centuries later, Constable's studies of meteorological conditions would have been understood by his mid-nineteenth century contemporaries as exercises in natural philosophy, rather than natural science. And the current structure of our universities – their division into various Faculties, such as Arts, Humanities, Science, Technology, and so on - is a legacy of eighteenth century Enlightenment thinking, when it was proposed that the human mind is 'naturally' composed of such separate and independent faculties. Consequently, art became divorced from science, and science itself was split into 'pure' and 'applied' branches. The conditions under which the exemplary 'Renaissance man', such as Leonardo da Vinci, might emerge were lost.

Efficiency became the watchword. At the risk of a reductive oversimplification one might say that the demands of the capitalist economy for maximisation of profit provided the imperative for this drive towards specialisation. The logic that underpinned factory production during the period of industrialisation - a logic fuelled by the demand for efficiency and rationalisation - was applied to human life and experience at all levels. In order for us all to contribute as efficiently as possible to this system it became strategically important for us to know more and more about less and less. Expertise in confined areas was prized more highly than general capability across a range of pursuits. We had entered the age of the expert.

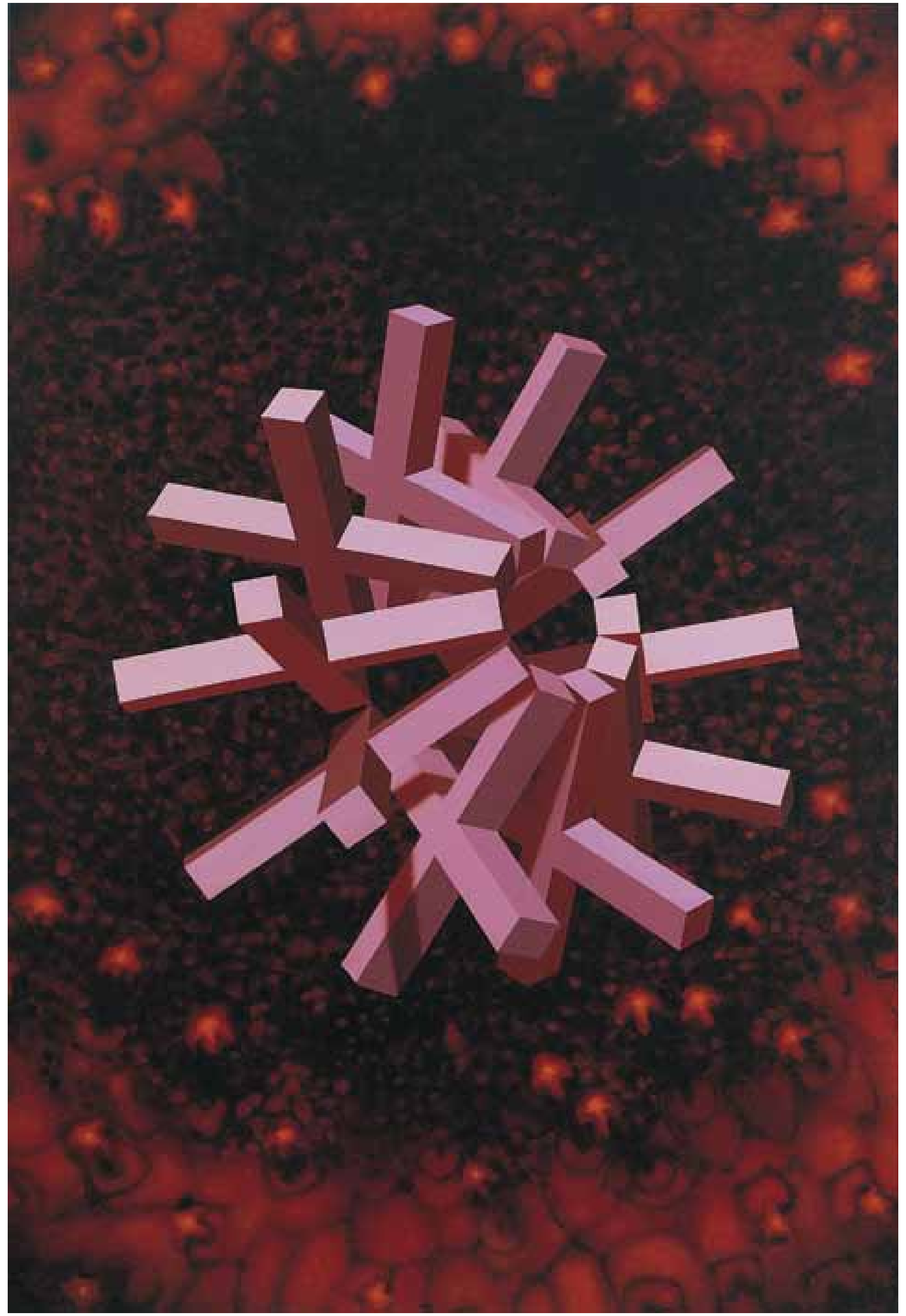
Needless to say, this meant that art and science (for example) became increasingly divorced not only from each other, but also from the general public. Modern art became 'obscure' and 'elitist', whilst science became 'incomprehensible' and possibly 'threatening'. Each developed its own specialist 'language', a 'language' impenetrable to the uninitiated layman. Their products could be 'seen', but not 'understood'. They seemed content to address themselves and their own self-defined issues, rather than the world of common knowledge and shared experience.

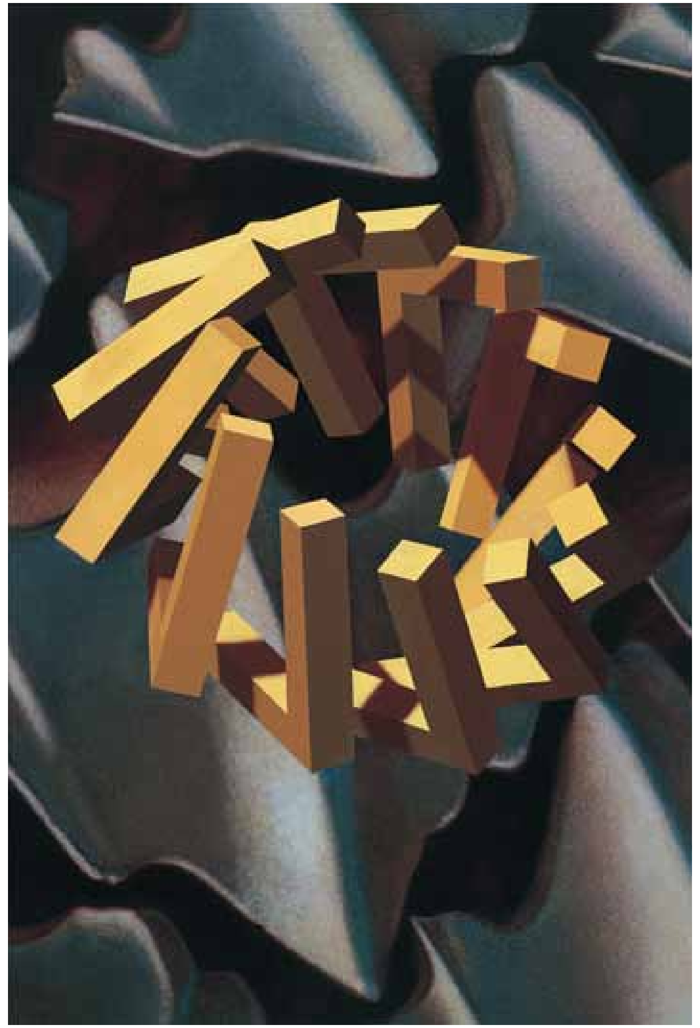
But this is not to say that a rapprochement between these two areas of specialist activity is not possible. In fact, it may be absolutely necessary. Seeing and knowing, as I have tried to suggest, are inseparable. And although the relation between seeing and knowing may be more complex than is often thought, they have the power to aid each other. In William Ivins's seminal study of the history of printmaking, Prints and Visual Communication (1953), he argues that the original value of the technology of printmaking lay not in the development of art and aesthetics, but in the development of science and technology. The value of the "exactly repeatable pictorial statement", he claimed, enabled knowledge to be transferred in a reliable and efficient form, allowing herbalists, for example, to identify plants and their medicinal properties with confidence. And imagine, says Ivins, trying to learn how to tie complicated knots if one were reliant solely upon written instructions unsupported by visual aids.

The situation confronting artists and scientists today is, of course, more complicated than that addressed by Ivins in his historical study. As knowledge continues to evolve and expand, the means used to convey that knowledge must develop apace. Abstract art, it has been argued, arose not from an internal need within painting, but because the world itself was receding from the ability of painting to adequately represent it. Simply put, the world has become more abstract, and thus demands more abstract means of representation. Such abstraction does not, of course, necessarily need to take the form of non-representational imagery: this abstraction can equally be effected by means of metaphor, analogy, or other equivalent tropes. In other words, something that is unknown or unfamiliar may be represented in terms of - translated into - something that is already known and familiar. Dürer's rhinoceros offer ample proof of the artist's continuing struggle to find adequate means to picture that which has never been pictured before.

If - to use the terms employed by Bryan Magee at the introduction to this essay - the apparatus available to us for experiencing, perceiving or knowing become inadequate in the face of a reality in the process of transformation, then we are perhaps presented with two options: either we transform that apparatus in such a way as to make it functional, or we use it as an instrument to convert the unknown into the already known. (It should perhaps be pointed out here that such apparatus is not to be understood solely in terms of technological hardware, but also - more importantly, perhaps - as including systems of representation, such as language and images.) This, according to the French philosopher Jean-Francois Lyotard, is similar to the challenge faced by artists in the face of the sublime. The sublime is understood here as the feeling of profound disquiet that arises in those moments when our ability to conceive of something is found to be incommensurate with our ability to represent it (the example of infinity is often given as a case in point: other examples might include hyperspace, the internet, black holes, the Higgs boson). In such situations artists faces two possibilities: they can, so to speak, 'illustrate' the sensation of the sublime (or its equivalent) by using the representational resources available to them; or they can attempt to 'produce' the sublime (or equivalent) sensation in their work, but in so doing they will necessarily have to exceed the available representational resources, and will thereby produce work that is, according to Lyotard, a form of "incommunicable statement". We may look at such a work, but we will not know what we are seeing. Eventually, however, our knowing may become transformed as a consequence of what we have seen. In other words, the artist may give form to something that as yet lacks form, and that new form may itself transform our ability to further understand the thing in question. The form may, in fact, become part of the very identity of that which had previously evaded attempts to define it.

John Calcutt





Left: **Pink Form**, acrylic/canvas, 124 x 183 cm.
Above: **Lemon Form**, acrylic/canvas, 81 x 122 cm.

Notes and Observations

From around 1989 until 1999 my work investigated ways of transferring and manipulating images and information using digital technology and the translation and re-modelling of virtual on-screen digital images of two and three-dimensional forms into paintings, prints and sculpture. These works explored and tested a range of autographic and digital media in order to translate on-screen illusory images into other forms, and to make them real, or tangible.

In 1996 I first gained access to a 3D virtual modeling programme, and re-worked a Uccello drawing of a mazzochio form using this technology. A mazzochio is a complex geometric form which was used as a test of perspective drawing skills during the Renaissance - this earlier drawing problem seemed an appropriate test for the new technology. The ability of this software to deal so quickly with this highly complex drawing problem, I found extraordinary. A printout of the computer-drawn result was used to design and build a shaped support for a large-scale painting, and also to translate the image onto this custom-built surface.

An initial group of paintings based on the mazzochio form evolved into a wider series of shaped paintings and prints - *Colour Maps*, which utilise and reflect on the perceptual processes which make it possible to re-interpret two dimensional images as three dimensional forms. They also highlight and consider the relationship between on-screen images, created using programmes which mimic traditional processes of mark making and sculpture, and the shaped, painted and printed results.

In June 1999 I was diagnosed as having renal failure and underwent C.A.P.D. (Continual Ambulatory Peritoneal Dialysis) until July 2002, when I received a kidney transplant. These events have had a huge impact on my life and my work.
The work illustrated here dates from around 2000 until now and includes work from five projects: *Layers*, *Translations*, *Connections*, *The Cube of Knowledges: towards a symbolic library* and *Ten Carved Stone Balls from the Islands of Scotland*.
In each series I have explored a range of recording and realisation methods appropriate to the specific project challenges. These include 3D scanning, rapid prototype modelling, painting, screenprint, lithography, sculpture and digital print.

Most recently in the *Carved Stone Balls* project I have introduced *Strata Foto 3D* as a recording method. This has allowed me to record these objects in the collections where they are held without the logistical problems and cost considerations of scanning these forms in 3D. This software generates a 3D model of an object that is placed on a calibrated turntable, rotated, and photographed from a number of angles.

The following notes and extract observations from accompanying publications describe and discuss these projects.

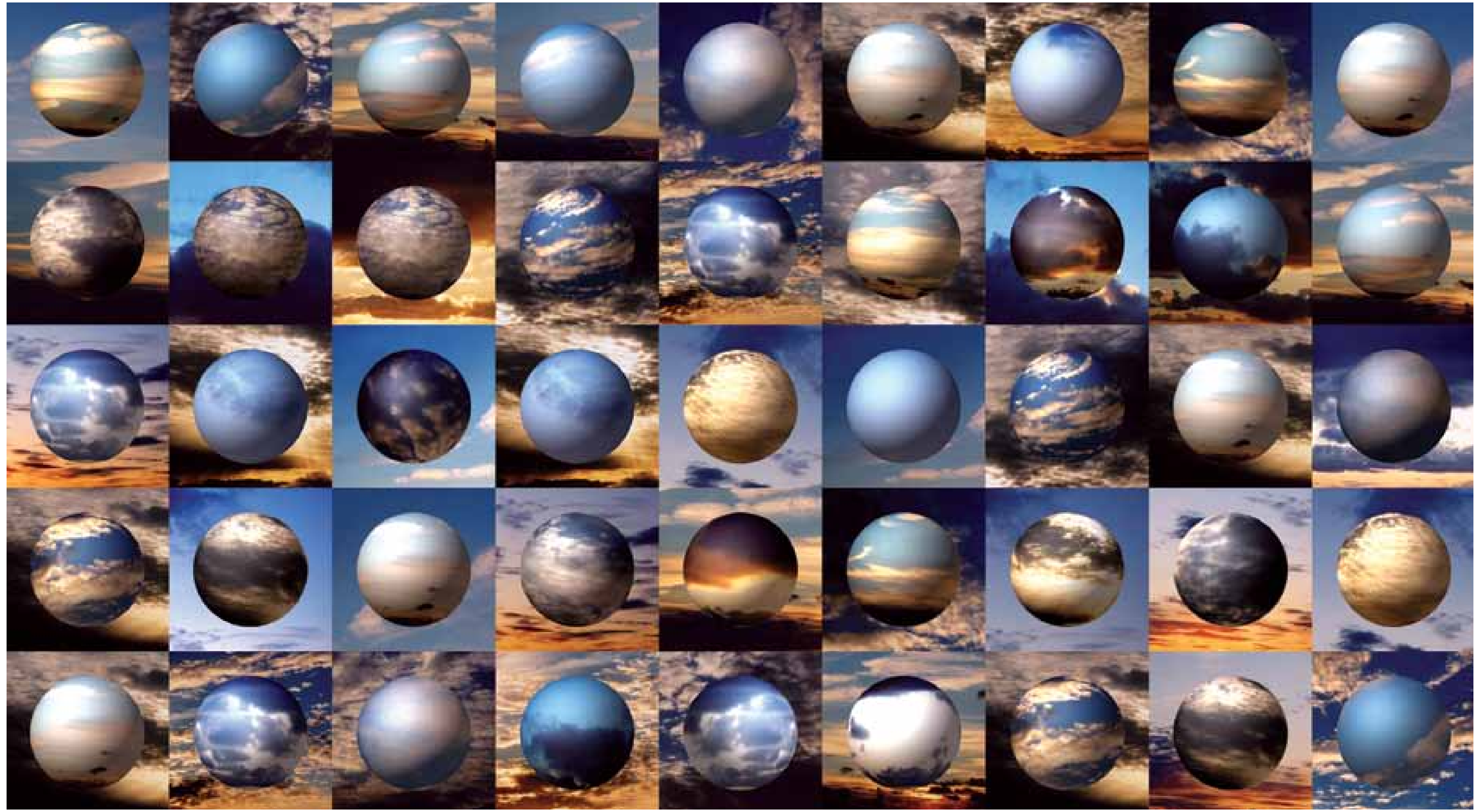
Layers (2000-03)

In *Layers* I used a range of digital and autographic processes and media in order to explore ideas of placement and replacement. This work investigated the potential for moving and overlaying images and forms between computer software, and ways in which the resulting visual contextual shifts might offer analogy or metaphor, and feign an illusory, or unseen, reality. These artworks, which were the first to refer to my experiences of renal failure, incorporate multiple layers in their design and realisation; formal, objective, issues combine with personal, subjective, concerns.

"Likewise, the *Forms* series, in which 'hard' objects developed from virtual images are inserted into soft environments based on images from the natural world, can be read as references to transplantation. Such intimate references and explicit meanings, however, are never forced on us. The art of *Layers* consists not of emotional outpourings or extravagant gestures but of something more discrete and subtle which, despite it's often bright colour and bold design, works on our consciousness with a much quieter insistence, gradually revealing its layers of meaning. Perhaps the closest parallel can be found in Francis Picabia's artistic transition from Cubism to Dada in the early 20th century, when his art used real or invented mechanical forms, seen in close perspective, as metaphors for deeply personal and emotional themes.

The *Portpatrick* works reintroduce the theme of alien forms transferred from their original context. Here, however a kind of resolution is achieved, for in fact, each of the shiny Magritte (?) inspired sun-stars echoes the previous work in the series by literally embodying it. The linear series has also given way to the circle, in which the last is contained in the first."

Hilary Macartney (2003), *Layers,* ISBN 1 899837 44 2



Above: **Portpatrick Sunsets**, archival digital pigment print, image size 91 x 51 cm.

Translations (2003-07)

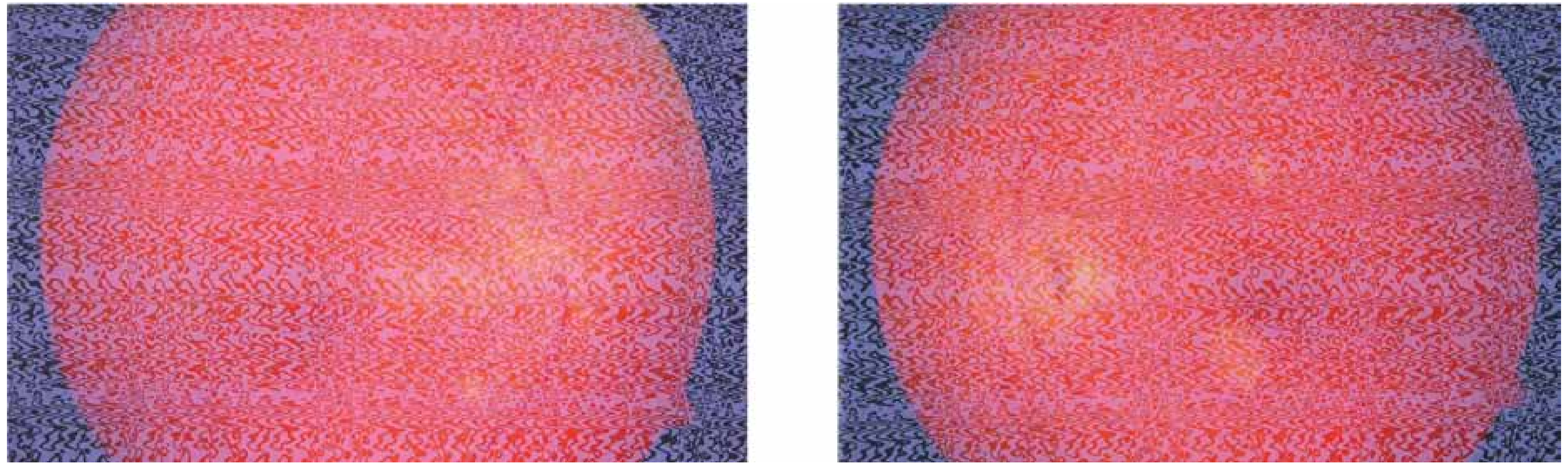
Throughout the processes of diagnosis, dialysis and transplantation I was aware of a need to make a visual sense of these new experiences and their associated language in order to form and structure this new information. The translation of information from medical condition into medical terminology, the communication and subsequent ordering of this information is complex, and moves through various forms. This AHRC funded research considered the parallel information transfers and shifts between digital technologies, with their potential to move, re-position and re-form information and images, and the ways of exploring, mapping and transforming information which occur in one's own thought process.

"In 2003, Jim Pattison made a pair of small apparently abstract prints, *Interference*, combining digital and screen-printing techniques, each with a centrally placed, somewhat blurred, circular motif marked by a few darker, broken smudged lines. Recognisable (if not immediately) as the retina of the eye, they are in fact based on images, from 1999, of the artist's own eyes. The smudged lines represent broken blood vessels, the result of high blood pressure and the first indication of the renal problems that form the context for the works in this exhibition. For a visual artist, any threatened impairment of the sight must be difficult to contemplate and though, as it proved, he actually faced other dangers, these two prints eloquently express the demanding nature of the project that is presented here. The artist has not only had to deal with a serious medical problem but has set himself the task of assimilating that experience into his art and sharing it with others.

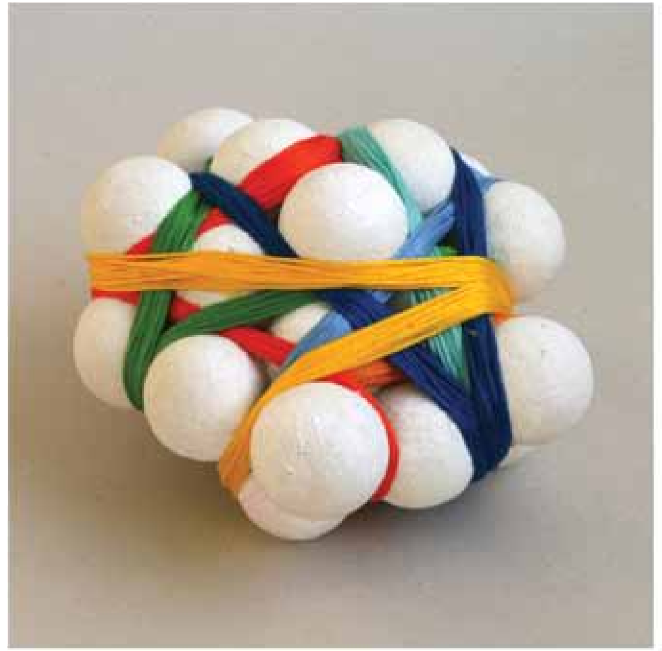
It is for reasons like these that an exhibition can arise from a highly specific medical source (in this case Jim Pattison's experience, between 1999 and 2002, of renal failure, dialysis and kidney transplant) and go beyond that to speak to the collective interest that we share as human beings. It is also a particular instance of the more general question of how scientific knowledge (and research) can be assimilated visually for presentation to a wider public. The works, then, are his reflections on that time and what it meant to him. They are autobiographical but in contra-distinction to, say, the paintings that John Bellany made following a liver transplant, Pattison's visual language is not representational, at least not in a direct sense. Pattison does not make himself the hero of his own drama: his visual language does not permit that. 'He' remains screened, not revealed as Bellany was. He is an abstract presence suggested by various visual metonyms. This is key to seeing how Pattison has assimilated his experiences into his art, and how his art has changed in the process. Bellany's paintings served a therapeutic purpose and so did Pattison's, for it seems that neither were content to make sense of what had happened simply by grasping the medical facts. Both, self-evidently, had to translate their experiences into their visual worlds and through that achieve a sort of integrated understanding that, perhaps, they needed most. 'Visual thinking' means not only the free imagination or seeing visual solutions to 'problems' but, more specifically to an artist, means assimilating experience into the existing visual terms of their work and creating new terms under that pressure."

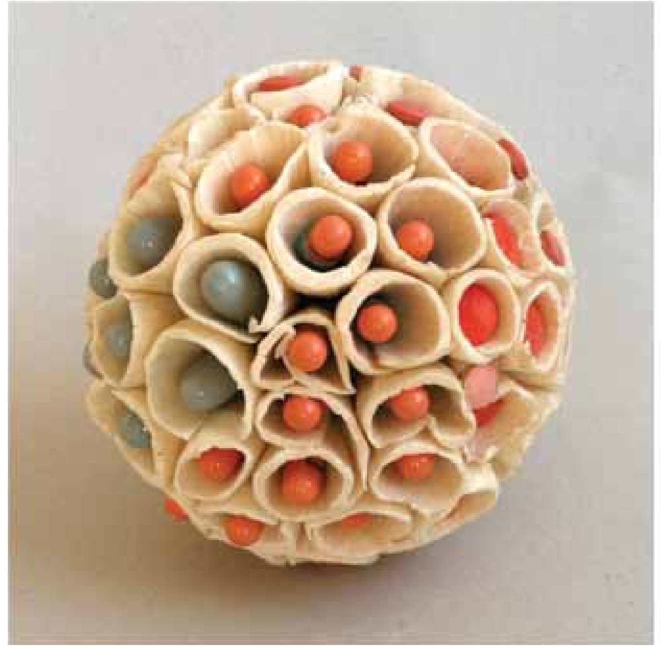
Euan McArthur (2006), *Translations*, ISBN 1 899837 51 5

Above: **Creatinine (10)**, acrylic/canvas, 91 x 122 cm.



Above: **Interference**, screenprint and archival digital pigment print on canvas, 56 x 36 cm (each).
Right: **MRI Scanner,** Gartnavel Hospital, Glasgow. Far right: **3D Scanner**, Strathclyde University DMEM Department, Glasgow.

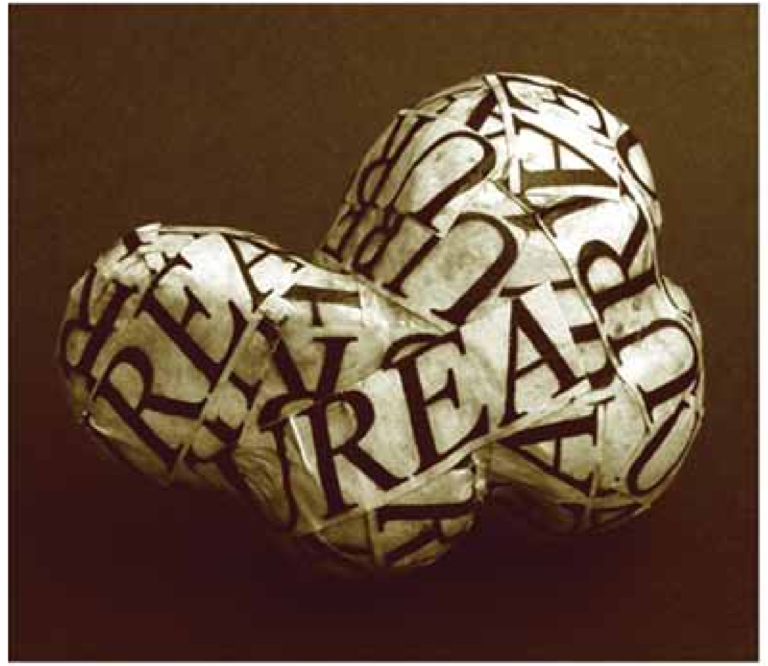





From top left:
Haemoglobin,
mixed media, 12 x 12 x 8 cm.
Haemoglobin,
rapid proto-type model, 15 x 15 x 10 cm.
Pills,
mixed media,10 x 10 x 10 cm.
Pills,
rapid proto-type model, 15 x 15 x 15 cm.

Haemoglobin,
archival digital pigment print,
image size 91 x 91 cm.

Pills,
archival digital pigment print,
image size 91 x 91 cm.



From top left:
Urea, lithograph, image size 20 x 18 cm.
Creatinine, lithograph, image size 20 x 18 cm.
Haemoglobin, lithograph, image size 20 x 18 cm.

Left:
Voltage, archival digital pigment print, image size 90 x 18 cm.
Gated, archival digital pigment print, image size 60 x 18 cm.
Potassium, archival digital pigment print, image size 114 x 18 cm.
Ion, archival digital pigment print, image size 42 x 18 cm.
Channels, archival digital pigment print, image size 108 x 18 cm.

Right:
Voltage Gated Potassium Ion Channels, archival digital pigment print, image size 91 x 51 cm.
Channels, archival digital pigment print, image size 91 x 51 cm.

Connections (2007-10)

This series of paintings, prints and sculptures are the results of a collaborative research project with neuroscientist Professor Brian Robertson, which was funded by a Wellcome Trust People Award. Brian's research seeks to unravel the roles of specific potassium ion channels in the membrane of a neuron. This series of visual proposals considers the location, form, and function of these channels. The aims in this instance were to identify appropriate autographic and digital realisation methods to describe known and unknown aspects of Professor Robertson's study. These incredibly small channel forms were depicted and modelled using a range of two and three-dimensional; approaches from data, images, clues, and intuition. Regular fact finding and information gathering visits, along with continued dialogue, introduced key concepts, issues, and illustrations, and provided interpretation of existing images.

"My lab has worked for many years on potassium ion channels, especially those present in nerve cells in the cerebellum. Starting with the largest structure, the cerebellum ('little brain') sits at the base of the brain in mammals, and in sections it looks a little like florets of cauliflower. The cerebellum is involved in co-ordinating movements (and much else) and movement is something we tend to take for granted. But every slight movement of your eye across this page, every keystroke on the computer, every tiny step, involves massive computation, feedback and comparison in the brain; some clue as to the complexity of movement is the fact that there are more nerve cells in the cerebellum than any other part of the brain.

Nerve cells are specialized for electrical and chemical communication by virtue of a large set of ion channels. Channels are tiny proteins present on the cell's surface, and they open and close (like little gates) for thousands of a second. These proteins have a specially tailored hole in the middle, which will only allow certain types of ion (like potassium, or calcium) to pass through. Ions move from one side of the cell to another, and since these are charged, tiny electrical currents flow. We measure these currents. The main ones we've researched over the years are potassium ion channels, one of the largest 'families' of ion channels present on nerve cells

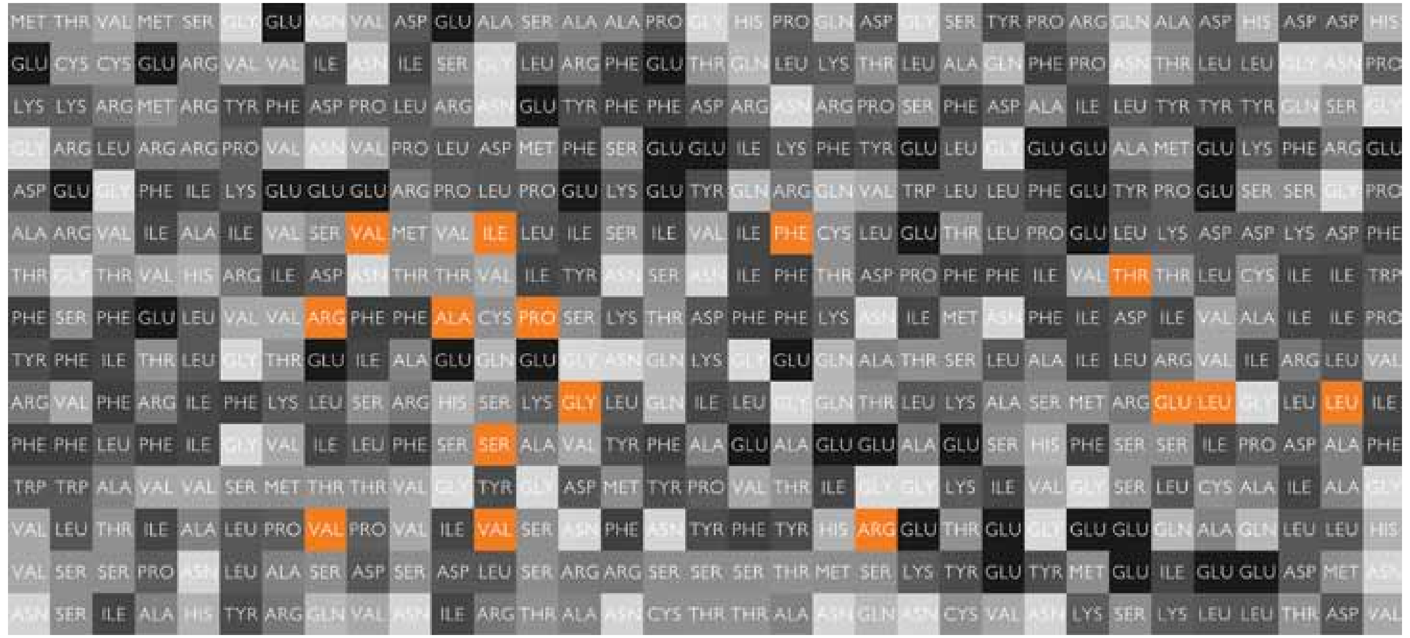
We now know the structure both in terms of what amino acid building blocks go into these potassium channel proteins, and more recently, what shape they are in the cell's membrane. We have a good idea which parts of these proteins move, allowing their little gate to open, and potassium ions to flow from the inside of a nerve cell to the outside. Jim has made sculptures of these, focussing on the main protein we worked on, the imaginatively named Kv1.1. (capital 'K' for potassium, small 'v' since it is switched to open by certain voltages in the nerve, and 1.1 because it was the first completely identified.) Different types of K+ channel are grouped into families, based on their molecular similarity. Like all families, members look alike, but the differences are crucial- they can behave quite differently as individuals, and are sensitive to different things. For instance, in Jim's work, you will see that 'our' Kv1.1 channel is highly sensitive to a component found in mamba snake venom! Since these potassium channels act as brakes on the excitability of nerve cells, blocking the brakes (whether by a toxin, another drug, or in some human disease, like some epilepsies) makes these cells get more and more crazy, till they can become hyperexcitable. Jim has illustrated this nicely in *Control* and *With Alpha Dendrotoxin* taken from real experiments when Jim was present. Most interestingly, Jim shows in *KV1 (1) Mutations* which parts of the Kv1.1 protein go 'wrong' in some unfortunate genetic diseases. It's fascinating to think that a simple single change in one tiny part of the overall structure of one ion channel can lead to such profound consequences for the affected individual."

Professor Brian Robertson (2009), *Connections,* ISBN 1 899837 59 0

www.jimpattisonconnections.co.uk

From top left:
Channel Form (Resin), mixed media, 10 x 10 x 10 cm.
Channel Form (Wood), plywood, 10 x 10 x 11 cm.
Channel (Resin), archival digital pigment print, image size 76 x 76 cm.
Channel (Wood), archival digital pigment print, image size 76 x 76 cm.

Potassium Channel, rapid proto-type model/perspex, 20 x 20 x 10 cm.

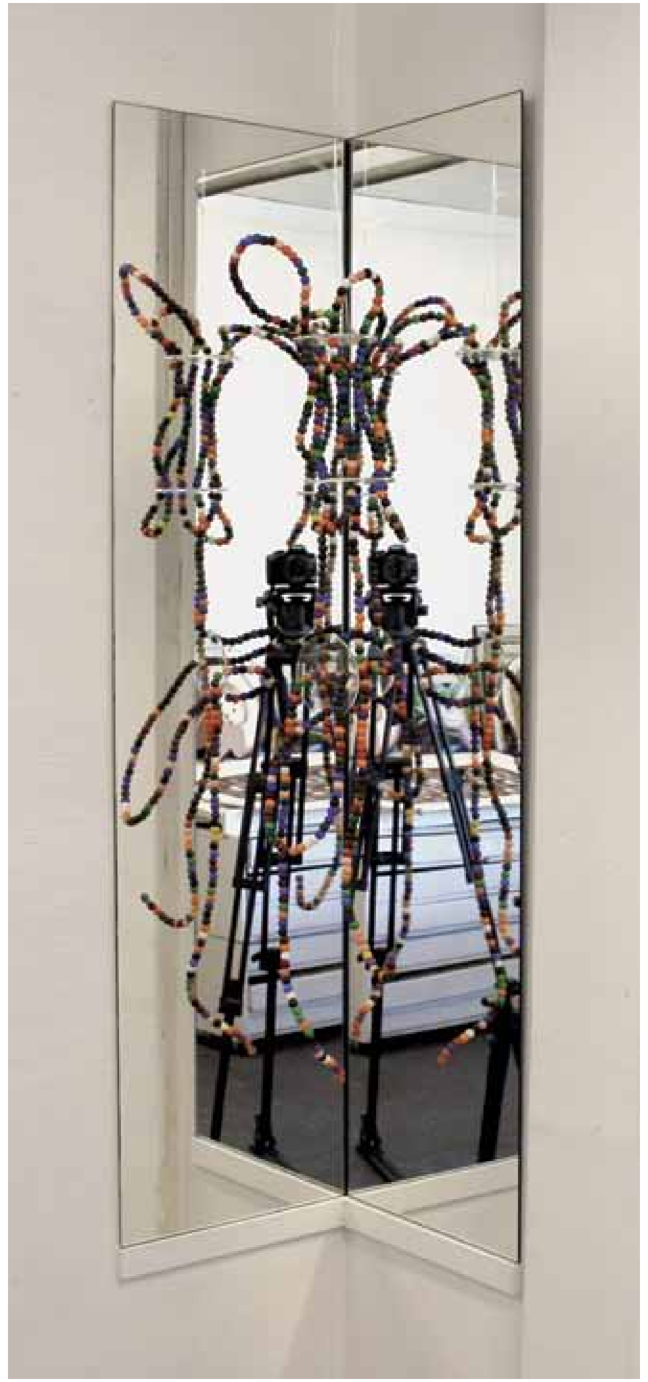


KV1 (1), archival digital pigment print, image size 110 x 50 cm.
KV1 (1), Mutation Sites, archival digital pigment print, image size 110 x 50 cm.

"To originate intuition across boundaries one must have a degree of trust between participants. In the case of Pattison and Robertson a mutual confidence developed early. Upon first meeting the scientist Pattison was taken by the degree to which his hands were used in a performative way to supplement the communication of complex biological data. For Pattison the scientist was already envisioning - and the knowledge being conveyed was literally being embodied.

Historically science and art had the anatomy class in common, they also share contemporary concerns. The gradual loss of visual acuity in science, and particularly medicine, has paralleled the undermining of drawing in the modern art college. Yet, in Scotland, there has been a tradition of 'visual thinking' as an integral tool of intellectual enquiry and Pattison's project merely re-discovers this. In addition, as with other such projects linked to the Visual Research Centre in Dundee, the Scottish epistemological tradition of democratic intellectualism is implicit to this project. The essence of Pattison's method demonstrates what R.D. Anderson says of the 19th century Scottish university curriculum, which 'enabled students to choose between intellectual interests and vocational needs'. As we can see from this exhibition such methodology allows for a dialogue where none would otherwise exist, while acknowledging a commonality, where superficially none may exist. Murdo Macdonald refers to this as 'mutual illumination'."

Professor Gavin Renwick (2009), *Connections,* ISBN 1 899837 59 0



Above: **Mutation Symptoms**, archival digital pigment print, image size 30 x 16 cm.
Right: **KV1(1)**, painted beads, perspex, mirror, 30 x 30 x 120 cm.

The Cube of Knowledges: towards a symbolic library (2010-11)

This series of virtual 3D models, sculptures and digital prints were produced in collaboration with Professor Murdo MacDonald in order to help review his earlier research.

A Model of Ways of Thinking

'So, things started to fall into place when I started to map arts and sciences onto a three-dimensional shape, namely a cube. There are substantial difficulties in communicating an unfamiliar model, but suppose you were faced with the task of designing a general library, so that the inter-relationships of the areas of thought covered by that library were reflected in the structure of the building itself. The design would only be satisfactory if it enabled people to progress from one subject area directly to any other closely related subject area. It would not be satisfactory if people could not go directly from, for example, social science to, on the one hand history, and to biology on the other. Similarly it would not be satisfactory if people could not go easily from music to painting or to literature.

The question is this: what shape would such a library be? The answer is the same shape as a coherent model of ways of thinking. It is interesting to reflect that since the model proposed is three dimensional, such a library could in fact be built. One day, no doubt, it will be.

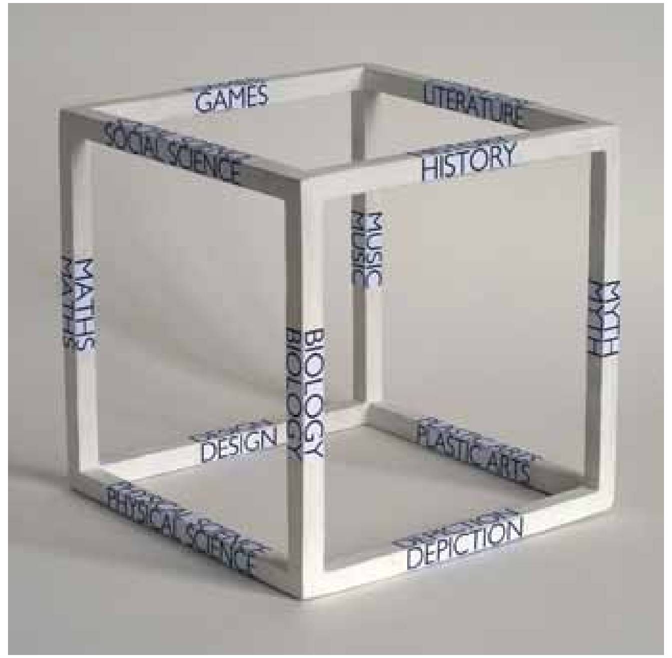
In examining the diagrams and descriptions below it might help to keep this 'coherently related library' analogy in mind. Imagining a journey round such a library may be of particular value. Bear in mind that the library will have a highly efficient stair, escalator and lift system connecting nearby areas to each other. Thus in your journey ignore gravity, which would otherwise bias the structure of the library by making it more easy to travel horizontally than vertically.'

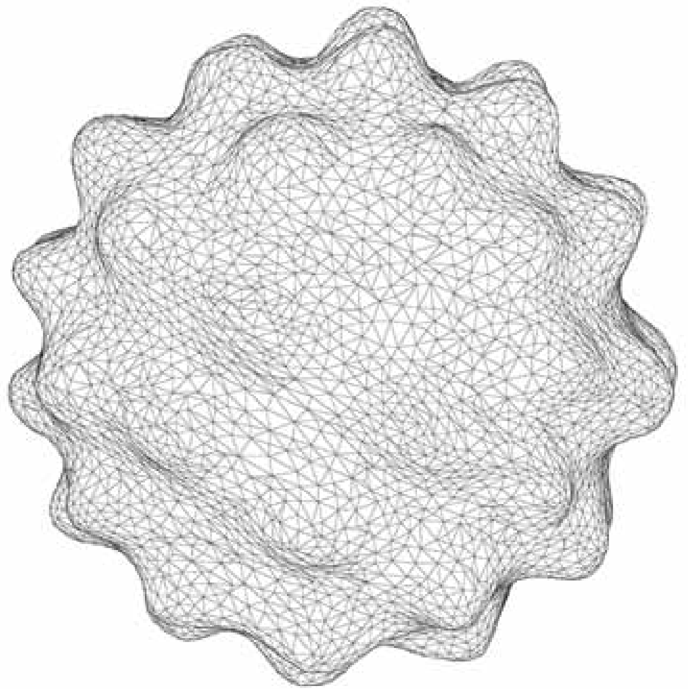
The model became the basis of work done as Library Consultant for the entry by D'Avoine, Fitton, Horne and Pappa for the Bibliotheca Alexandrina Competition in Alexandria in 1989.

From Professor MacDonald's PHD thesis of 1986 (updated September 2011).

Right:
XYZ, archival digital pigment print, image size 68 x 68 cm.
CUBE, archival digital pigment print, image size 68 x 68 cm.

Left:
Black Mamba, acrylic/canvas, 31 x 26 cm.
Alpha Dendrotoxin, archival digital pigment print, image size 108 x 44 cm.
Alpha Dendrotoxin + Channel Form, mixed media, 12 x 10 x 10 cm.
Control, archival digital pigment print on canvas, 26 x 26 cm.
With Alpha Dendrotoxin, archival digital pigment print on canvas, 26 x 26 cm.





Ten Carved Stone Balls from the Islands of Scotland (2009-12)

Carved Stone Balls are among the earliest examples of art in Scotland. In addition they are almost unique to Scotland. Over 425 examples are known worldwide and the majority were discovered between the Moray Firth and the River Tay, especially in Aberdeenshire. Drawing from, and building on, my own and Professor Murdo Macdonald's previous research, this project aims to draw greater attention to specific examples found in the Islands of Scotland, and to Carved Stone Balls generally, by the creation of new artwork that helps re-appraise these remarkable objects.

The examples that we have chosen to study were found in Benbecula, Bute, Islay, Lewis, Orkney, Skye and South Uist. The objects are in five collections: Bernera Museum, Glasgow Museums Collection, The National Museum of Scotland in Edinburgh, The Orkney Museum in Kirkwall and Museum nan Eilean in Stornoway. These examples were all discovered within the geographical focus of Professor MacDonald's Window to the West research: http://www.dundee.ac.uk/djcad/research/researchprojectscentresandgroups/windowtothewest/

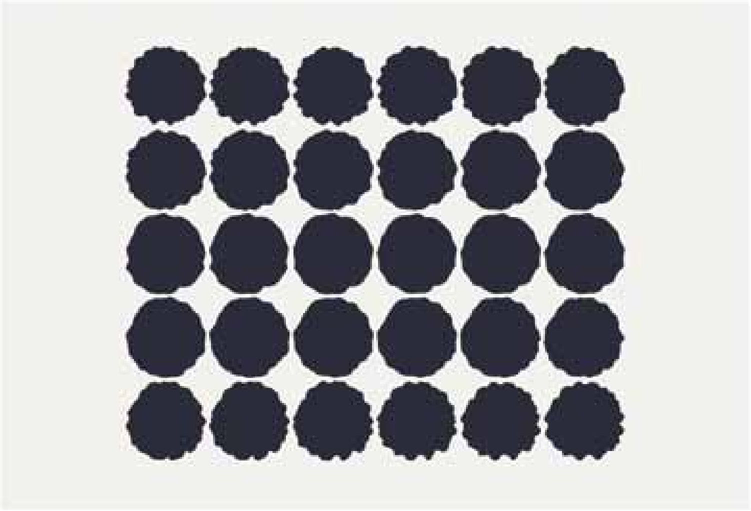
Carved Stone Balls have a powerful sculptural presence and a tactile immediacy. They have from 3 to 160 protruding knobs on the surface, are fairly uniform in size (around 8 - 8.5cm in diameter), and they range from having no ornamentation to incorporating extensive and highly varied engravings. By making new artworks in response to these Neolithic artworks, this project aims to highlight and reveal specific aspects of drawing, geometry, colour, texture and design within this group which may previously have been overlooked and denied to the viewer without access to see and examine these objects closely at first hand.

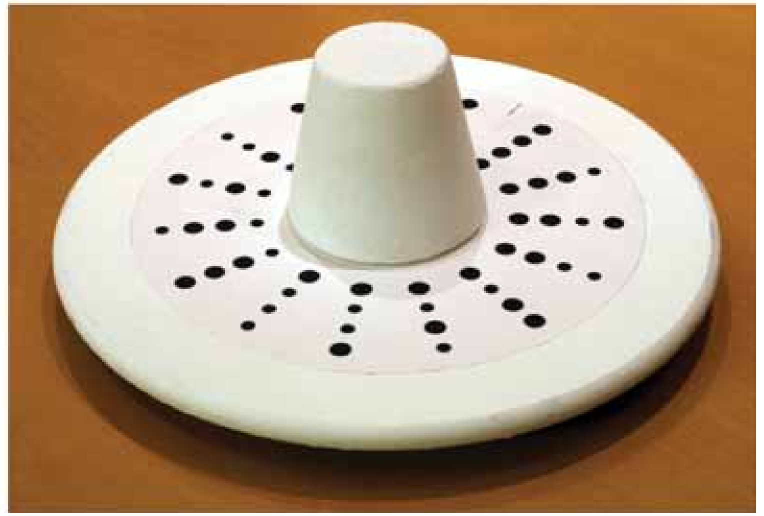
Much speculation has arisen as to the possible function or usage of these easily transportable objects. These proposals range from: throwing objects (or weapons), sink stones for nets, units of weight or measurement, signifiers of power; where the holder might have had the right to speak and fortune telling devices. They have also been studied from a mathematical point of view, as they may be seen to have amongst them all the symmetrical forms of the five Platonic solids. However, there is so little hard fact to be obtained from the evidence available about Carved Stone Balls that conjecture as to their evolution and use is very difficult.

The first exhibition of this series of 50 images will take place in Taigh Chearsabhagh Museum and Art Centre in Lochmaddy in North Uist in Autumn 2012 and will include five images made in response to each of the 10 selected objects. The images here focus on a Carved Stone Ball found at Skara Brae in Orkney.

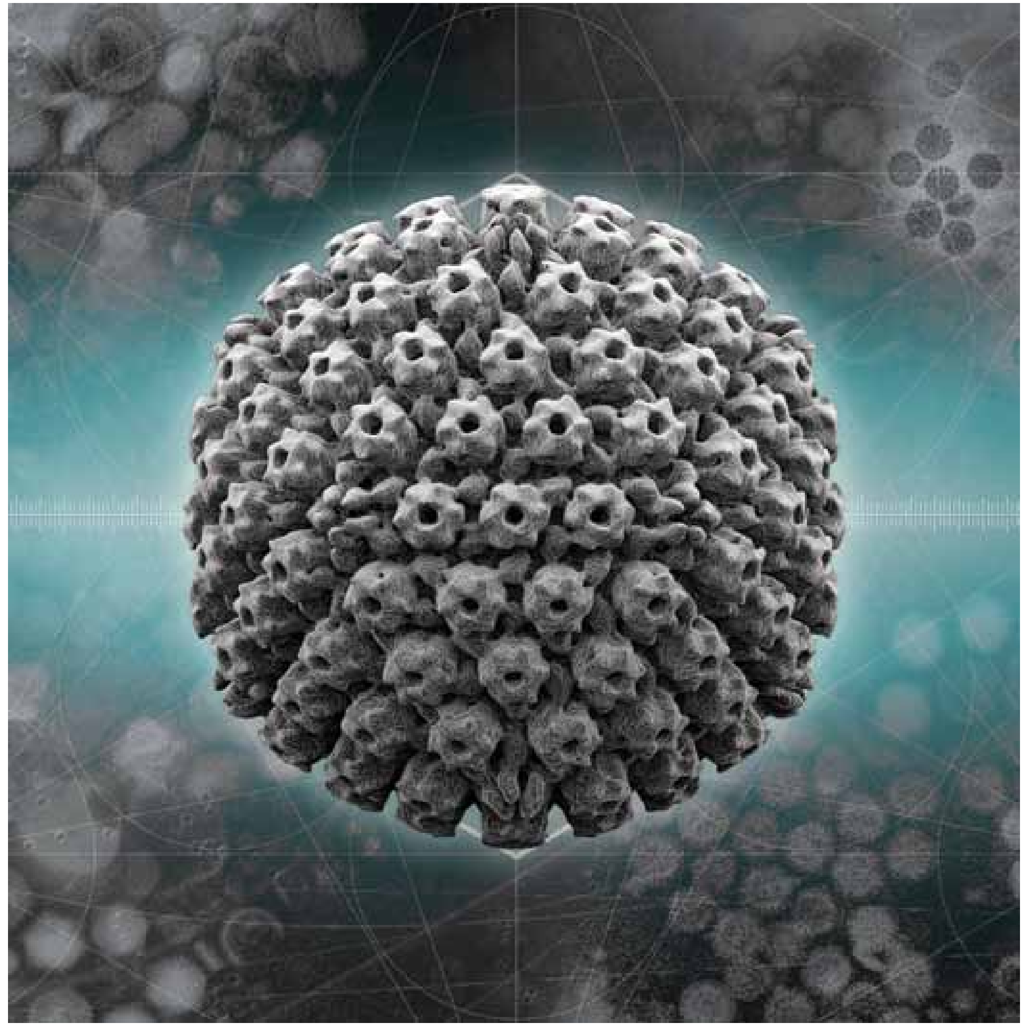
Left:
Skara Brae (Wireframe), archival digital pigment print, image size 68 x 68 cm.
Bottom left: **Skara Brae (Location)**, archival digital pigment print, image size 34 x 24.5 cm.

Right:
Skara Brae, acrylic/oil/canvas/board, 45 x 45 cm.
Skara Brae, acrylic/oil/canvas/board, 45 x 45 cm.
Skara Brae, screenprint, image size 70 x 50 cm.
Strata Calibrated Recording Turntable.





At their best, collaborations reunite things that have become radically severed.
Martin Kemp



Murray Robertson

Chemical elements are the fundamental materials of which all matter is composed. From the modern viewpoint a substance that cannot be broken down or reduced further by chemical process is, by definition, an element.

Notes and Observations

Extract from an interview with Hank Pellisier, Director of the Institute for Ethics and Emerging Technologies, San Francisco, USA. February 2012.

HP. What is your background and how did you become interested in science?
MR. As a young boy I spent many hours browsing in bookshops, particularly attracted to the illustrations featured in volumes on a wide variety of subjects including astronomy, chemistry, biology, history and archaeology. This fascination has remained with me and continues to trigger a response today.

HP. How do you create the imagery?
MR. The images are created digitally using a combination of 3D modeling and photo editing software utilising a variety of source imagery and data. The scientists consulted were able to provide diagrams, charts, micrographs and verbal explanations of their respective research areas. As individual images progressed, further meetings were undertaken to hopefully ensure a balance between the clarity of presentation of scientific ideas and creative interpretation.

HP. Do you believe art is a great way of helping people understand science and new technology?
MR. I believe that art can make science more "accessible" and can perhaps assist in bridging some of the gaps in understanding and awareness of the complexities inherent in new technology. In the projects I have worked on there has been a general consensus from those involved that if viewers of these works are enlightened by even one item then the outcome is a positive one.

HP. Do people ever say "that isn't art?" do they try to separate science and art?
MR. Expounding science based imagery or ideas in a "fine art" context or environment undoubtedly presents challenges to the formal aesthetic values of some people. Especially so, if that imagery is computer generated.

HP. Your images are very beautiful (to me) - are they beautiful to you as well?
MR. I enjoy the creativity, concentration and immersion required for the production of the imagery I create. Perhaps, for me, that is where any beauty really lies. I hope a sense of that pleasure is communicated through the works.

Overleaf: **Symmetry and Scale (detail) - Herpes Simplex Virus**, archival digital pigment print, image size 100 x 100 cm.

Left: Main wall - **Periodic Table of the Elements**, 112 x archival digital pigment prints, 396 x 198 cm (each 22 x 22 cm). Far wall - **Densities of Solid Elements at 298K, View I, Periodic Landscape Series**, archival digital pigment print, image size 100 x 60 cm. Glasgow Print Studio Gallery, 2012.

Visual Elements (1999 - 2011)

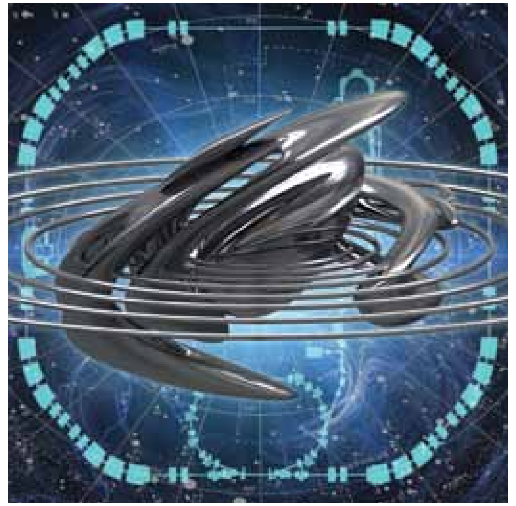
A collaborative project supported by the Royal Society of Chemistry which explores and reflects upon the diversity of elements that comprise matter.

No chemistry textbook, classroom or research laboratory is complete without a copy of the periodic table of the elements. Since the earliest days of chemistry, attempts have been made to arrange the known elements in ways that revealed similarities between them. However, it required the genius of Dmitri Mendeleev in 1869 to see that arranging elements into patterns was not enough; he realized that there was a natural plan in which each element has its allotted place. This applied not only to the known elements, but also left room for elements that were undiscovered at that time.

This interpretation of the periodic table aims to produce a new and vibrant visual assessment of the startling diversity of material that constitutes the world in which we live, not simply by rendering images of the respective elements but also by investigating the manner in which they affect our daily lives in largely unseen and often unexpected ways.

The table produced by Robertson is based on scientific data provided by chemist and science writer John Emsley.

www.rsc.org/periodic-table



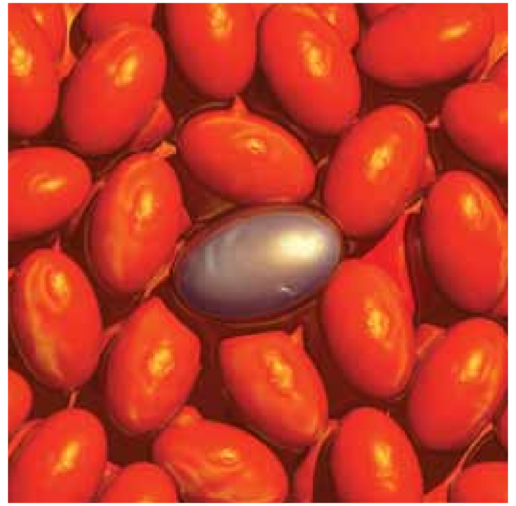
Above: **Copernicium**, archival digital pigment print,image size 22 x 22 cm. Copernicium is the most recent addition to the periodic table. Discovered in 1996 and confirmed in 2009.

There exists a natural affinity between iconography and chemistry. Chemistry, in contrast to physics which leans towards abstract mathematical representation and biology with natural form, relies on symbolism which has a very concrete expression through the physical reality of the elements themselves. It is very much a science of the senses but its sights and smells are at a remove from nature and are penned into a symbolic universe much as the alchemists remained sealed in their laboratories in search of the *Philosophers' Stone*. Thus the chemist, like the alchemist before him, hopes that by reducing nature to its simplest elements and then putting them back together to gain mastery over it. With this end in view, chemistry has evolved as a science based on the symbolism of the chemical elements which are individually loaded with attributes which can inspire artistic expression. These attributes take many forms, historical, geographical, sociological, economic, physical properties and appearance. These attributes ramify when an element's hermetic isolation is breached and it combines with other elements to produce materials with new properties.

There are currently 112 named elements, their standard arrangement is in octaves where the properties of each note are to some extent repeated by heavier elements within subsequent octaves. Because nature is awkward and does not like perfect analogies, after the first two octaves subsequent octaves are disrupted by the introduction of additional blocks of elements between the second and third notes for the next three octaves. The sixth octave remains to be completed and awaits the discovery of new elements.

Robertson has produced a new representation of the chemical elements drawing on the symbolism that surrounds them from the commonplace, nickel in baked beans, to the mythological, Oppenheimer's invocation of Shiva as the genie behind the destructive power of the element plutonium. The images work on a number of levels, and such representations of the elements bring an appreciation of the complexity of the chemical reality which underlies the universe, and promotes the subject as being exciting and full of potential. If it were but possible to fully understand and manipulate this symbolic universe the key to life might be found. The icons used to represent each element are just the surface representation of something that is ultimately unknowable in its entirety. However, the surfaces of these symbols have an arcane aspect which makes us want to look deeper, to experience the element as a living symbol rather than a list of numbers: such as boiling point, atomic radius, first ionisation potential, valency, charge density. The complexity of the physical nature of the elements underlies the images and the image like a cypher compells us to decipher. The importance of this collection of images is that it tells a story, science is not just something remote practised in laboratories but is our modern mythology - we use it to interpret our world and it is a story that continues to unfold. To this end it is very important that art and science are not viewed as separate. Einstein said that the most important quality possessed by a scientist was imagination. In *Visual Elements* we have the alchemist's dream of gold and the philosopher's stone in a modern aspect which we can but hope symbolises a new golden age.

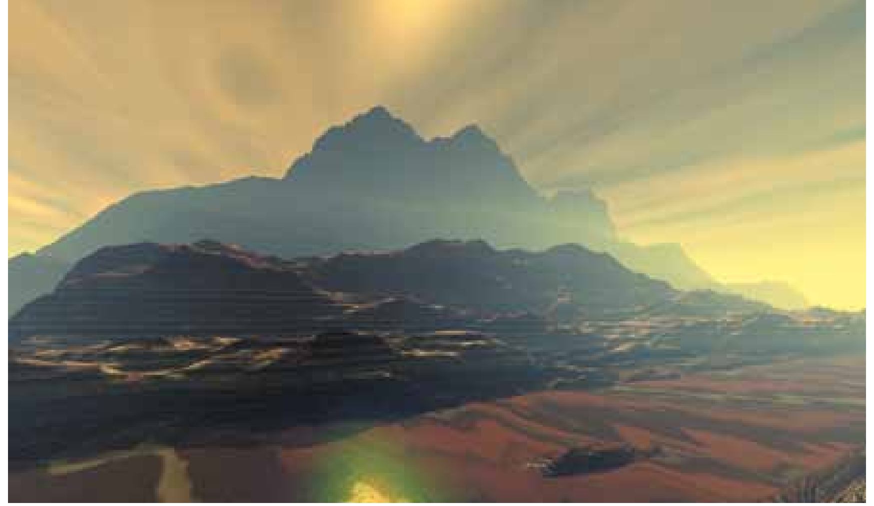
Dr David Watson
Senior Lecturer in Analytical Chemistry, Strathclyde University, Glasgow.



Above: **Nickel**, archival digital pigment print, 22 x 22 cm.
Nickel is an essential element for plants such as the navy bean, which is used for baked beans.

Below: **Plutonium**, archival digital pigment print, 22 x 22 cm.
'A few people laughed, a few people cried, most people were silent. I remembered the line from the Hindu scripture, the Bhagavad-Gita. "Now I am become Death, the destroyer of worlds." I suppose we all thought that, one way or another.'
Robert Oppenheimer

Periodic Table of the Elements. The 112 currently known and officially named elements that currently comprise the Periodic Table (IUPAC 2011).



Visual Elements - Periodic Landscapes (1998 - 2000)

During the development of imagery for the periodic table it was emphasised by the participating chemists that because the table accurately predicts the properties of various elements and the relationships between properties, it provides a useful framework for analysing chemical behaviour. After a series of discussions held with Dr. Anne Prescott (Abertay University, Dundee) it was suggested that the entire periodic table could be therefore be 'seen' as a landscape (or landcsapes) and a series of computer generated views and models based on various patterns and relationships within the table could perhaps be visualized.

The resulting images are generated from chemistry data using entirely digital resources. Two dimensional graphs of the various properties are transposed into 3D bar charts from which the values are rendered as greyscale height maps (where pure white is the highest point and solid black the lowest). These 'maps' are then imported into 3D modelling software and a fractal landscape generated from the respective values.

It is at this point that a purely visual process takes over; the computer wireframe models 'sculpted' to achieve a sense of the general trends or patterns prevalent within the values chosen - also the 'views' taken are a compromise between being able to perceive these patterns yet present a landscape image within more familiar traditional parameters. Inevitably the computer camera view may distort certain aspects of the patterns much as a wide angle lens does in traditional photography, but the intention is that an overall trend can be perceived.

The ionisation energies, relative masses of the atoms and densities of the atoms are rendered as mountainous landscapes with the heights of the peaks and valleys referring to the original 2D graphs. The atomic radii models differ in that they take the form of a 'canyon' in which the diameter of the atom dictates the width between the canyon walls - the larger the atom the wider the gap. The first three models present the entire periodic table whilst the atomic radii model features sections of the table.

From top left:
Relative Atomic Mass View I, Periodic Landscape Series, archival digital pigment print, image size 100 x 60 cm. The periodic table viewed from the north east.
Atomic Radii View I, Periodic Landscape Series, archival digital pigment print, image size 100 x 60 cm. The periodic table viewed eastward from copper towards zinc (left) and silver (right).
Relative Atomic Mass View IV, Periodic Landscape Series, archival digital pigment print, image size 100 x 60 cm. The periodic table viewed from the west toward the lanthanides and actinides

Ionisation Energies View I, Periodic Landscape Series, archival digital pigment print, image size 100 x 60 cm. The periodic table viewed from the north-east with the pillar representing the high values of hydrogen in the foreground, and to the west the peaks of helium and fluorine. The transition metals straddle the centre.

Above: **Densities of Solid Elements at 298K, View I, Periodic Landscape Series**, archival digital pigment print, image size 100 x 60 cm.
The periodic table viewed from the north-east across the transition metals towards the peaks of osmium and iridium.

Above: **Ionisation Energies View VI, Periodic Landscape Series**, archival digital pigment print, image size 100 x 60 cm.
The periodic table viewed northwards across the transition metals with hydrogen centre right.

From everyday coughs and sneezes to life-threatening illnesses such as AIDS and Hepatitis, viruses have a major impact on our lives and our health. Unlike other disease causing agents such as bacteria and parasites, viruses are unable to live and grow on their own, instead they live inside the cells of their hosts, turning them into factories to produce millions more viruses.

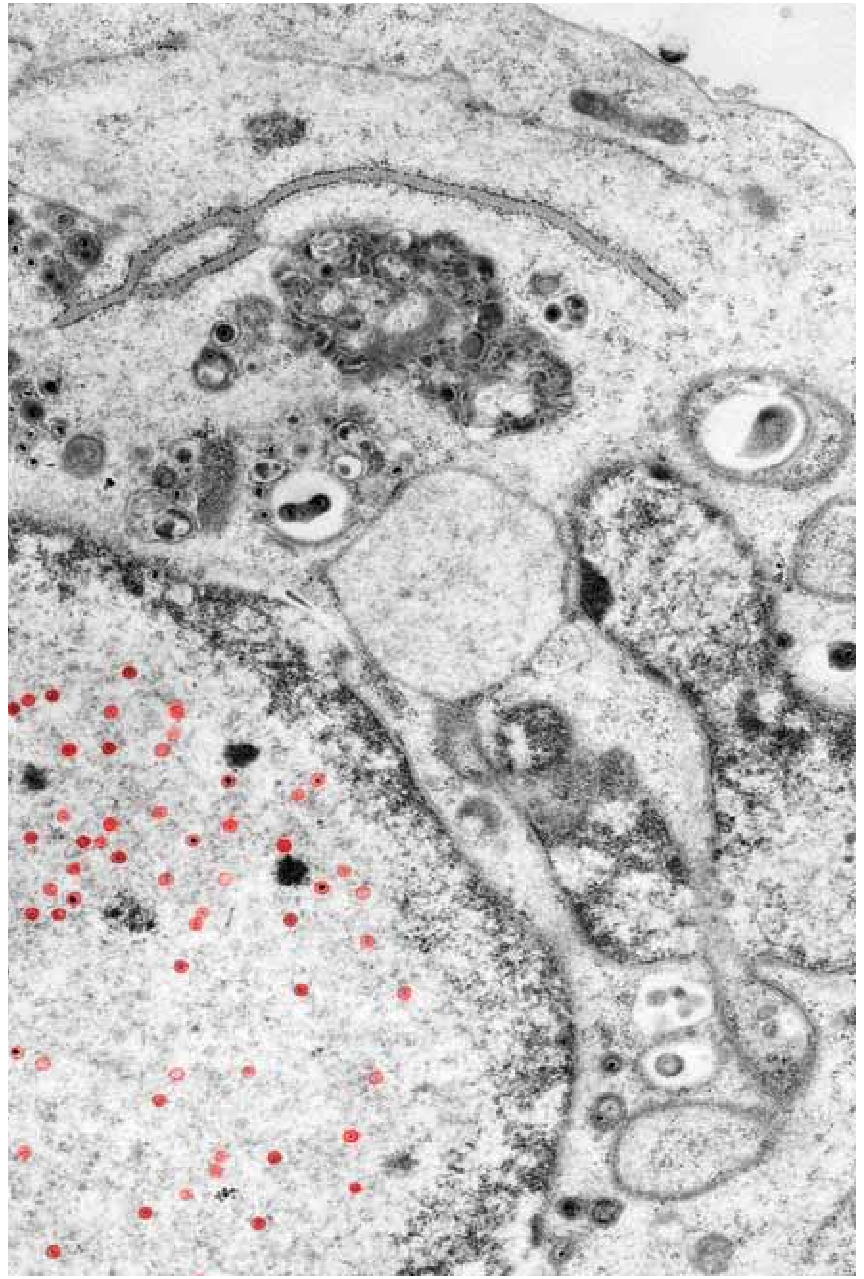
Researchers have made great strides forward in controlling and preventing viral disease through the production of vaccines, for example, against measles, mumps, polio, rubella and smallpox and through the invention of medicines to combat viruses such as Influenza, Human Immunodeficiency Virus (HIV) and Herpes Simplex Virus (HSV).

The snowflake-like abstract beauty of their symmetrical structures, contrasts starkly with the sinister manner in which viruses mercilessly enslave their hosts. Viruses represent an intriguing area of research for scientists working to understand how these smallest of parasites cause disease.

Molecular Machines is a collaboration between scientists from the Medical Research Council - University of Glasgow Centre for Virus Research (CVR) and Murray Robertson, using images from virus research. The CVR employs state of the art molecular and structural biology techniques to investigate viruses, building knowledge that will lead to the development of more effective treatments for viral disease.

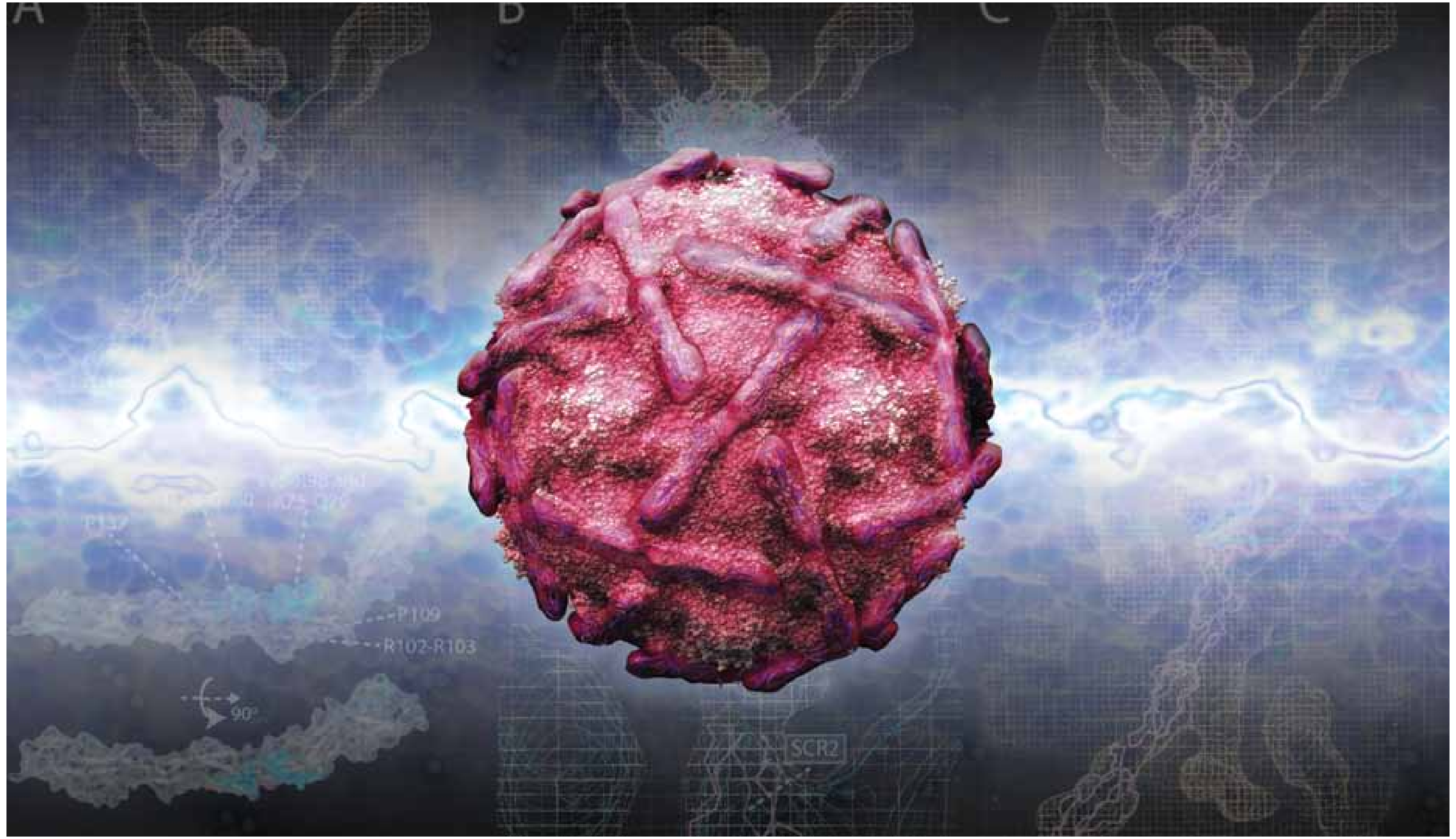
Dr. David Bhella
Honorary Lecturer
University of Glasgow Centre for Virus Research

www.molecularmachines.org.uk



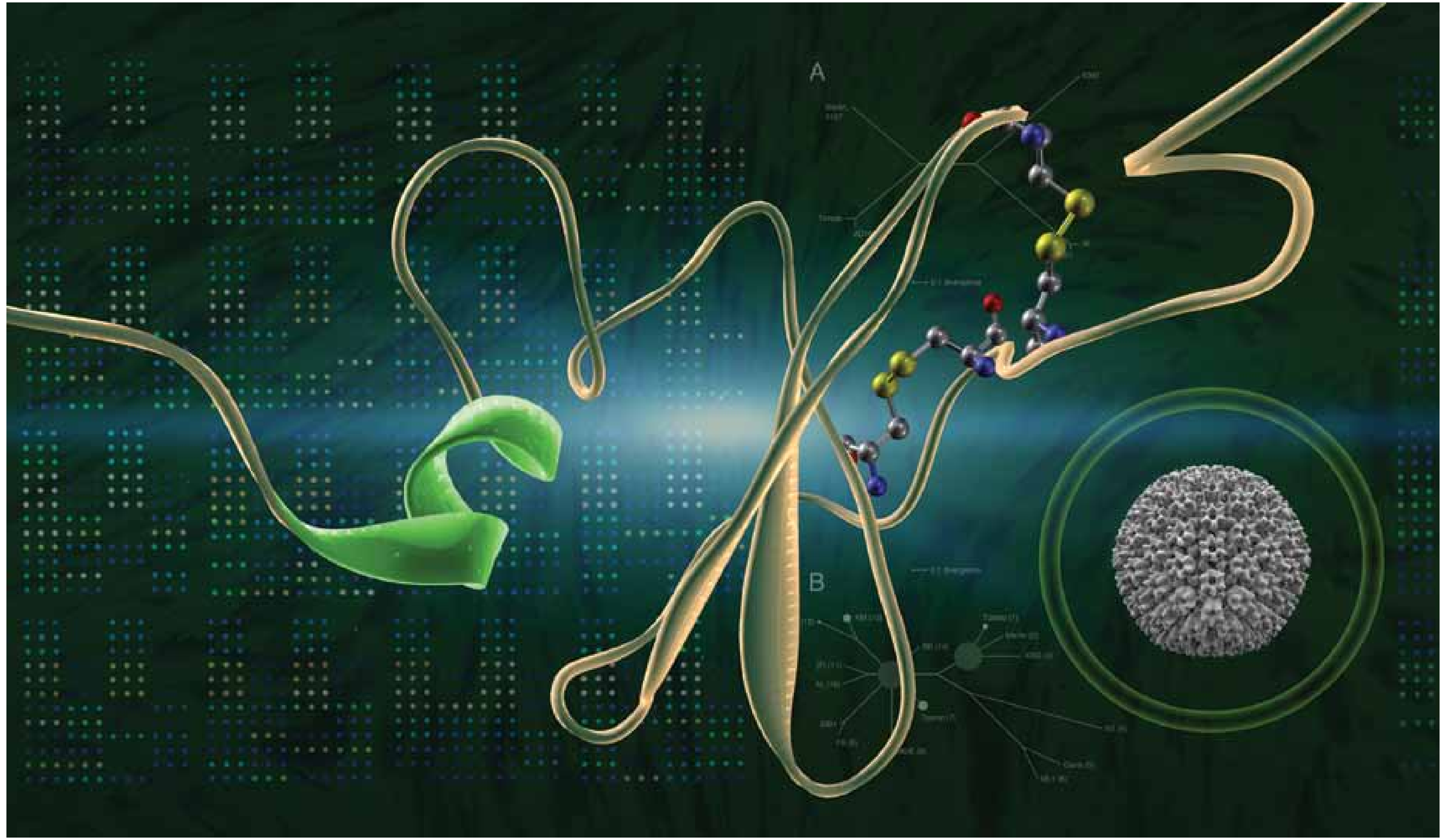
Right: **Thin-section image of HSV-1 infected cells (coloured red)**, detail from archival digital pigment print, image size 68 x 42 cm.

Herpes Simplex Virus (HSV) is a very well studied virus as it is easy to grow in the laboratory. Viruses cannot replicate outside of animal cells so scientists grow cells in plastic bottles. These are then infected with the virus to study how it uses the cell's machinery to make copies of itself. To see what the virus is doing inside the infected cells, they are embedded in plastic and cut into very thin slices that can be viewed in an electron microscope. Data: Dr. David Bhella & Dr. Frazer Rixon.



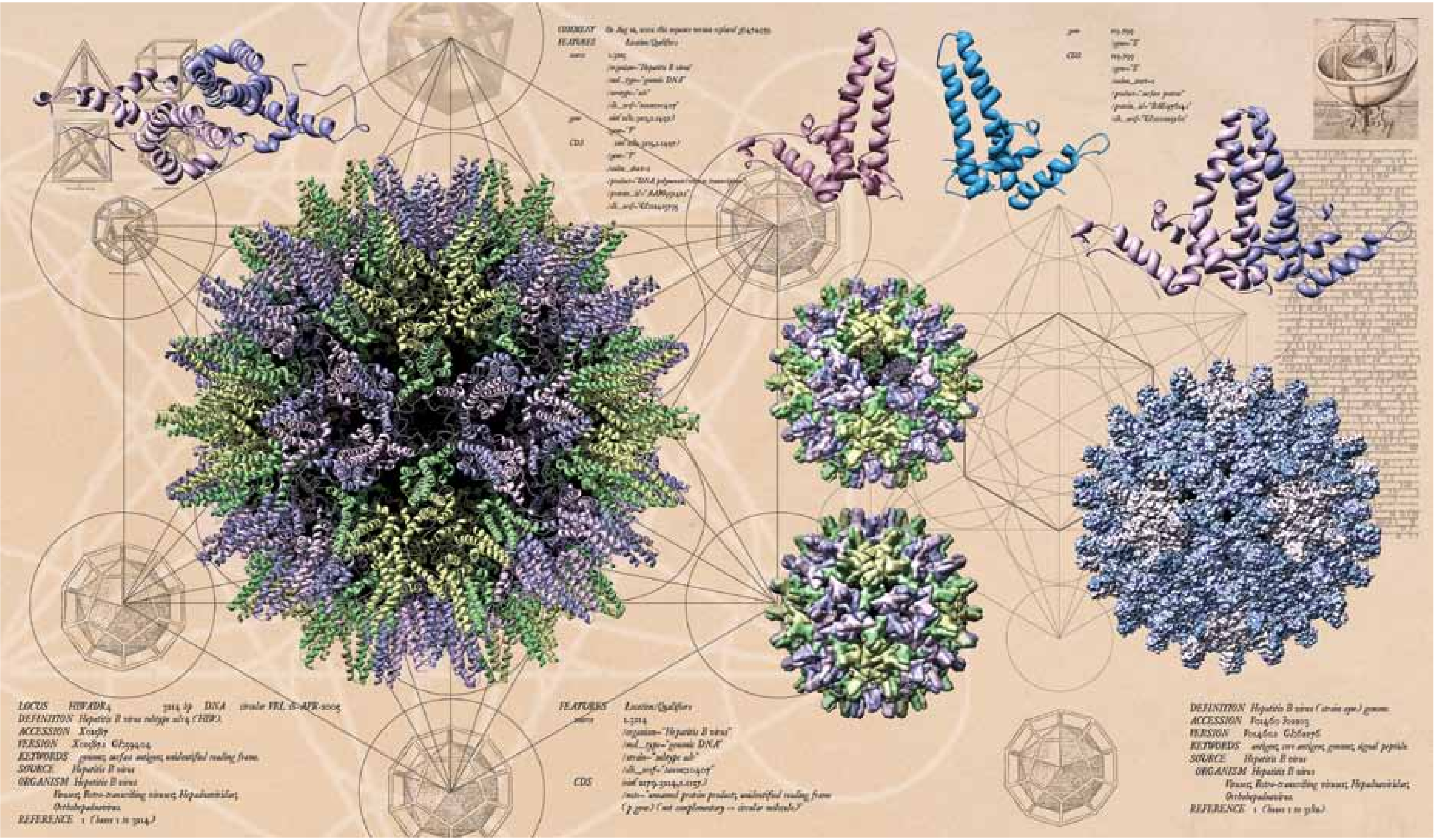
Above: **Echovirus particles bound to their cellular receptor**, archival digital pigment print, image size 84 x 48 cm. Data: Dr. David Bhella

Structural Studies of Echovirus-Receptor Interactions: The first stage of infection is when the virus attaches to the cell. Viruses attach to a specific molecule on the cell surface called a receptor. The receptors usually have another role in the cell but the virus takes advantage of them being there. Scientists study how the virus attaches to the cell because this knowledge can be used to develop medicines to combat viral diseases.



Predicted structure of the UL146 protein from Cytomegalovirus against a backdrop showing a microarray of CMV gene expression, archival digital pigment print, image size 84 x 48 cm. Data: Dr. David Bhella.

Cytomegalovirus (CMV) is a particular threat to transplant patients or people infected with the Human Immunodeficiency Virus (HIV).



HBV Architecture I, structure of the Hepatitis B Virus core and the geometry employed by viruses, archival digital pigment print, image size 84 x 48 cm. Data: Dr. David Bhella.

Viruses have small genomes that contain all of the instructions for making copies of themselves. They have evolved to be very efficient. Many viruses have a spherical protective coat (capsid) that has 'icosahedral' symmetry. An icosahedron is a 20 sided polyhedron made up of triangular faces. These structures are not only economical, they are also very strong.

Above: Nanoscale I, archival digital pigment print, image size 100 x 100 cm.

The insect here is shown next to a silicon chip and a human hair. The length of the insect is a few millimetres, approximately one million times bigger than a nanometer. Using a scanning electron microscope (SEM) much smaller features can be seen. The insect has a compound eye made up of many small eyelets. The diameter of these eyelets is around 15 microns or 15000 times bigger than 1 nanometer. The diameter of these hairs between the eyelets at their base is around 100 nanometers. Engineers can make devices on this scale and much smaller. Routinely, computer memory chips are manufactured that have features of around 100 nanometers and some devices have layers of different semiconductor alloys that are one nanometer thick. The images were taken on an SEM at the James Watt Fabrication Centre, Glasgow University (with thanks to Alexander Ross, Department of Electronics and Electrical Engineering).

“In small proportions we just beauty see ” Ben Jonson

Microelectronics was possibly the most important technology of the 20th century. It was fundamental to many new types of new industries and it led to new companies that produced new and revolutionary products - including personal computers, the internet, mobile phones, games consoles and MP3 players.

The “micro” in microelectronics refers to electronic chips with dimensions at 1 millionth of a meter, 10^{-6}m or 1 micron. In the 21st Century to maintain equivalent progress we need to take this to the next level and operate on a scale of a 1000th million of a meter, 10^{-9}m, or 1 nanometre.

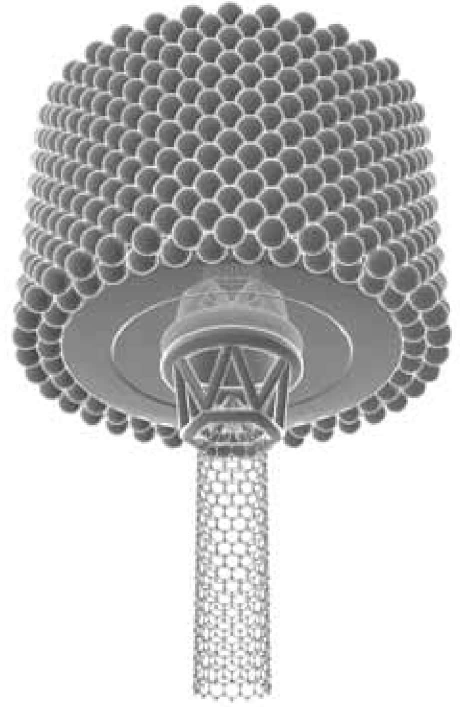
However, nanotechnology will not just be about electronics and physics; it will also include chemistry with new materials, biology and medicine with new sensors, devices and drug delivery - plus many other new applications currently being explored.

The Nanovisions project showcases some aspects of nanotechnology - it is a blend of art, engineering and science. At the Department of Electronics and Electrical Engineering, University of Glasgow there are a three major research groups, nano, bio and opto electronics; their activities involve nano and micro technology including modelling, design, fabrication and characterisation of nanodevices. These activities have received a recent boost from a large investment in a new facility, the James Watt Nanofabrication Centre.

Robertson has used the visual material supplied by the University of Glasgow and other sources and has produced images, stills and animations based on this material. The result is a novel vision of a world of micro and nano features, normally below the edge of our perception, but fundamental to much of the past, present and future of the modern world.

Dr Charles Ironside
Professor of Quantum Electronics (Electronic and Nanoscale Engineering)
Department of Electronics and Electrical Engineering
University of Glasgow

www.nanovisions.co.uk

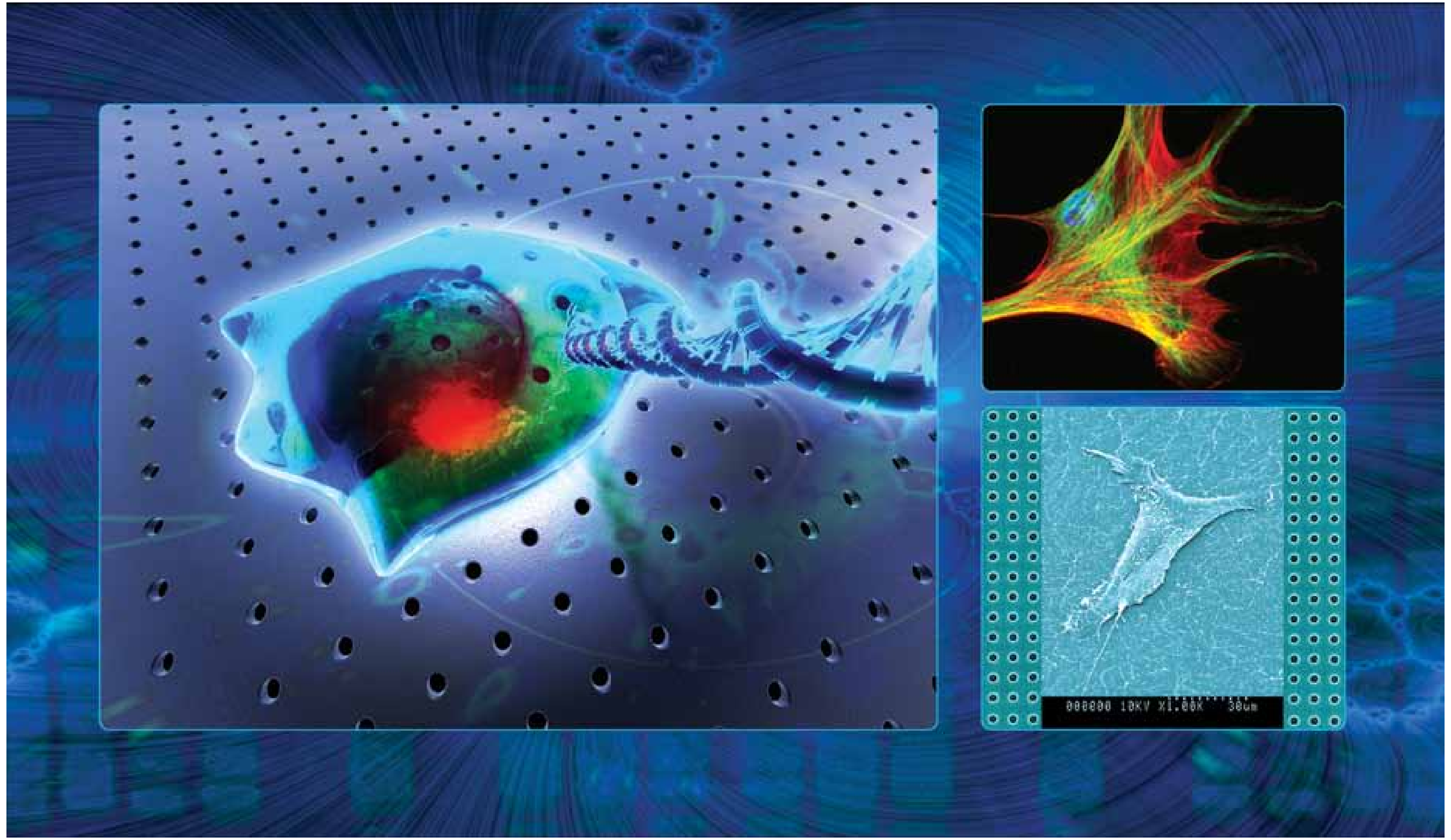


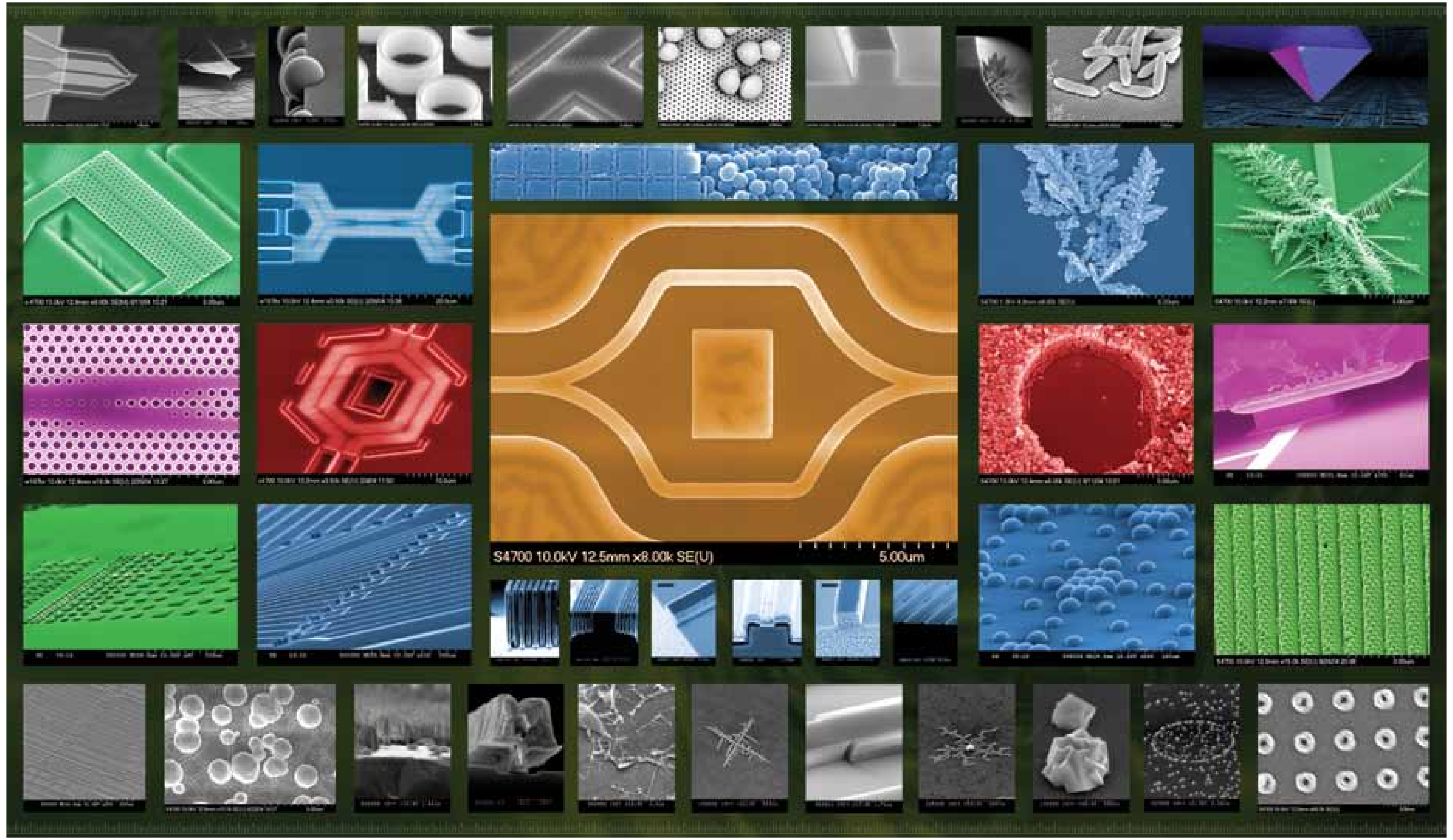
Above: Design for a Nano Carbonbot (Detail 6).

Nanotechnology gives engineers the capability of manipulating materials at the atomic level so that new materials and devices can be put together atom by atom. The Nano Carbonbot is a speculative concept that illustrates one of the future directions that nanotechnology could go in - it does not inviolate any of the laws of physics but some minor and some major technological hurdles need to be overcome before it could be realised.

This device takes the greenhouse gas carbon dioxide (CO_2) and turns it into carbon nanotubes, potentially a very useful material. The carbon dioxide molecule is shaken apart by absorption of light at a frequency resonant with its structure. Many quanta of light need to be absorbed in a process called multiphoton absorption to blow apart a carbon dioxide molecule.

The carbon that is released is captured by growing a carbon nanotube crystal which prevents the CO_2 molecule from simply reforming and produces a strong material. Carbon nanotubes have 50 times the strength of high tensile steel. The nano carbonbot is shaped like a hollow cylinder with an outer photonic band-gap reflector that forms a photon resonator that stores photons in the centre core. Going in towards the centre, the next layers are a semiconductor solar cell that powers a quantum cascade laser that emits at the CO_2 resonant energy. At the centre of the cylinder multiphoton absorption blows apart the CO_2 molecules in the air leaving carbon and oxygen. The carbon is captured at the end of the nanobot and forms the carbon nanotube crystals that grows at the end of the structure. The oxygen is released to the atmosphere. The nanobot is powered by sunlight absorbed in the solar cell part of the nanobot.



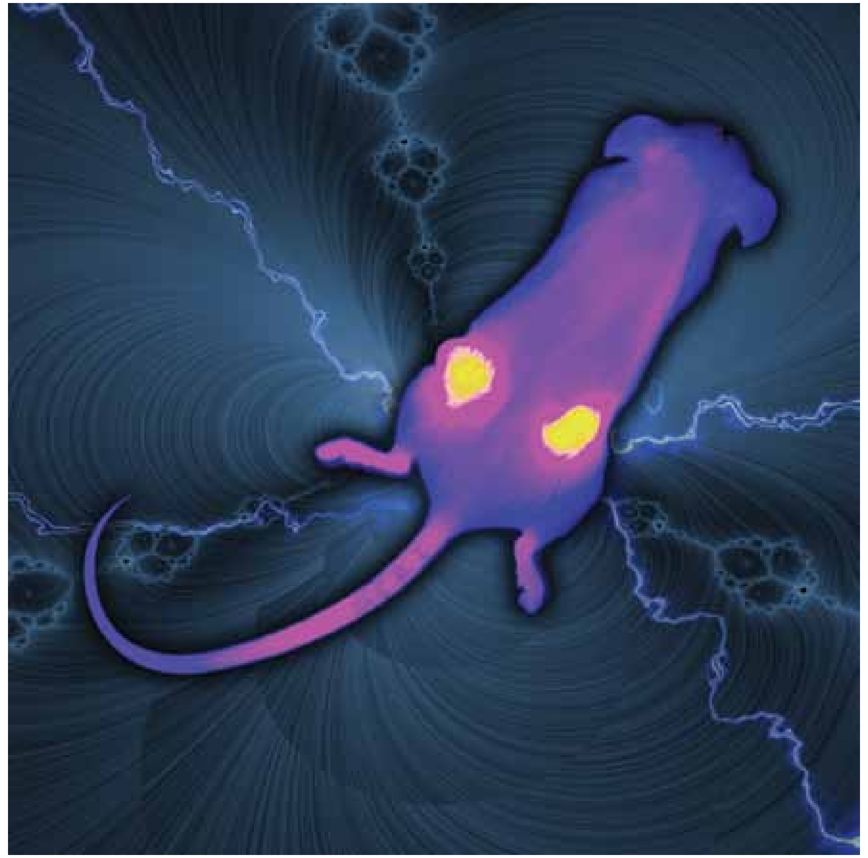


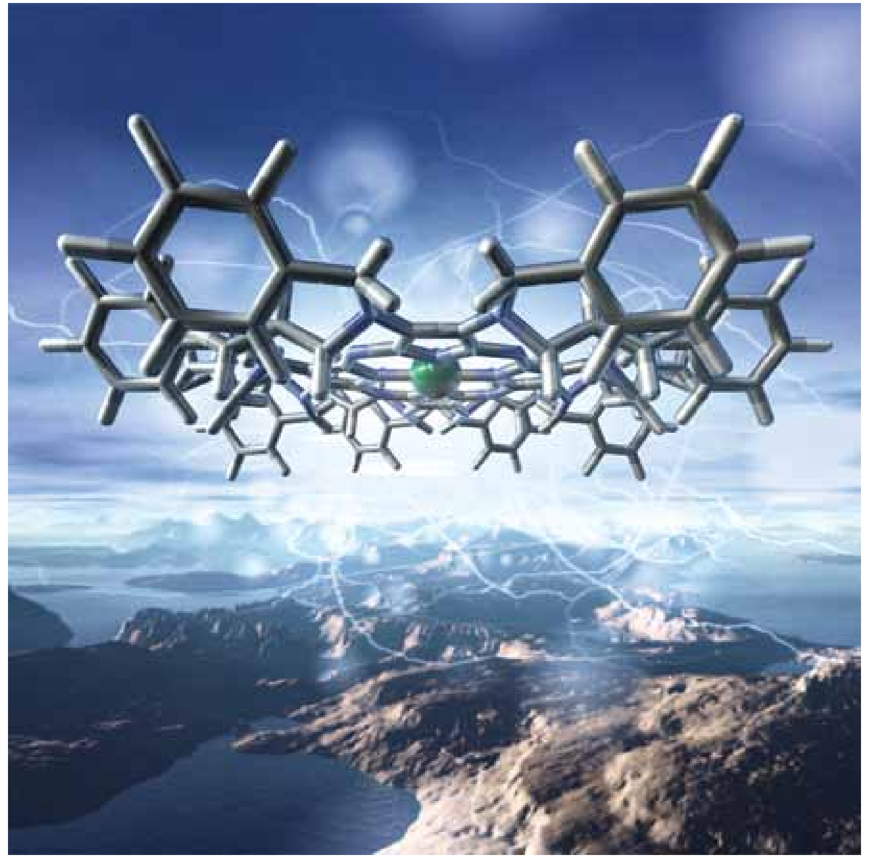
Above: **Tissue Engineering**, archival digital pigment print, 97 x 56 cm. Data & SEMs: Department of Electronics & Electrical Engineering, Glasgow University.

There is an ever increasing aging population which means that more people are facing orthopaedic surgery. One of the most common procedures is hip replacement. Implants currently used often fail due to various reasons, but one of the most common causes is the loss of integration between the implant and the bone. To date, orthopaedic companies have tried to get an interlocking effect by roughening the surface by sandblasting. However, roughening the surface produces a random surface texture which cannot be exactly reproduced from implant to implant. Also, research has shown that sandblasted surfaces may have a negative effect on the bone cells. Glasgow University has developed a technology whereby tiny holes (100 nanometre in diameter, that is 0.0001 mm) can be made in a surface. Semiconductor technology is used to make 1 billion (1.000.000.000) of these holes in one square centimetre. When the holes are arranged in a specific pattern adult stem cells from bone marrow can be encouraged to develop into bone producing cells resulting in mineral production. This means that the cell will make bone directly on the implant surface. This is a substantial improvement over current techniques where cement is used to hold the implant in place.

Above: **Scanning Electron Micrographs (SEMs)**, archival digital pigment print, image size 80 x 46 cm. Data & SEMs: Department of Electronics & Electrical Engineeringz, Glasgow University.

The SEM is a vital tool for nanotechnology and uses a beam of electrons accelerated to energies that give the electron a wavelength that is less than the wavelength of visible light.
By using the SEM much higher resolution can be achieved compared to the normal microscope that uses visible light.



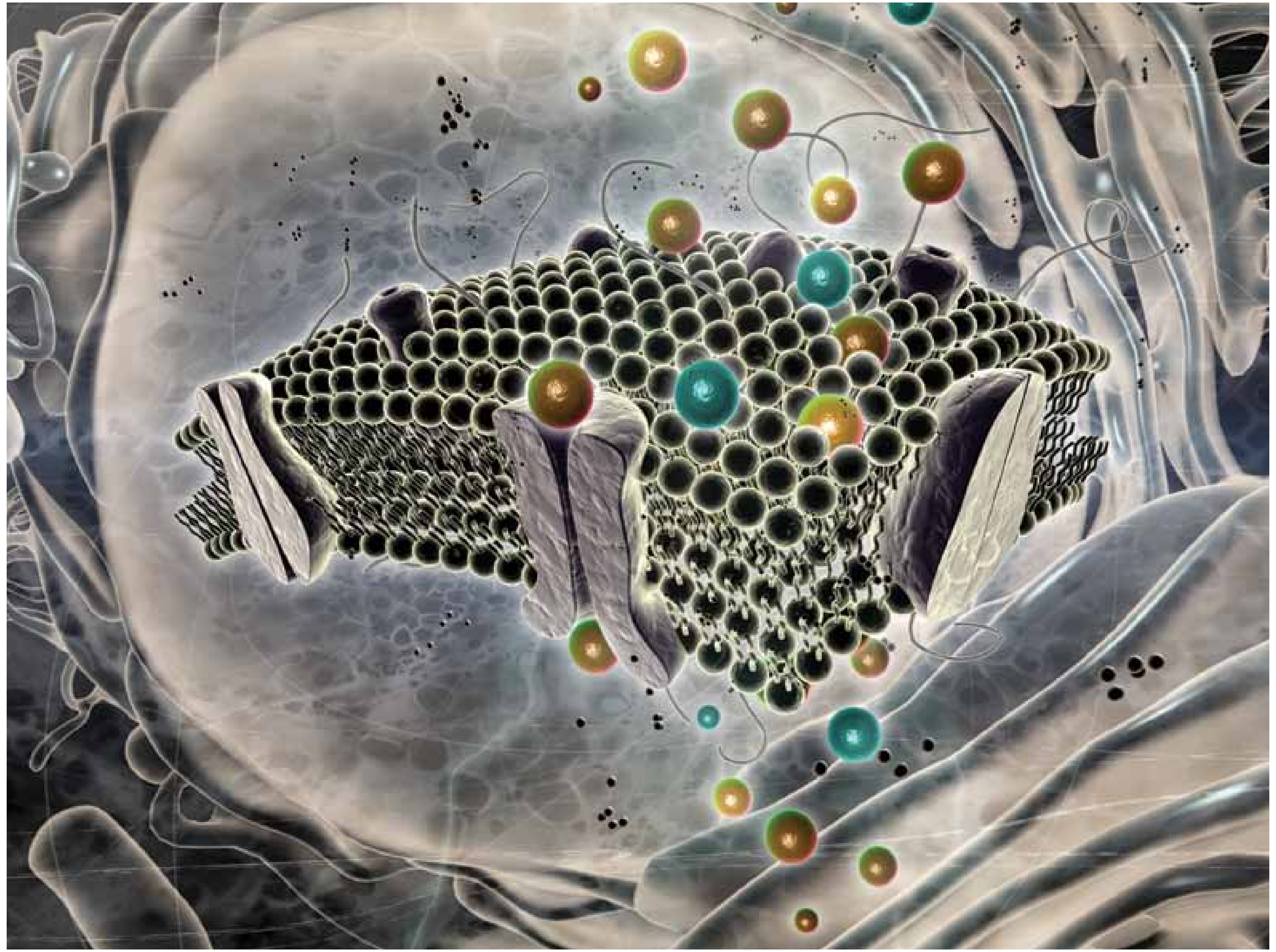


The Synthesis Group, Imperial College, London research programme is focused on the synthesis, characterisation and application of novel organic, organometallic, inorganic and metal organic compounds.

Current projects include the total synthesis of bioactive natural products such as antibiotics, antifungal agents, antiviral compounds and anti-cancer agents. These endeavours, which include the design of new synthetic methodology, enantioselective transformations, heterocyclic chemistry, parallel synthesis and combinatorial chemistry, are directly relevant to pharmaceutical innovation.

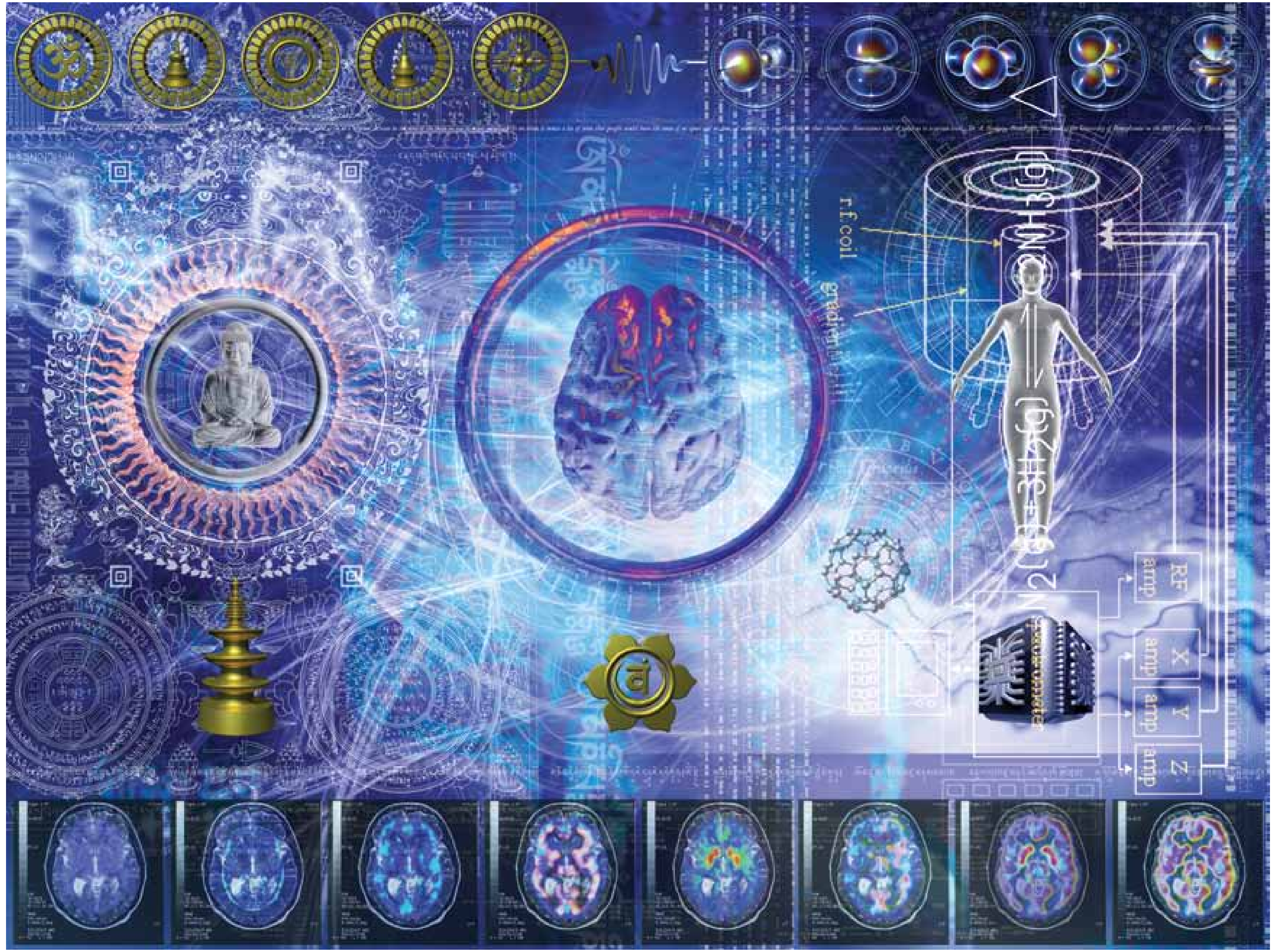
Above left: **Tumor-Selective Optical Imaging with a Chiral Porphyrazine**, archival digital pigment print, 100 x 100 cm. Data & confocal microscopy: Professor Anthony GM Barrett & Professor Brian M. Hoffman. Survival rates of breast cancer patients might be dramatically improved if tumours could be detected in their early stages. Fluorescence imaging with near-infrared (NIR) contrast agents is an emerging, highly sensitive method for tumour detection.

Above right: **Synthesis of Porphyrazine - Octaamine, Hexamine and Diamine Derivatives**, archival digital pigment print, 100 x 100 cm. Data: Professor Anthony GM Barrett. Research shows potential in a range of applications including biomedical agents, novel charge-transfer complexes, chemical sensors, novel electronic materials and non-linear optics.

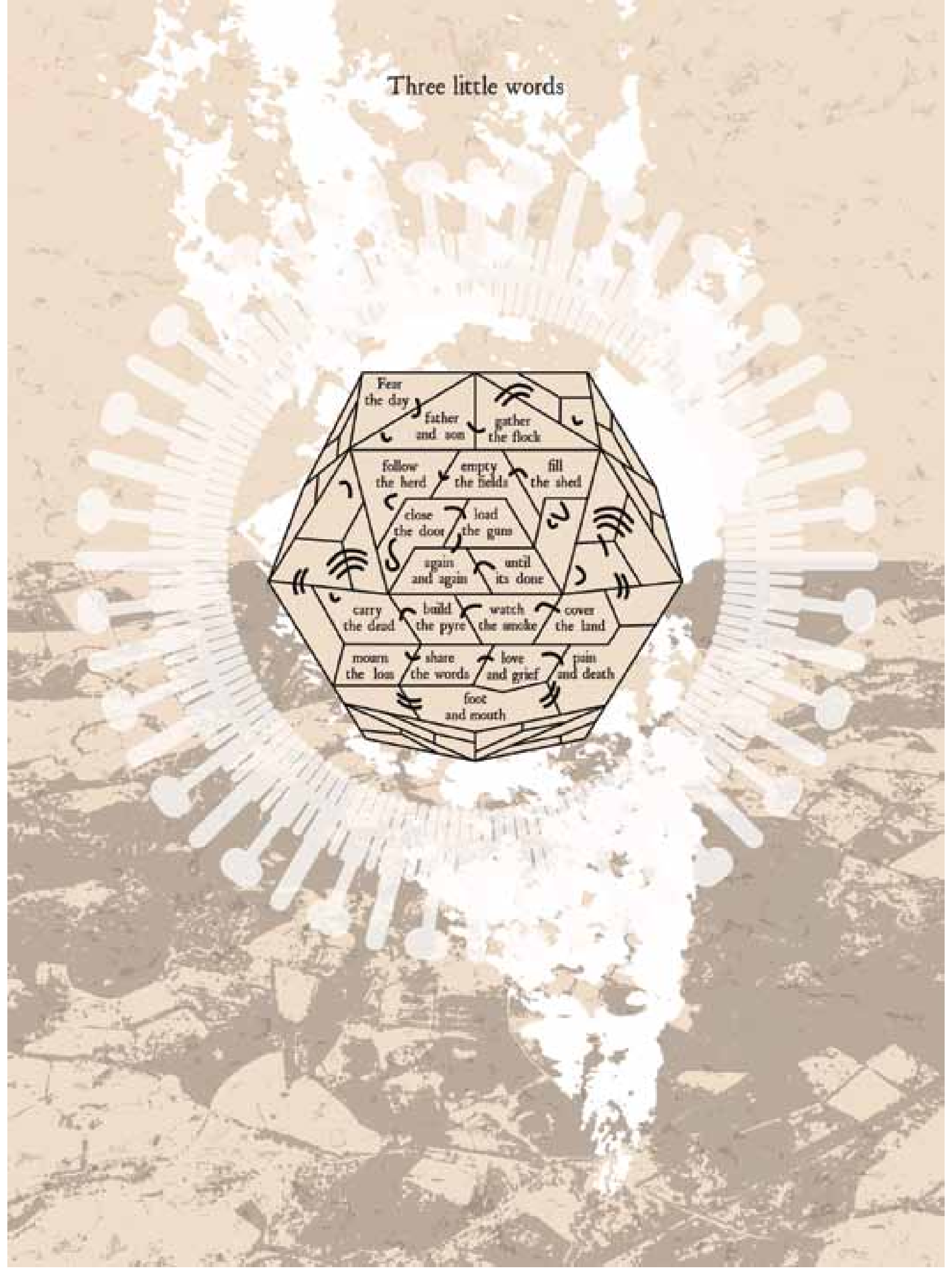


Above: **Drug Interactions with Lipid Membranes**, archival digital pigment print, 133 x 100 cm.

"The field of drug-membrane interactions is one that spans a wide range of scientific disciplines, from synthetic chemistry, through biophysics to pharmacology. Cell membranes are complex dynamic systems whose structures can be affected by drug molecules and in turn can affect the pharmacological properties of the drugs being administered."
Chemical Society Reviews, Issue 9, 2009.



Two Cultures (Magnetic Resonance Imaging II), archival digital pigment print, image size 97 x 73 cm.
"We scanned their brains during a resting state and then again during a 'peak' v of meditation - what we found in our work so far is a relative decrease in the area of the brain we use to orient ourselves. So we think it makes lot of sense that people would have the sense of no space and no time, of oneness with something larger than themselves." Dr. A. Newburg, Neurologist, University of Pennsylvannia on the MRI scanning of Tibetan Monks.



Three Little Words, screenprint, 56 x 76 cm, Jim Carruth and Murray Robertson (from the Poetry Beyond Text project).

The imagery in 'Three Little Words' developed in direct response to both the structure of the original poem by Jim Carruth and its subject matter. Carruth is a poet whose work is often focused on the life of farmers and rural dwellers; in this poem he was responding to the devastating impact of the Foot and Mouth Disease Virus in 2001.

The architecture, which forms the 'shell' of the virus, is often represented in scientific diagrams as an icosahedron with triangular or trapezoid faces. It was felt that these faces would serve to carry the words of the work across the polyhedral form without losing the impact of the poem.

Acknowledgements

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