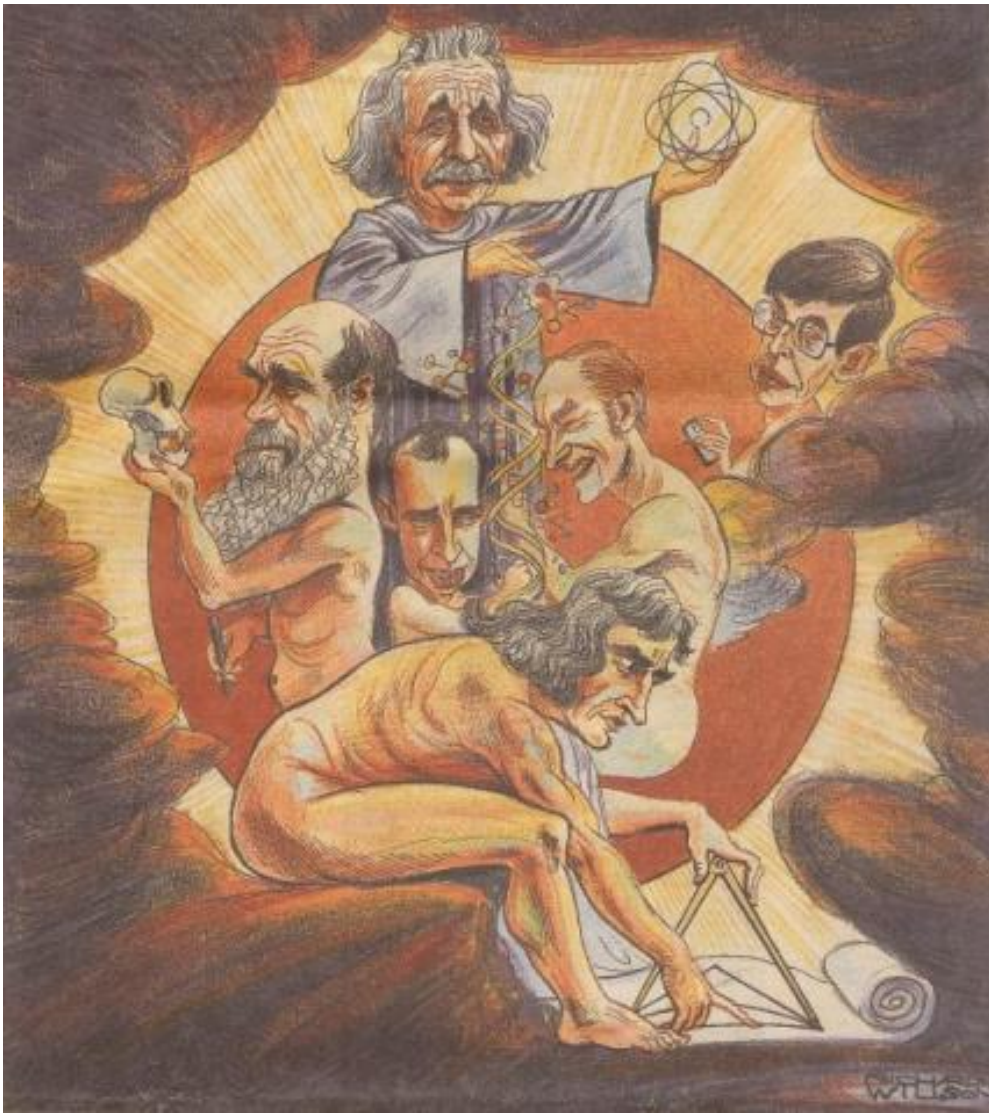
ATUM to ATOM

Book 3: Atoms – their Shapes, Notes and Colours

'GOD DOES NOT PLAY DICE' Albert Einstein

Asia Shepsut

2013



Frontispiece: Richard Willson's evocation of Western scientist heroes: clockwise Einstein, Hawking, Crick, Newton, Darwin and Watson – The Times 7 May 1992

Title and Contents pages: The Ouroboros Symbol

The *Ouroboros*, - the snake eating its tail - represents the seamless continuity of the Universe, the reality beyond the illusion of a beginning and end. In the present book it stands for the meeting of Ancient with Modern knowledge, and encapsulates the idea of recurring octaves in cycles – *the one on the title page is taken from an Alexandrian Gnostic manuscript with the Greek inscription 'All is One', whilst that on the Contents Page twists into the symbol for infinity*

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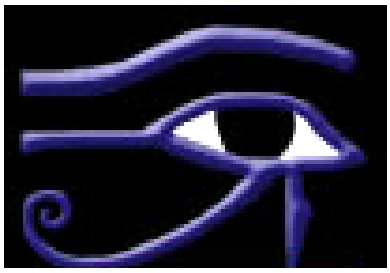
THE GEOMETRY, MUSIC AND COLOUR OF ATOMS

Key numbers: 1 2 3 4 5 6 7 8 (The Octave)

AIMS OF THIS BOOK

The brilliant British recluse and mathematician Oliver Heaviside described the universe as 'boundless towards the great and also boundless towards the small'. To see what is there, the observer has first to move his eye – powered by the all-seeing eye of consciousness – onto the right scale, and all is revealed.



Ill. 3- 1: The Masonic all-seeing Eye of Consciousness on the American dollar bill is based on the Egyptian Eye of Horus the Sky Falcon[1] in the ancient Egyptian religion

This Eye can be positioned to view changes of dimension all the way up the Tree of Life. While living within any one dimension, the others are invisible, as if not there at all - accessible only through a dark hole (which Alice in Wonderland came across by accident). This is the problem of dark matter in a nutshell. We ourselves need to be aware of our own 'travelling eye' as we change dimension: not only do we have a physical eye but we also use the 'eye of the mind', emotional understanding, and ultimately the all-pervading Third Eye of Knowledge and Consciousness (not to be confused with the brain, which is simply their biological processor).

Opening up the world of the atom during the last century has caused momentous changes in mankind's view of life that have been both beneficial and destructive. We have enough hindsight now to assess these, and to check how they might yet dovetail with earlier world views. I write this particular booklet from the point of view of a reasonably intelligent person in the street who is both fascinated by the original discoveries and then puzzled by the continued updates coming in from the key laboratories and universities of the world that imply, 'We don't fully know what the universe is, but here is the latest change you have to make in your thinking – in the meantime put your life on hold until we tell you what is probably the most likely case'. My overall purpose here is first to find out for our own peace of mind what we definitely know about how the atomic world ties in with the laws of music, geometry and colour (whose basics we have considered so far in general terms in ***Books 0, 1*** and ***2)***, and secondly, as an ex-teacher, to offer the kinds of keys we need to hand to our children at school level so that in

[1] See *Utterance 81* from the ***Egyptian Pyramid Texts*** on the Eye of Horus power (follow this link for commentary by http://www.grahamhancock.com/forum/HarveyCH1-p3.htm Clesson H Harvey - referred to again in the final pages.

later life when they move on into the minutiae of specialised fields they have developed the ability to see the wood for the trees - and the vision to really enjoy all levels of their human role in the ocean of the created world we swim in. We remember those lines delivered by Lorenzo to Jessica in ***The Merchant of Venice*** when they look up at the night sky and 'tune in' to the music of the spheres:

> *The man that hath no music in himself, nor is not moved with concord of sweet sounds*
> *Is fit for treasons, strategems and spoils. The motions of his spirit are dull as night*
> *And his affections dark as Erebus. Let no such man be trusted. Mark the music.*

We ourselves, and our children who make the future, have to rub shoulders with the people of treasons and stratagems in increasing numbers, and we should not only enable them to develop in ways to avoid those traps leading to 'the dullness of night', but also to know the arguments that ensure that, although passing through it, they are not limited by it, becoming instead the ones in charge of the best view up the mountain to pass back to others.

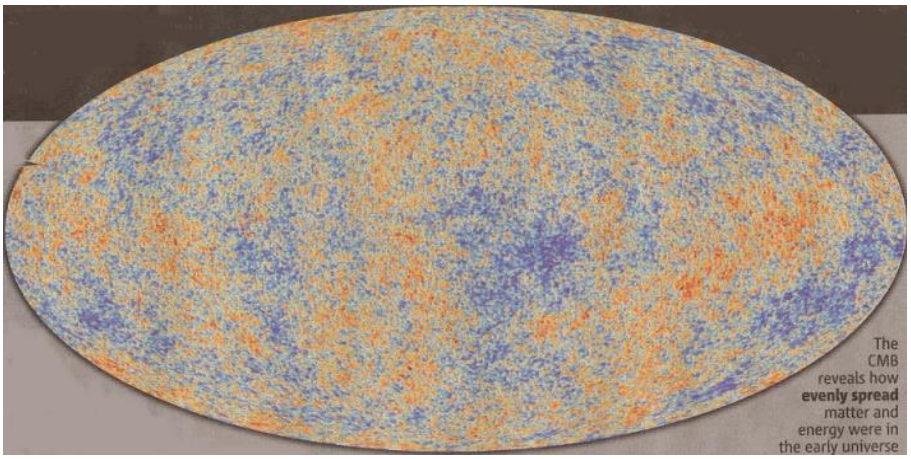
One could easily tell the story of the opening up of the atomic universe from the point of view of the human stories of the scientists involved, as much intrepid explorers into the realm of sub-atomic activity as their forbears were in the Wild West. To some extent they *are* brought in, but by now the few single heroes who stand out (as in our frontispiece) have been replaced by hundreds in teams sitting at computers and monitoring colliders, attempting to push back to new boundaries in the world of matter. We owe a great deal to these data-gatherers, though their interpretation of what they find is sometimes better left to others. Fortunately for me in putting this together, a handful of people and their books creatively and often poetically helped to explain and popularise the quantum world during the last quarter of the 20C, and I would not presume to better them or repeat their coverage overmuch. Not being a scientist, I have fully leaned on others in this particular book, and unashamedly quote from them in large chunks! My purpose is to give the atomic world status as a primordial manifestation of musical law which embraces all things in one huge symphony, and I will suggest further books where the full detail can be pursued, many still classics from the 1980s and 1990s that have never since gone out of print. Not to be left out, of course, are the standard text books used by every student of maths, physics and chemistry which you should use for the basic facts and coverage of the subject, and from which I can select only a handful of signpost examples. Once later books in our series on the finer divisions of the Octave are finished, the fundamentals of the atomic world can be expressed on the Cosmokrator model in rather exciting ways.

Scientists themselves, whilst keen to work out a comprehensive Theory of Everything, tend to eschew the mysticism that the atomic world opens up, seeking ever more elusive particles with astonishingly banal names that alienate the average man in the street as quite meaningless and superfluous to his own experience. It is both the scientists and the man in the street who tend towards materialism as a consequence, maybe because – to use two trite clichés – they have

thrown out the baby with the bathwater, not so much because they cannot see the wood for the trees but, more crucially, because they do not see how to position the wood on the mountain. In fact the atomic level of existence slots in nicely into the Kabbalistic Tree of Life (***Book 0 Ill. 0-26***) rather than being the only tree there is – which is ***The Science Delusion***[2].

AN INTERCONNECTED UNIVERSE WITH NO CENTRE

There is no doubt the twentieth-century journey of Man's mind, eyes and ears into the tiniest of the small - the microcosmos of the atomic realm - has proved to be a turning point in cosmology because it has totally overhauled our understanding of our place in the material world, which scientists such as Max Planck proved is interchangeably wave and solid, the cornerstone of quantum physics neatly summed up in Einstein's famous equation, *Energy = Mass x the speed of light squared* (***E = mc²***). Man-made instrumentation sends our extended Eye as a spotlight into the darkness of a vast nano-universe of miniature galaxies whose substances we also hold in our bodies and negotiate in the world at large. No longer is it 'out there', but 'in us', and at first glance there appears to be no particular Centre of centres. The extreme macro and micro scales gradate into each other due to the uniformity of substance in the entire universe - as Timothy Ferris writes in ***The Mind's Sky***, 'Wherever we look across millions of light-years of space and aeons of time, everything appears to be built out of the same chemical elements we find at home… the carbon atoms of which diamonds and orchids are made are identical with the carbon atoms of the Pleiades star cluster'. So much part of the



Ill. 3- 2: The spread of matter in the earliest universe in terms of visible electromagnetic background radiation, within which is an invisible 99% of anti-matter: photo by The European Space Agency's Planck spacecraft, 2013

public Western world view is this new perspective now (due in part to the popular science writing of the 1970s and 1980s by authors such as Stephen Hawking and others whose names will crop up as you read this book) that even the free ***Metro*** newspaper handed out to commuters on the London Transport system featured the above picture on 25 March 2013 along with other news items about film stars, cooking and West End reviews.

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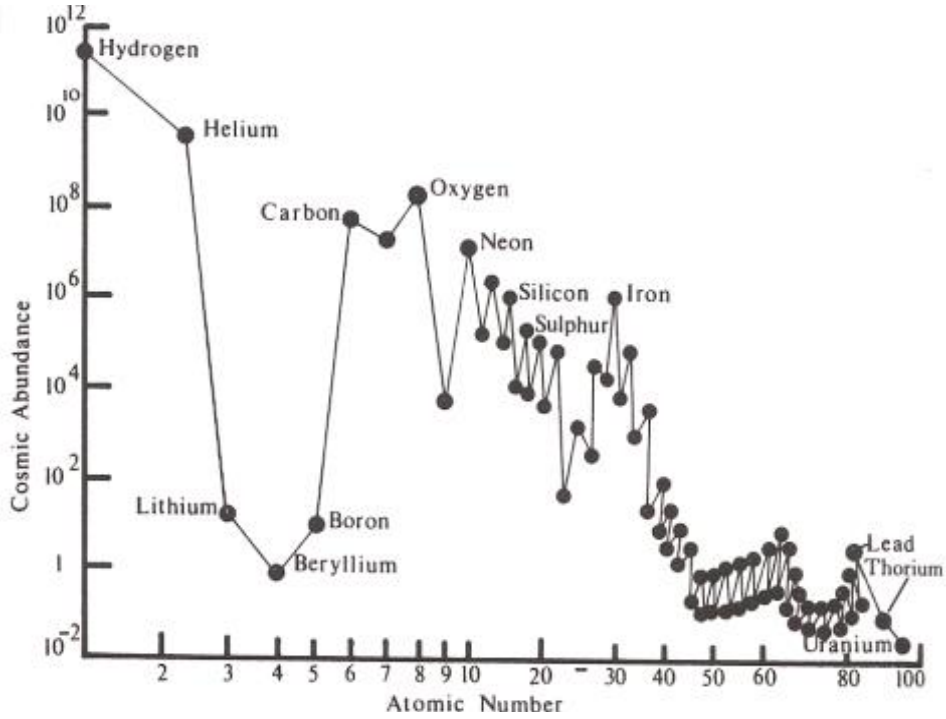
[2] The title of the latest book by Rupert Sheldrake - a riposte to Richard Dawkins' ***The God Delusion***.

THE BIG BANG AND THE UNFOLDING OF THE ELEMENTS IN THE UNIVERSE

Is there an order and scale to the way the elements unfold in the universe? Let us view a preliminary overall picture of the distribution of elements and their order of succession after the so-called Big Bang – which may be better termed The Primordial Sound. The scientists tell us that almost 75% of all matter is Hydrogen (the simplest atom – no. 1 on the Periodic Table) and 24% Helium (no. 2 on it) taking up a further one quarter of our material existence, leaving just over 1% of the rest of the substance of the universe taken up by all the other elements, nearly all playing key minority roles. This in itself is astonishing, as if to say that most of the Universe is still at the stage of sounding Middle C at Hydrogen, with Helium as its first diapason. The ripple of elemental harmonics arising from these two, so important for our very existence, seems precariously vulnerable in the tininess of its proportions. We have to rely on Middle C Hydrogen to keep everything else in continued resonance. As to the order of succession of these 'minor' elements, there is controversy at the highest scientific level about how they unfolded from each other when the universe was created, and this is germane to how we arrive at a definitive version of their arrangement in the Periodic Table. Their order is in turn dependent upon their inner structure and later we will look inside the structure of two elements in detail, those whose combination enables life: water.

Since in the Sun Helium is formed by the fusion of Hydrogen atoms that then form Helium, looking at the succession of ensuing elements, it is likely, according to Harkins, that those with even number atomic weights are more abundant because doubling up through fusion of even-number predecessors in order of creation (e.g. Hydrogen (1) to Helium (2) to Beryllium (4) to Carbon (6) to Oxygen (8) to Neon (10)) leaving nothing over when compared to combinations

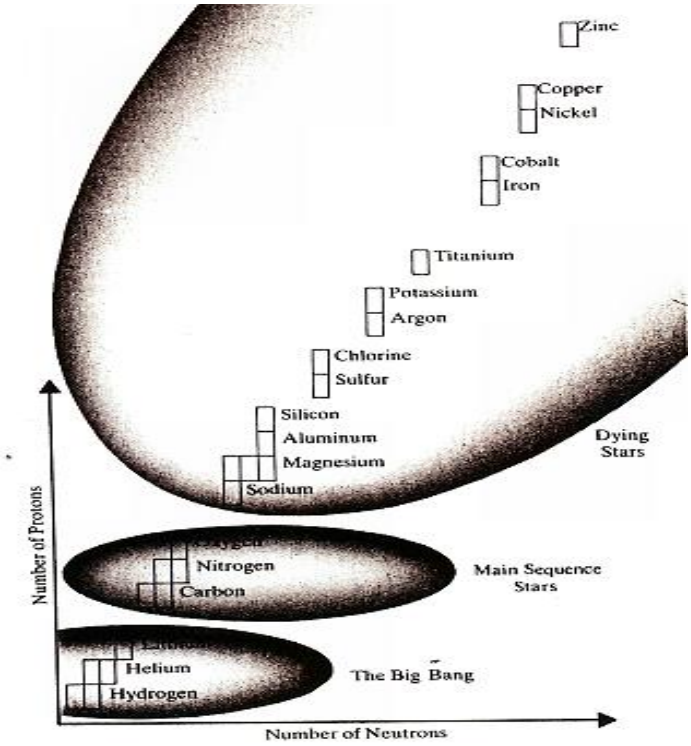


Ill. 3- 3: Relative abundance of the 92 naturally occurring elements –Ferris after Taube

between odd-number elements (e.g. Lithium (3), Boron (5), Nitrogen (7) and Fluorine (9)), the idea being that elements will not so easily fuse if they do not 'fit' exactly into each other (how this fitting works we look at in due course). The even number elements that engender each other also result in more stable elements because numerically the 'ball bearings' of their cores stand, as it were, foursquare.

Because exploration of the atomic universe has proved the presence everywhere of the same building blocks of matter, in theory signals in the form of pulses can be transmitted from any one part of the universe to any other: it is totally intercommunicative since the universe is isotropic – the same, in terms of elements available, in all directions from wherever the observer, and any extensions of his senses, happens to be. These are Aquarian concepts and make for quite a change of consciousness from older views that only the top echelons of any hierarchy provide the way into what is needed for the entire structure (as tree trunk to the branches) – yet the eruption of the elements from simple to complex at the sub-atomic level does follow a tree-like succession of branching, meaning Hydrogen and Helium seem to be the tree-trunk, as it were. So there is in fact an inevitable hierarchy of succession at subatomic level in the initial process, and that remains embedded within the atomic ocean of seeming uniformity. Once all manifest, Atomic Awareness (morphic resonance) then presupposes instant access to the entire network from any point without needing to go down the hierarchy - analogous to the way the Internet works.

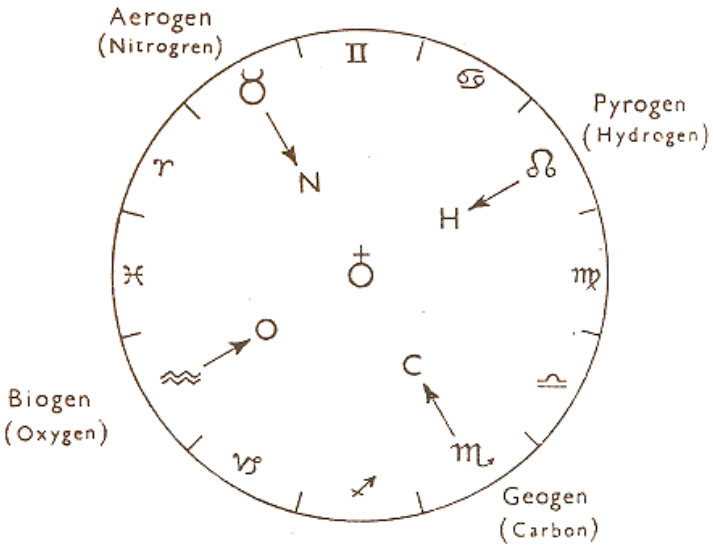
It is believed only Hydrogen and Helium were formed at the moment of the Big Bang, the starting process of the material universe, for only at the extremely high temperature of that



Ill. 3- 4: Presumed three-fold phasing of the genesis of the elements – Reeves via Ferris

moment would it have been possible for the first, most basic two elements to emerge out of the nothingness of dark matter and, more precisely, their antimatter counterparts. Thus current thinking has gone some way forward from Gamov's original view that *all* the elements of the universe formed in the first 20 minutes of the Big Bang, the surplus of Hydrogen being explained by the fact that many protons did not get neutron partners which would have enabled them to become more complex elements. Fermi and his colleagues argued that only Hydrogen, Helium, Lithium and Beryllium could have been formed at the Big Bang stage, and that the elements from 5 onwards would have been engendered by fusion in the 'local furnaces' of forming stars which were gaseous masses spinning round an ever densifying core. Ferris quotes the useful diagram by Reeves (above) showing the main successive stages of the creation of the elements which can be translated into the cosmic element abundance curve he quotes from Taube. Here a harmonic progression is clearly discernible, analogous to playing Doh on any musical instrument or singing that prolonged note, and then noting the reverberations as a miniaturised version of the creation of the elements.

Carbon, the seventh element on the Periodic Table, emerged from combinations within the stellar environment from the nuclei of Berylliuim, and as Barrow puts it in ***Theories of Everything***, much more Carbon than should be expected was manufactured by this process due to a 'coincidentally' precise resonance between this process and the surrounding stellar environment which nurtured it rather than it being swallowed up into further stages of combination. Scientists were at first surprised to find large amounts of Carbon in the earliest gas clouds of the universe, given they expected to find only Hydrogen, meaning that immediately after the Big Bang Carbon should not yet have shown up. Its presence could only be explained as coming from a further stage following the Big Bang, at which the material of the early universe became ionised. If it had *not* ionised it would have absorbed so much light that we would not today be able to see distant quasars, so the presence of carbon is debris

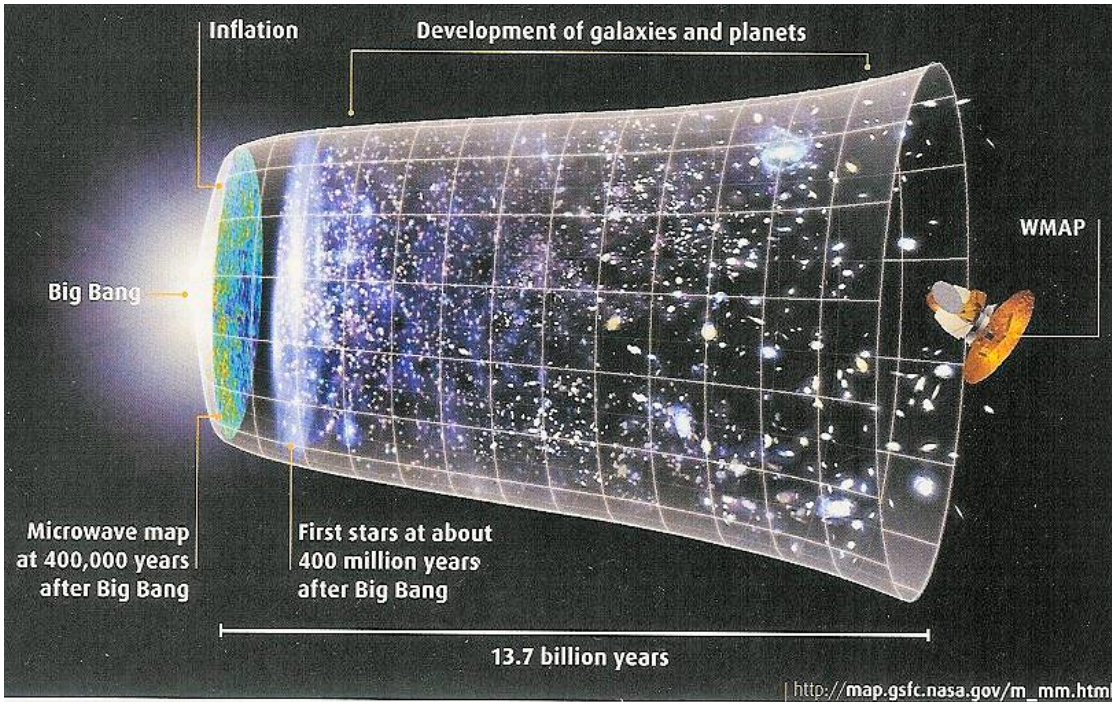


Ill. 3- 5: The Elemental Cross of Earth's Atmosphere – from Hauschka

from burned out stars giving greater volume to the early universe than there would be if no ionisation had taken place. At issue in recent times, of course, is the production of *too much* Carbon by Man in his industrial processes which damages the Ozone/Oxygen layer enveloping Earth, upsetting the balance between them that in the wrong proportions are deadly.

If such large quantities of Carbon had not been produced, organic life as we know it on Earth would be impossible. The Carbon nuclei in turn reacted with further free-flying particles of elements at the heart of stars to form Oxygen atoms which also, providentially, happened to be on a good resonance level for enough quantities to be produced to enable organic life on Earth – at just the right temperature to make sure that not all the Carbon was converted. 'The Carbon atoms in our bodies which are responsible for the marvellous flexibility of the DNA molecules within animal flesh have all originated in the stars as a result of these dovetailings, and it is thus interesting to note how Theosophist Rudolf Hauschka[3] assigns the four key elements in organic chemistry (Nitrogen, Oxygen, Carbon and Hydrogen) to the Cardinal Signs of the Zodiac (above) in what he terms the *Elemental Cross* - matching them in his supplementary labelling to the Pythagorean Four Elements (***Ill. 3- 16***). The addition of Phosphorus provides the fifth element necessary to make the DNA molecule.

Now, after years of accumulated observation and analysis the accepted conclusion is that, following Helium all succeeding elements up to Iron were formed by successive stages of fusion inside developing star cores that had started to evolve out of swirling gas clusters after the Big Bang. Only when stars ran out of the fuel given off by the internalised fusion processes at their



Ill. 3- 6: The Big Bang as presented on the NASA website

[3] Rudolf Hauschka ***The Nature of Substance*** (1950 in German/1966 in English, and continually in print thereafter)

core did they begin to run down and implode on themselves as the heaviness of end-stage Iron dampened fusion reactions altogether. Ferris in ***Coming of Age in the Milky Way*** (1989 and reprints) gives a good idea of what happened next as dying stars started to explode in a fission process: 'When the Iron core collapses it emits a single great clang, and this final ringing of the gong sends a sound wave climbing upward through the inrushing gas from the envelope of starstuff left behind. As the sonic wave rushing outward meets the waves of gas falling in, the result is a shock stronger than any other in the known universe. In a moment, tons of Gold and Silver, Mercury, Iron and Lead, Iodine and Tin and Copper are forced in the fiery collision zone… [and, in time, late-formed] planets inherit these star-forged elements'. We return in more detail to the Big Bang in ***Book 9***, on ***Astronomy***.

THE CHANGE OF WORLD VIEW CAUSED BY ATOMIC PENETRATION

The explosion of knowledge about the atom and its structure in some ways had a negative mental effect on humanity at large since, along with the outbreak of WWI, it destabilised their sense of the permanence and reliability of the material environment. The painter Kandinsky experienced the splitting of the atom as a spiritual crisis, gradually moving from work still recognisably referring to the physical world to pure abstract paintings often inspired by music:

Ill. 3- 7: Kandinksky's painting 'WWI' (left), still a recognisable mountain landscape with prancing horses and (right) detail of 'Yellow Red Blue - Contrasting Sounds', a pure abstract

During the Thirties and Forties most people had got their minds round a semi-planetary model of the atom consisting of the three main particles of neutron, proton and electron, the idea that photons conveyed energy between them, and even that mass and energy could interchange in alternating wave and solid. It was like seeing things in terms of the primary colours, black and white. But by the next generation of physicists these basic subatomic particles had been intricately subdivided along the lines of the microtones of Hindu music (of which more in ***Book 13***). They lifted the lid on a yet more minute world of over fifty possible subatomic particles - causing confusion certainly to the layman and even to scientists themselves. These were seen either as constituents of particles already known, or further ingredients seemingly needed to

explain atomic behaviour, as if parallel to moving from the three primary colours to the 256 imaginable hue nuances the computer spectrum could by now differentiate. It took some decades before the harmonics of subatomic ordering could be brought under some kind of overview also – but we are getting ahead of ourselves here.

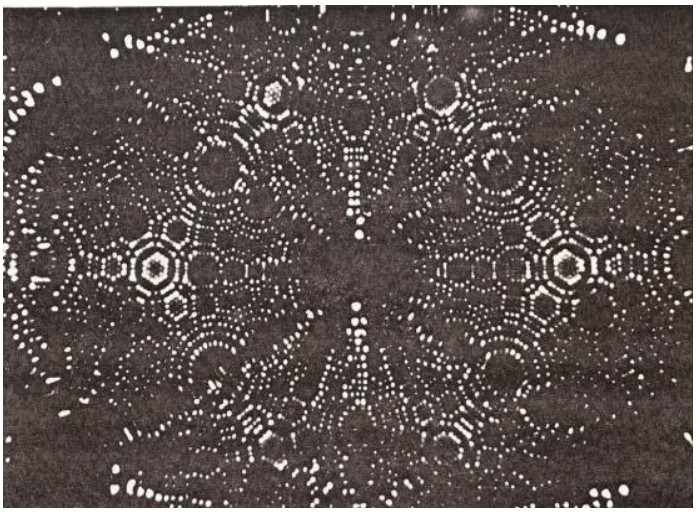
One way or the other mankind has now learned to incorporate the atomic viewpoint into its perspectives on life. I was amused to hear Stephen Hawking at the time of writing this in December 2013 saying he was glad his ***A Brief History of Time***, the highest recent best-seller after the Bible and Shakespeare, meant that society was 'not just subject to Religion and Politics'. There is no avoiding living in the atomic dimension because it exists - and its metaphysical benefits should in the end enable a new balance spiritually. As Galen Strawson expressed it so well in a review of two science books in ***The Independent on Sunday*** of 21 February 1993*,* 'In one large region [of the Universe] there is simple, repetitive, passive order. In another, there are the shattering cascades and unserviceable intricacies of chaos. *In between, at the edge of chaos - a special region in itself - lies an area where rules become optimally powerful and creative'*. In other words, although the harmonies of life struggle constantly to survive the onslaught of the destructive forces of dissonance, still the overall balance is held by the forces of order – otherwise nothing would last. In fact his words call to mind those two contrasting paintings by Kandinsky just illustrated, full of both chaos and order.

So the aim in this book is to look at the world of atoms from the point of view of its order, rather than of intermediate phases of its intermediate formation or change – and especially to consider any obvious musical structures. Despite all the competing rhetoric of physicists and chemists to find one theory that sums up the whole of science in one equation (several of which we consider in the later Cosmokrator book on Astronomy) the best Theory of Everything staring us in the face are the mathematics of music itself. The enlightened writers of that 20C Golden Age of science writing will help me pick out just such structures, hoping to provide you with simple keys to open doors beyond the more prosaic, but necessary, chemistry text books that spell out the basic facts on each element and their individual uses - this very short book can select only a handful of key elements to demonstrate key principles.

In fact, atomic physics and modern astronomy together demonstrate in new mode the old Hermetic saying: 'As above, so below'. By the late 1960s it was realized the behaviour of matter was of direct relevance to the detective work being pursued by astrophysicists into the makeup of universal matter in its interstellar and galactic reaches, and at Fermilab, the major particle physics laboratory outside Chicago, the offices of astrophysicists and atomic particle physicists were wedged side by side. The reason two seemingly opposed fields of science have teamed up derives from their common research into atomic behaviour, the basic units of the Universe's continuous stream of matter, and the elusive particles that form them.

THE SHAPES OF ATOMIC BEHAVIOUR

Were we to look at the throbbing patterns of atoms resonating under a field emission microscope, as in the image below, from experience of the ratios and geometrical force-fields learned in ***Books 1*** and ***2***, we immediately feel ourselves on familiar ground, looking at a what might be described as a moving Islamic pattern. But this time we are looking at a cluster of Tungsten atoms on a needlepoint, each dot being an atom (think how mediaeval philosophers

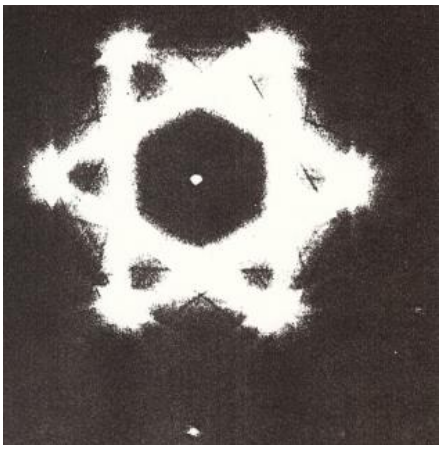


Ill. 3- 8: Tungsten atoms under a field emission microscope – from Keighly

would speculate on how many angels would fit on the point of a pin – perhaps after all the thought was not far-fetched). Each Tungsten atom attracts round its nucleus 74 tiny 'planet particles', or electrons, and as the atoms exposed by the X-rays press together they vibrate under specific constraints of hexagon, pentagon, square and circle, resembling Hans Jenny's photographs of substances excited by music. The dominance of certain shapes and positions in the overall field suggest key harmonics of fifths and fourths interspersed as focal bursts of energy amongst the smaller intervals that crowd between them. Remembering what we have learned from ***Books 1*** and ***2***, we should expect also to hear a very high-pitched music holding this beautiful array of shapes in place, on an extremely high wavelength. We will describe at the end of this small book the work of one man who has tried to notate this music.

To begin to get a sense of how the interior of one atom looks in a frozen moment when its surrounding 'planets' happen to fall into the most regular disposition available, we ourselves as laymen and women are not in a position to check for ourselves because of the instrumentation involved. Here we rely on images supplied to us by laboratories which have perfected the techniques of capturing atomic activity on millions of photographs. A simpler atom than Tungsten is Silicon (below) which has a central core surrounded by 14 tiny satellites moving in three dimensions round it, disposed within invisible spheres – meaning that they all stay at regular distances out from the centre and move in such a way that they do not bump into each other. Cutting through the Silicon atom reveals some of its satellites falling momentarily into a star hexagon around its centre, a structure we have noted on other levels of existence in 6-

petalled flowers, beehive cells or Mercury's six-fold cycle against the sky. From this one element of Silicon, chosen at random, harmonic activity is evident, and in books that cover the detail for



Ill. 3- 9: A silicon atom, prime element of the computer chip - by Prof. Gareth Thomas

all the other elements, the individual number combinations can be checked. Musical interplay in terms of simple intervals is going on all the time in the tiniest structures of matter, in whose chainmail we are all enmeshed, providing the framework of ratio and interval, colour and order. Though we cannot experience it directly, due to the Law of Correspondences the presence of the music can be surmised indirectly in terms of a correlated image – as we have just done – whether in terms of colour (through spectra) or measuring atomic wavelengths which repeat the octaves of audible sound at higher frequencies.

However complex any atom might be (the number of surrounding points can go up to no more than 120 in the naturally occurring atoms), the electron satellites are organized into orbits whose size is dependent on the number of whole movements (or waves) that can be fitted into it. From our knowledge of the whole-number intervals in the Pythagorean scale, it means we must be looking at the three-dimensional harmonic scales to be found in single elements (as opposed to their combinations into molecules considered in ***Book 5***). Later, we list the simple number sequences that govern the diameters of these atomic spheres and the numbers of electron satellites allocatable to each 'shell' – whose positioning and sequencing determines the physical nature of each element and how it behaves.

If not in the eyes of the scientists preoccupied with the tedious procedures of precisely measuring these microworlds, certainly to the layman on the lookout for harmonic evidence, both the ordering of atomic structure underlying the amazing variety of all elements, *and* the overall arrangement of all atoms in relation to each other, serve to underline and confirm those traditions about the harmonious nature of the universe passed down through the more 'old-fashioned' cosmologies. As Guy Murchie[4] wrote, 'the views provided by microscopic vision are 'sweeping confirmation of the ancient, but no longer regarded, legendary theory of the 'music

[4] ***Music of the Spheres: The Material Universe from Atom to Quasar, Simply Explained*** (1961 and reprints)

of the spheres', sounding on a subatomic scale the same music of the spheres attributed to the spacing and whirling of the planets themselves by the ancients'.

THE CLASSIFICATION OF ATOMS

The new mythology is atomic. Secularists who scorn myth and religion have complete faith in all the explanations for life that arise from over a century's discoveries about particle physics, even though undetectable by the ordinary human senses unaided. The extent to which we rely on specific chemicals for domestic, medical or beauty use shows how chemistry is active in practical terms on our mode of life in the West.

Although science is often linked to atheism, many physicists have admitted that their work on the sub-atomic world has to them confirmed the existence of God. Einstein famously said 'God does not play dice' – meaning that such is the order and arrangement of this infrastructure of the Universe, that it could not have arisen through mere chance. Now we have the instrumentation to see the basic framework of how atoms and their particles work, we can show from macrophotographs and diagrams those aspects of this dimension of existence which particularly stand out, appearing to tune in with the way the Octave works. This means leaving aside collateral information which can be pursued in other books, leaving us free to home in on how atomic ordering bears out the musical sequences we explored in ***Books 0, 1*** and ***2***.

One of the biggest tasks facing chemists and physicists since the separate atoms of life began to be identified has been how to relate them to each other, like stringing beads on a multi-stranded necklace. All kinds of attempt have been made to arrange the elements into some kind of chart in which an overall pattern can be discerned, and we will look at a few of them. (The full detail of such attempts is usefully given by Asimov in ***A Short History of Chemistry***.) I believe the different models of classification depend on what other disciplines any scientist learned at school – those most likely to make connections to music[5] have had musical instruction somewhere along the line, showing up the intervals of atomic behavior in this light.

Going through all my newspaper cuttings and articles thrown into the 'Atoms' file in my Cosmokrator cabinet over three decades, I came across a book review in the ***Times Literary Supplement*** for 9 August 2002 by R J P Williams on John Emsley's newly published ***Nature's Building Blocks: an A-Z Guide to the Elements***[6] which takes a non-specialist approach by going through the elements from the point of view of their uses, from every-day life to intergalactic existence. It was the reviewer's last paragraph that struck me, so closely does in tie in with Platonic thinking:

> *In his last chapter, Emsley gives the history of the approach to the building blocks used by chemists – the arrangements of the elements not in an A-Z but in the Periodic Table.*

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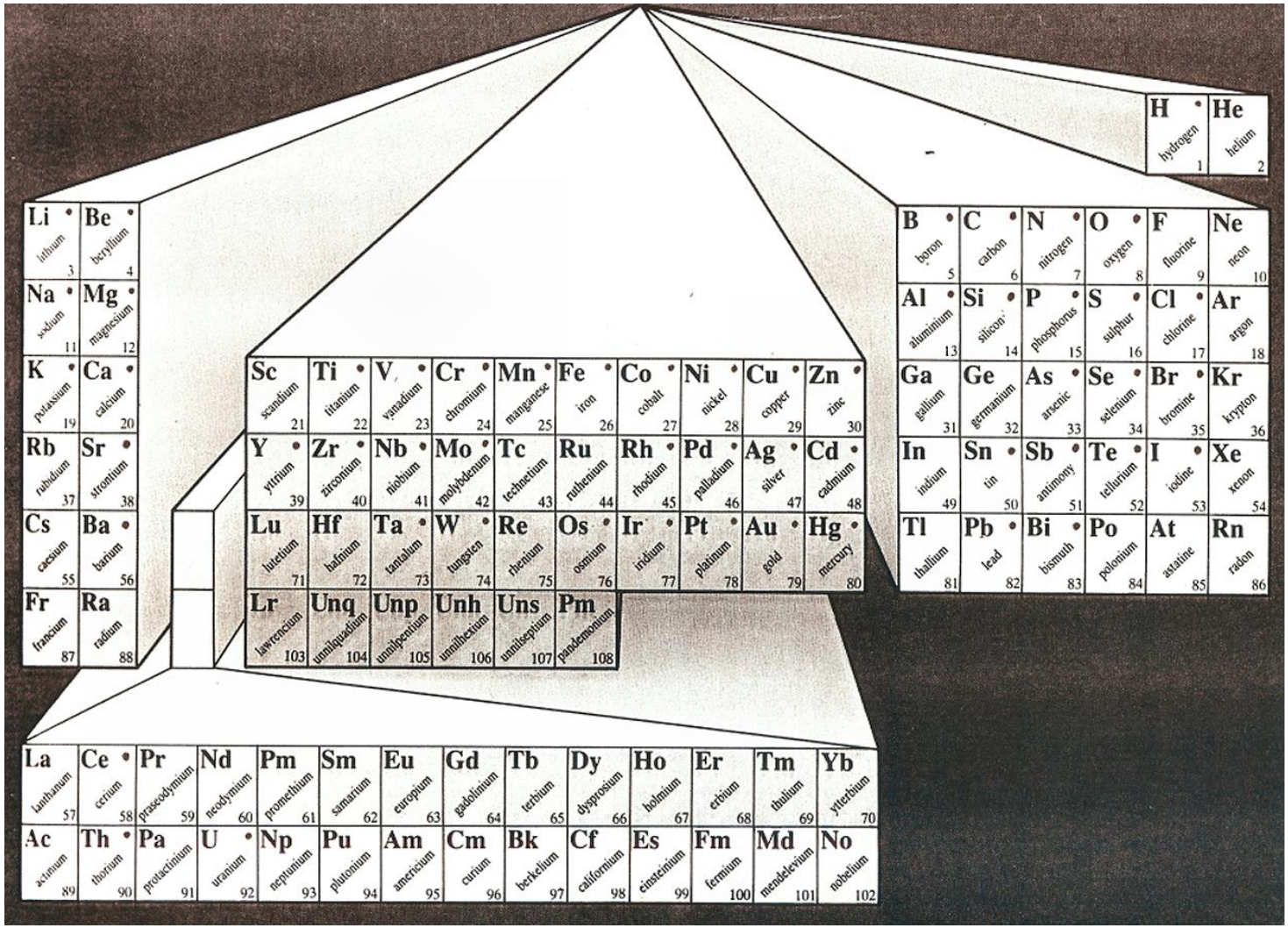
[5] In his book, ***The Act of Creation*** (1975), Arthur Koestler called the blending of two subject areas 'bisociation'

[6] A readable and engaging gazetteer of all the Elements and their uses, first published 2001 and continually in print.



Ill. 3- 10: The overall compact arrangement of the Table of elements - more or less as devised by Mendeleyev – divided up into the commonly accepted blocks (the bottom one should in fact be strung out horizontally between the first and second vertical blocks)

> *In this Table lies for me the greatest surprise mankind has ever uncovered. The building blocks of all systems, the elements, are based on underlying combinations of two or three small particles. They come together in simple numbers, namely 2 x 1, 2 x 3, 2 x 5, 2 x 7, so that there are sets of 2, 6, 10 14 elements. Thus behind all materials is a mathematical feature of the universe – quantified and quantized. The first to the ninetieth building block arise by adding basic particles, one at a time, to make periodic sequences of 2 (six times), 6 (five times), 10 (three times) and 14 (once) sets of particles (plus four), giving ninety elements in total. Chemistry's building blocks are deeply intriguing mathematical sequences, built with numbers, not letters. If John Emsley were to give us an account of the elements based on numbers, not on an A-Z, … the general reader might see that, unlike the arbitrariness of the alphabet, there is an underlying order in the building blocks of chemistry in the universe.*

The 90 elements he refers to are those occurring naturally up to Uranium (plus Hydrogen and Helium, making the official 92), to which a further by now 34 or so *manmade* elements (up to no. 126) have been added over past decades (and still rising, though ephemeral in nature). We consider the arrangement of these later separate element blocks and look briefly at the on-going saga of new additions to the group (in his updated edition Emsley has an Appendix listing the names of people and/or laboratories responsible for 'discovering' them – or should I say 'forcing them into existence').

PRECURSORS OF THE PERIODIC TABLE AND ITS GRADUAL FORMULATION

From Classical times there are enough records (some fragmentary) to show that the known main lustrous metals (usually taken as seven, or nine) were seen as mysteriously associated with the planets – whilst Carbon and Sulphur were also known this early. These featured in the efforts of the alchemists, including Newton himself, to transmute one element into another with a view to making Gold from baser metals. For those on the spiritual path, alchemy provided analogues for changes of state in the purification of the soul, actual chemistry providing the physical combinations and separations as guides for the processes of liquefaction, hardening or crystallization needed for the soul to develop. Now with electronic apparatus and modern knowledge of the structure of the atomic nucleus it is an everyday matter to transmute one element into another by merely adjusting the number of its inner particles – a secret the alchemists never knew, and that would have brought real results to a lifetime of fruitless work.

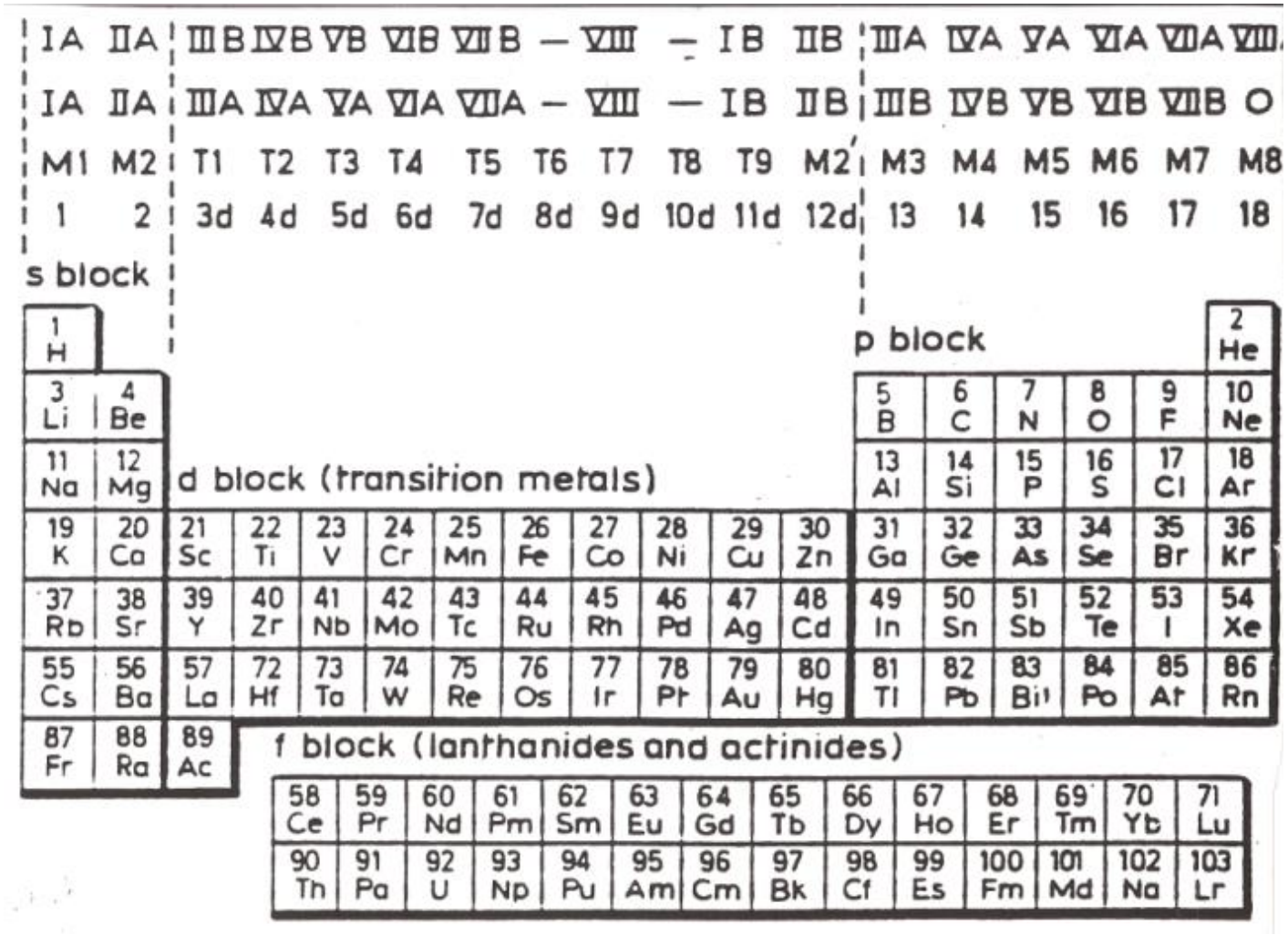
Rutherford was the first in Edwardian times to succeed in changing one element into another artificially, by bombarding the atomic kernel with other atomic particles as if in a game of micro-billiards. The alchemists had tried to do this through chemical interaction which involved mixing substances together physically and – as it turns out with hindsight – only redistributing the satellites of the atomic nucleus, being unaware in their time that

transmutation of any one element into another depends on a redistribution of the core particles too. The benefits and dangers of nuclear energy, genetic engineering and soil, food or drug abuse (including those used by the medical profession) stem from this simple fact. This inner view of the mechanics of transmutation now provides even more telling metaphors for spiritual growth and human effort. Primo Levi, having worked in a colour paint shop all his life, in his ***The Periodic Table*** (1975) associated different people he knew closely with different elements, whether inert or fissile, social and combinable - or solitary and noble. I certainly can see some people acting as Oxygen to human society, others as dangerously radioactive!

'The scientific method' as we know, laying great store on first-hand observation of material phenomena, got under way as High Renaissance lapsed into the Age of Reason in Europe (it had, in fact, been pioneered centuries before in the meticulous recording of sidereal and planetary behavior in Babylon in the last two millennia BC). Now it involved a closer analysis of the basic constituents of physical life than ever before, and from the late 17C and throughout the 18C further common elements apart from the well-known metals, such as Oxygen, were isolated in historic experiments of early classical chemistry. Experimenters such as Boyle, saw that the way to further detail was to break down matter into its constituent particles, counting the proportions by which elements combined in chemical reactions, given they remained constant, following the simple ratios most school chemistry pupils now know without question. Thus began *deduction* (of what cannot be seen) *through observation* (of what *can* be seen).

At the beginning of the 19C Dalton had been the first to take Hydrogen as the simplest unit (1 Dalton) by which to order other known elements in order of relative mass, drawing up a list of 20 elements which due to their combinability in simple proportions he argued must be made up of atoms. In fact some were compounds and the order turned out not to be strictly correct, but Dalton had begun the attempt at ordering matter on the basis of increasing complexity which through many other people's contributions was to end as the grand array of elements on the Periodic Table we know today. All these early chemists realized that the reactions they were observing must depend on each atom having a particulate nature – not realizing precisely how it was determined. Two centuries before, Newton and Huyghens had respectively debated whether light consisted of particles, or waves of different lengths. They would have been surprised to know from Einstein, 300 years later, that both were right. It took three centuries for scientists to realize that *all* matter exists in alternating particle and wave form – and that this phenomenon happens across several orders of octave, as we will see.

The process of observing atomic movement and finding ways to measure the tiny scale of its universe speeded up during the 19C at the hands of Ostwald, Brown, Maxwell, Svedberg, Perrin and others. The idea that different atoms had specific, constant weights was gradually proved



Ill. 3- 11: The same arrangement in 2-D with full itemisation of the blocks, rows and columns

by the work of Avogadro, Cannizzaro, Stas and Richards, and by the time 54 elements were known in 1830 there was speculation as to whether more would emerge. People such as Dobereiner, Newlands, Berzilius and Mendeleyev discerned some kind of periodicity in their qualities pointing towards an octave structure, yet could not integrate them into a satisfactory layout further down the line. It was Newlands in the second half of the nineteenth century who arranged the known elements in order of increasing atomic weight, arranging them into vertical columns of seven according to what he termed 'the law of octaves', for he noted that similar elements seemed to line up with each other at spacings of seven or its multiples, in diapasons.

The rationale behind such ordering is well explained by Hauschka:

> *If the chemical elements are arranged in a sequence based on a scale of increasing atomic weight their characteristic qualities reappear at definite intervals. We find that the seven elements in the first series, arranged according to weight, characteristically show no interrelationship:*
>
> ***Series 1***

Li	*Be*	*B*	*C*	*N*	*O*	*F*
7	*9*	*11*	*12*	*14*	*16*	*19*

> *But if we proceed beyond fluorine the next higher atomic weight belongs to sodium and we see at once that it repeats lithium's essential qualities. Magnesium, which follows it in the second series, shows a like relationship to Beryllium, Aluminium to Boron, Silicon to Carbon, Phosphorus to Nitrogen, Sulphur to Oxygen, and Chroine to Fluorine:*
>
> ***Series 2***

Na	*Mg*	*Al*	*Si*	*P*	*S*	*Cl*
23	*24*	*27*	*28*	*31*	*32*	*35.5*

> *The next substance in the weight series is Potassium, with qualities which are at once recognised to be almost identical with those of Sodium and Lithium. This is the start of the third octave, with Potassium related to Sodium, Calcium to Magnesium, Scandium to Aluminium, and so on:*
>
> ***Series 3***

K	*Ca*	*Sc*	*Etc.*
39	*40*	*44*	

On this reasoning the table started right, but lower down the scale the rationale of repeating octaves could not quite be followed through systematically, and Meyer with an arrangement of elements in peaks and troughs showed that a straight succession of octaves one after the other could not give the full answer. However, by 1958, 92 elements (numbered 1-92) had been slotted into place into what has become the standard Periodic Table. ***The Independent*** newspaper of 4 September 1993 published a picture of sulphate miners at Karabogaz Bay on the Turkmenid eastern coast of the Caspian Sea, which before its disastrous exploitation, said the caption, was 'the only area of water in the world to contain all the chemical elements listed in Mendeleyev's Periodic Table'.

THE ORDERING OF THE 92 NATURAL ATOMS INTO ROWS AND BLOCKS

After a summary overview of the Mendeleyev Periodic Table we will look straight away at the nature of atomic structure in closer detail, and consider certain atoms that particularly stand out in musical terms, coming back at the very end of this small book to the grand arrangement of all the elements in terms of musical notes by the German writer, Krüger.

The earliest stage of the table still in use today in schools (though with further appendages) was devised by Mendeleyev in 1869 after a day of shuffling pieces of paper about and making lists, ending up with 62 elements arranged in order of atomic mass, noted from chemical reactions to be constant for each element. Note that Mendeleyev initially took the *mass* of each element (rather than its atomic weight) as the criterion for ordering the Periodic Table, even though intuitively in some instances he reversed the sequence for harmonic reasons (an indication he had not really chosen the ultimate criterion – but it was good enough as a start). Although he did not know at the time that an atom's weight, the real guiding principle of their arrangement, is governed by the number of electrons occupying the seven available orbits of its structure, he nonetheless sensed the elements fell into an arrangement of a horizontal Octave made up of seven rows, crossed by mini-octaves running down its resulting columns numbered I-VIII (separated into A and B halves - ***Ill. 3- 11*** above).

Because of the way similar elements seemed to slot naturally into columns following simple, small number proportions (which turns out also to relate to combinability with other elements - 2 Hydrogen atoms combine with 1 of Oxygen to form H_2O for example) – it meant Mendeleyev felt able to leave gaps for as yet unidentified elements he predicted should be there and which, according to simple counting, were bound to emerge in time. Later it was realised this was really due to how many vacant electron spaces remain in the outer shell of any element, enhancing or decreasing its combinability. This, as spelled out later, determines atomic weight. For instance, in the case of the inert gases of group VIIIA in P block, all have their outer shell completely occupied and hence they have no 'hooks or eyes' by which to combine with other elements – thus termed noble, because non-degradable. In a few cases by virtue of their atomic number (i.e. number of protons in the nucleus) octave ratios could be shown at work within the structure of the element itself (especially demonstrable in Oxygen – ***Ill. 3- 26***), though by no means in all. Since then, on the whole there is consensus on the order and terminology of Mendeleyev's table for practical purposes, even though it is also implicitly held that the total arrangement of the entire Periodic Table has not yet reached its clearest formulation, the blocks listing elements discovered later remaining unintegrated.

As seen in the next illustration, the Table was by consensus subdivided into four main blocks set next to each other horizontally according to vague similarities between atoms within each group (some arrangers visualised these as the arms of a cross - see under the *Alternative*

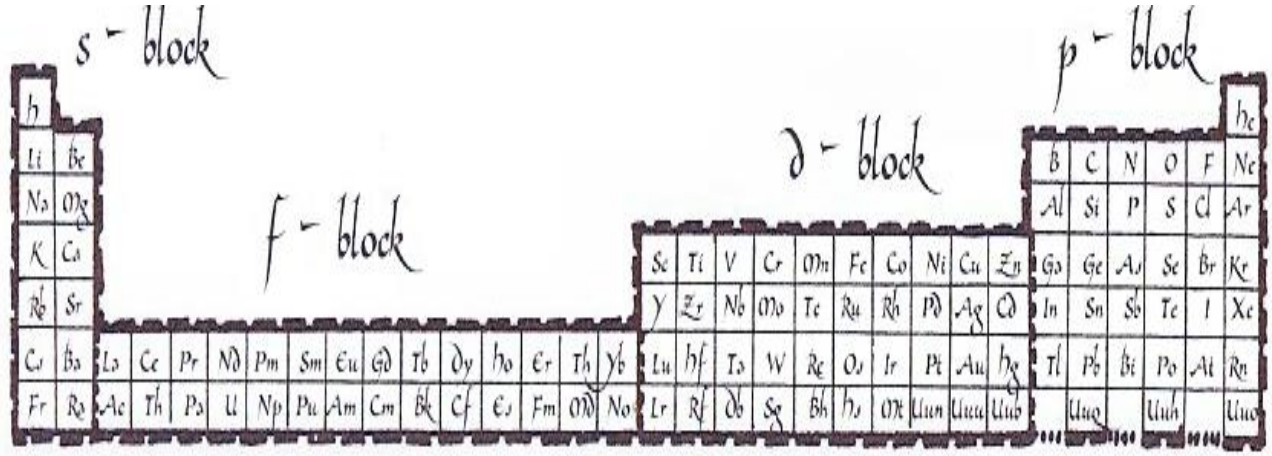
Arrangements section below). Below is Tweed's rough characterization of these blocks, which in most displays are pulled under or above each other in more compact form, as in ***Ill. 3- 10***:

S-Block: ***ALKALI AND ALKALINE-EARTH METALS*** *- dramatic in colour and fission*

F-Block: ***SUPERHEAVIES*** *- enormous atoms, islands of stability*

D-Block: ***TRANSITION METALS*** *- shiny, hard and strong, useful in alloys and amalgams*

P-Block: ***AMBIGUOUS ELEMENTS*** *- a bunch of metalloids, liquids and gases*



Ill. 3- 12: The four main blocks of the Periodic Table – from Matt Tweed[7]

The fourteen elements numbered 58-71 along the top row of F Block (see the larger versions of the Table) is a subgroup that does not readily fit into the table: known as the lanthanons, or rare earths, they stand apart from the main table as if needing to lock in at right angles to their linking points in the series on the main table. Most of these have unusual magnetic properties dependent upon the imbalance of left- and right-spin within its particles. Iron, for instance, has a subshell in its third terrace with 5 electrons spinning in one direction and one electron in the other, creating a net magnetism of four magnetons, and thus highly attractable by a magnet.

On the standard Periodic Table, only Hydrogen and Helium occupy the first row, like the mother and father of the greater and lesser octaves of unfolding substance. Reminding ourselves of the relative abundance of the elements as distributed throughout the Cosmos in Taube's diagram above, we remember these two are also by far the most abundant – and that from them all the other elements develop, precisely according to the escalation of the number of electrons in their seven surrounding orbits, as arranged in their recurrent, yet escalating rows and columns.

Thus as they manifest in due order, certain properties in the atoms (which may be physical, chemical, electronic, optical, crystalline, radioactive, etc.) recur within these periodic cycles of eight, meaning elements in the same column row by row gain an orbit. Overall, as Michael

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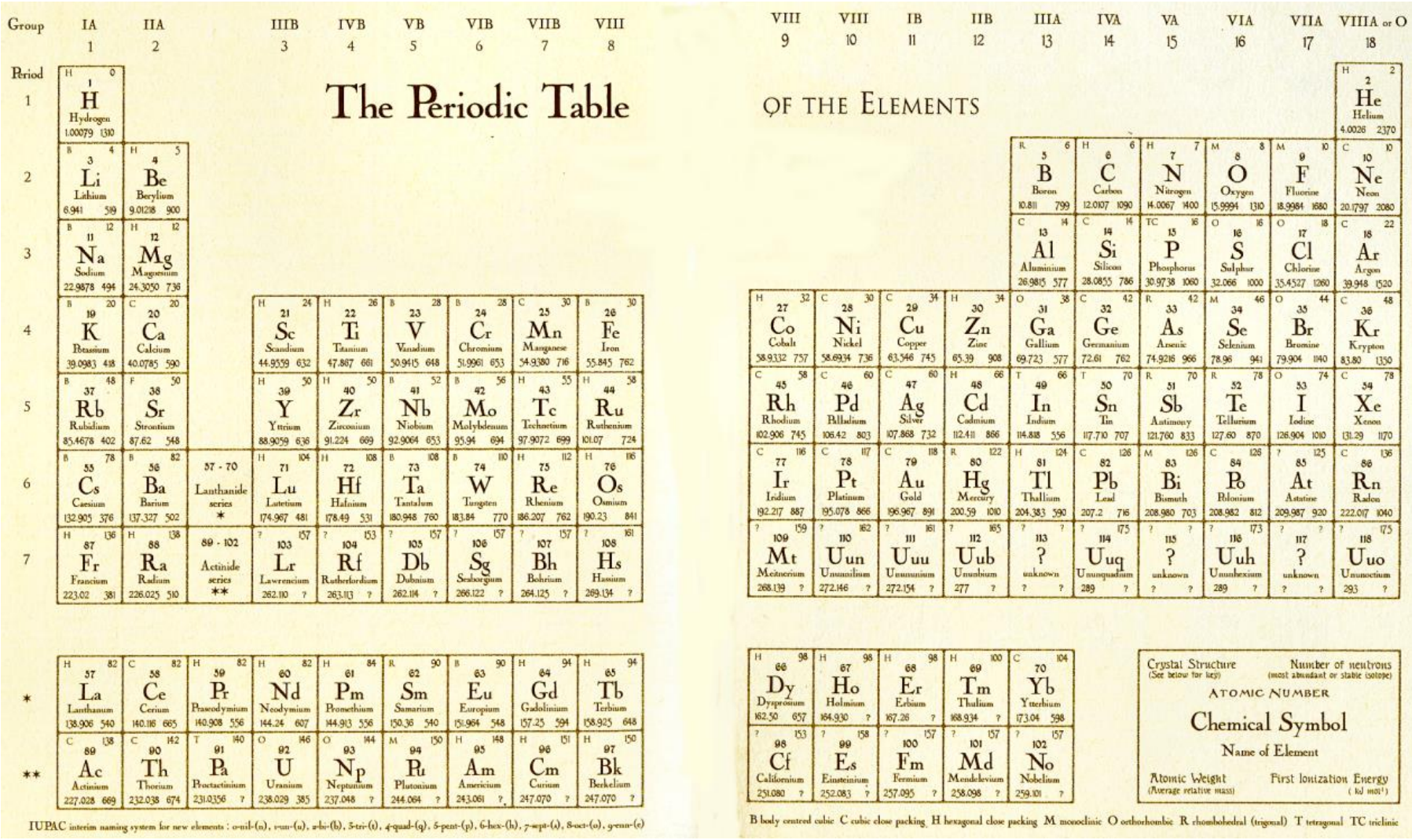
[7] ***Essential elements*** Wooden Books 2003 – a useful and neat small book, with good graphics



Ill. 3- 13: Again the Mendeleyev Table with further information included (see the Key bottom right) – from Matt Tweed

Schneider[8] sums it up so well, 'The Periodic Table of Elements is like a piano keyboard'… and is 'a modern cosmological model, a contemporary depiction of the Breath of the Compassionate [Buddhist idea], the cosmic web of Grandmother Spider [Red Indian idea]…. Each horizontal row of the Periodic Table represents another 'octave' or eighth step up the 'scales'. When each row's final chemical 'note' is reached and the outermost electron shell is filled with eight electrons, the next row, or 'octave' begins. The entire Periodic Table, the complete list of known types of matter, spans seven 'octaves', the number appropriate for the full spectrum of material configurations'.

Over time, chemists have been able to add a mass of measurable information about the nature of each atomic element, as in the layout given in yet another version of the Periodic Table above (the Key at bottom right explains the different statistics inserted for each element – best read more clearly by blowing up and printing on A3 paper). Most recently a display of actual examples of each element and their association with the particular individuals who discovered them (if not a gas or a radioactive substance) has been set up in a display, best seen on-line through this link, if you are unable to go to the States and look at it in person: http://theodoregray.com/periodictabledisplay/index.html. Exploring the nature of each individual substance I must leave to you to follow through since this small book tries only to consider the musical principles holding all the elements of the Atomic World together in what is emerging is a simple - yet also complex - harmonic progression.

THE ELEMENTS IN THE HUMAN BODY

Man is clothed in a preponderance of key elements combined into a living organism. Referring to the Periodic Table, in physical terms the human body consists of:

- ◊ **OXYGEN** **61%**
- ◊ **CARBON** **23%**
- ◊ **HYDROGEN** **10%**
- ◊ **NITROGEN** **2.6%**
- ◊ **CALCIUM** **1.4%**
- ◊ **PHOSPHORUS** **1.1%**
- ◊ **POTASSIUM** **0.2%**
- ◊ **SULPHUR** **0.2%**
- ◊ **SODIUM** **0.1%**
- ◊ **CHLORINE** **0.1%**

with small but vital increments of Magnesium, Iron, Fluorine, Zinc and other trace elements to make up the full complement – this accounts for the vehicle: the spirit within is beyond! You

[8] ***A Beginner's Guide to Constructing the Universe*** 1994

will note these commonest atoms to appear in human and animal biology are unevenly syncopated across the Periodic Table - as are the radioactive atoms (Strontium comes at 38, Radium then pops up at 88 and Uranium follows on more closely at 92), and the underlying

Ill. 3- 14: Man is more than the elements - detail from 'The Burning Bush' by Ernst Fuchs

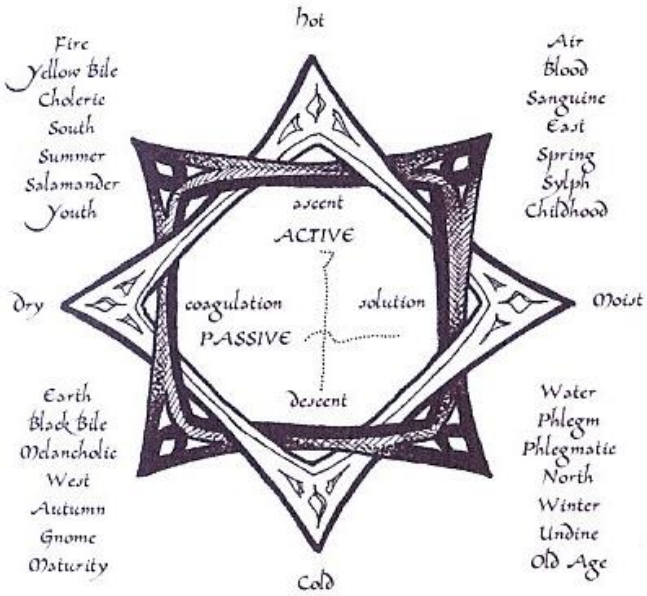
rationale is not yet clear. Knowing that chemicals build our body reinforces our sense that we are *more* than chemicals, though as far as bodily health is concerned we know the importance of a regular intake of *all* these elements through breathing, drinking, eating, bathing and so on. Where do God and consciousness fit in? We come back to this when considering atomic particles and the seemingly absurd search for 'the God particle'. Suffice it to say here that the Hindu philosophy of Vedanta describes a man as having a physical body, an emotional body, a mental body – and a divine body (these are mapped on the Kabbalistic Tree of Life). In ancient

Egypt these separate bodies were known and dealt with separately in their religion, as the ***Egyptian Book of the Dead*** reveals, as do the functions of different artefacts left in tombs.

One could therefore claim the human body is a kind of incarnation of the Periodic Table of natural elements – Uranium and elements beyond in *isolated* form cause it to break down: yet it can sustain the penetration of radioactive elements bombarding Earth's atmosphere. When we look at the key early elements in the Periodic Table that make up the human body, with Carbon second only to Oxygen, I like to take Damien Hirst's diamond-encrusted skull as a statement about the importance of Carbon to human life (with Calcium it forms bones for its framework). It gives a novel twist to the usual *memento mori* skull commonly inserted in Renaissance

Ill. 3- 15: (left) 'For the Love of God' by Damien Hirst and (middle) Holbein's The Ambassadors, with skull in the foreground as viewed from side of the painting (right)

paintings, as in Holbein's ***Ambassadors*** (where the skull only looks right when standing at the side of the painting), since it refers more to life than to death – its title referring to the incarnation of Christ. Think also of the role Iron plays in haemoglobin in blood, enabling the body to process Oxygen –we look at molecules in ***Books 5*** and ***6*** on ***Molecules*** and ***Animals***.



Ill. 3- 16: The Four elements and corresponding Humours – graphic by Tweed

In Greek and mediaeval times the human body and temperament was simply seen as made up of combinations of four 'humours', corresponding to the constituents of Air, Fire, Water and Earth, which still go a long way in dealing with human ills, as in present-day Ayurvedic medicine (I know I've become ill from too much damp, or too much heat, for instance, without needing to know any further chemical detail). Greek philosophers such as Pythagoras saw the entire makeup of the world in these terms (including also a Fifth element: Aether/Space holding them together in a pyramid) and it is still quite valid to look at our environment in that overarching way. This basic categorization corresponds to the five-finger division of the musical scale and has survived, like old simple folk tunes, for thousands of years, never to be completely ousted. Only slightly later in time did Democritus say, 'Opinion says hot and cold, but the reality is atoms and empty space'. He is said to have been the first to introduce the idea of matter being made up of atoms in the West, although Vedic seers in India also held this concept and may have passed it to the Greeks.

We come back to the full array of atoms now seen to form our material world, and different ways of ordering them.

ALTERNATIVE ARRANGEMENTS

Despite later attempts to reorder the elements in other ways, the classic Table of Elements as devised and refined by Dimitri Mendeleyev more or less into columns of octaves is still used in classrooms today (the three renditions above repeat this universally accepted arrangement). The transverse rows are more difficult to analyse, being of different lengths, yet displaying a certain order at times despite 'spare' elements that seem to lack any coherent relationship with the others. It is due to certain criss-crossing interconnections between some of the elements - in terms of structure or behavior – that point to better possibilities for expressing their layout, some in three dimensions, and some of the alternative arrangements put forward by others deserve attention.

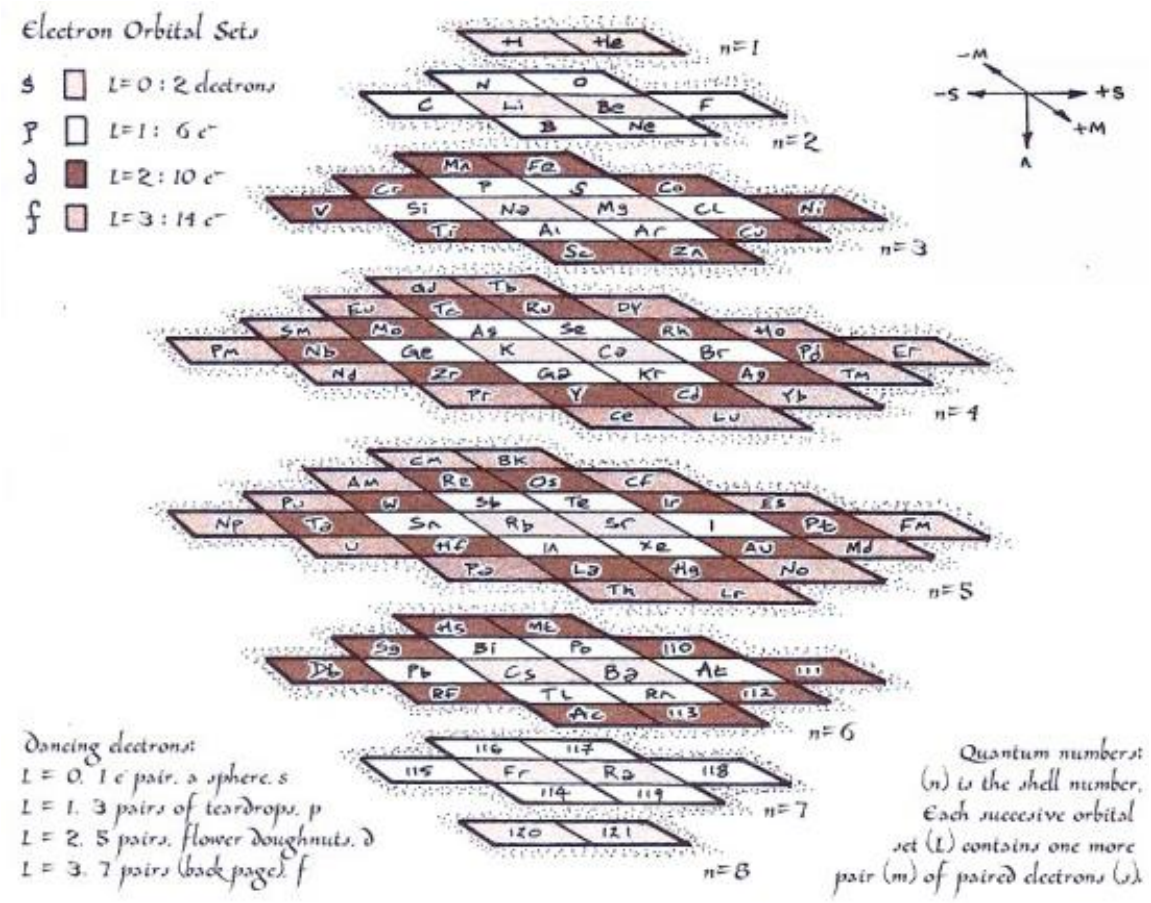
So, only 92 elements in the Periodic Table occur naturally without human manipulation. These Teilhard de Chardin referred to as 'notes of the atomic scale', though there is no orthodox consensus yet as to which atomic numbers fit which notes and what the overall chords of the Periodic Table must be. Many other writers - including scientists themselves - saw it as natural to describe their sequences in musical terms but without arriving at a satisfactory overall picture, meaning some factor of ordering was still missing, so the final form it should take is 'work in progress'. P D Ouspensky in ***In Search of the Miraculous*** tried to extract evidence of the Octave at work in the relationship between certain atoms, but they did not stand the test of atomic facts. His table for one column, the elements in octave and fifth ratios to their neighbours, was laid out as follows, though the numbers do not match the usually accepted

Khz 1	Hydrogen	1-1.12		SO
16				FA
24	Fluorine	9-19	24-	
32				MI
48	Chlorine	17-35.548		RE
64				DOH
96	Bromine	35-80	96	SI
128				LA
192	Iodine	53-127	192	SO
256				SA
384	Astatine	384-		
512		DOH		MI

figures. He argued there were 'components in some atoms that the chemists cannot observe' (meaning triads operating under the Law of Three: positive, negative and neutral forces), but despite having a general sense of a harmonic underplay at work, his ideas were over-speculative. Asimov notes that Dobereiner a century earlier had used the same idea.

From a wider perspective Arthur Young in ***The Reflexive Universe*** put forward an arrangement taking into account octaval stages of creation beyond the elements. His analysis of octaves within octaves is differently applied compared to Ouspensky's approach. Young envisaged seven cycles of seven levels of 'process', including the descent of energy into matter preceding the unfolding of the elements themselves; seven biological levels at varying complexity, from amoeba through plants, insects, animals and man, and on up to seven levels of consciousness. Altogether he identified 49 levels of process in all, showing from the Periodic Table how the elements basic to biological life occur in the first two rows, with elements essential to sustain those organisms at DNA or hormonal levels following in the third and fourth rows, giving way from the fifth to seventh rows to those rarer or isotopic elements concerned more with radiation and separation.

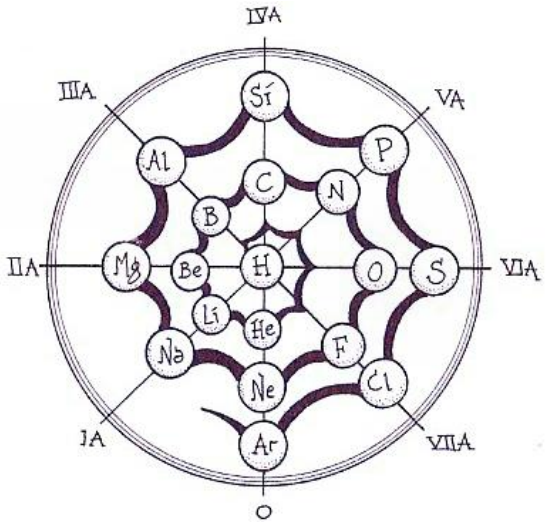
Kelvin visualised atoms as hundreds of miniature vortices – spirals like water going down the plug-hole – spinning within substance in general, held in place by the four-fold governing parameters of **ELECTRICITY, MAGNETISM, GRAVITY** and **ENERGY/LIGHT**. Several chemists sensed a three-dimensionality which might provide a more integrated arrangement, as in the version below which puts each horizontal level into a cross with positive and negative arms, bringing out different underlying aspects of their hidden order, not as easy to represent on a two-dimensional chart. Einstein himself had spent the last part of his life trying to see how the four main forces of the universe, the **QUADRUPOLE**, or Cross of Existence, could be seen as one interrelated force in a unified field theory, but failed, and work continues on the Grand Unified



Ill. 3- 17: The 3-Dimensional Periodic Table showing crossover relationships – from Tweed

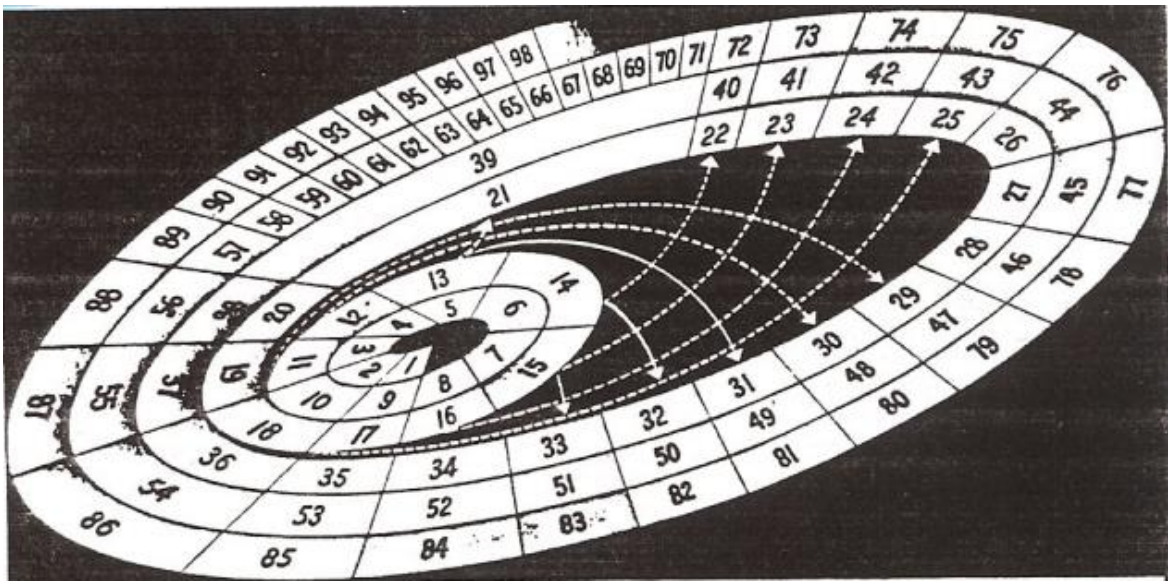
Theory. The idea is that the Grand Cross of energies (ELECTROMAGNETISM and GRAVITY, STRONG and WEAK FORCES) all derive from one ultimate energy, given the strong and weak forces are each other's opposite. The mathematics for it has not been found so far, but the metaphysicians got there a long time ago, since Spirit knows all things come from the One, and that Duality (as described by the cult writer of the 1960s, Alan Watts) is nothing other than the workings of 'the two hands of God'. These are simply metaphors which physicists would prefer expressed in particle form, but most of humanity finds symbols taken from ordinary experience more immediately intelligible, and telling. It would be interesting to do research on the education of leading scientists in terms of whether they did literature and the arts at school, since the idiosyncratic vocabulary they sometimes use to describe subatomic particles points to an inability to coin imaginative metaphors (Koestler's idea of 'bisociation' is relevant here).

It is that ultimate combined energy of the four arms that must constitutes the 'spindle' spacing the levels from each other (as in the role of Aether to the Classical Four Elements). It is not surprising, then, that there have also been attempts to visualise the unfolding of the element columns I-VIII as a spiral movement that would explain the recurrence of characteristics on each descending row:



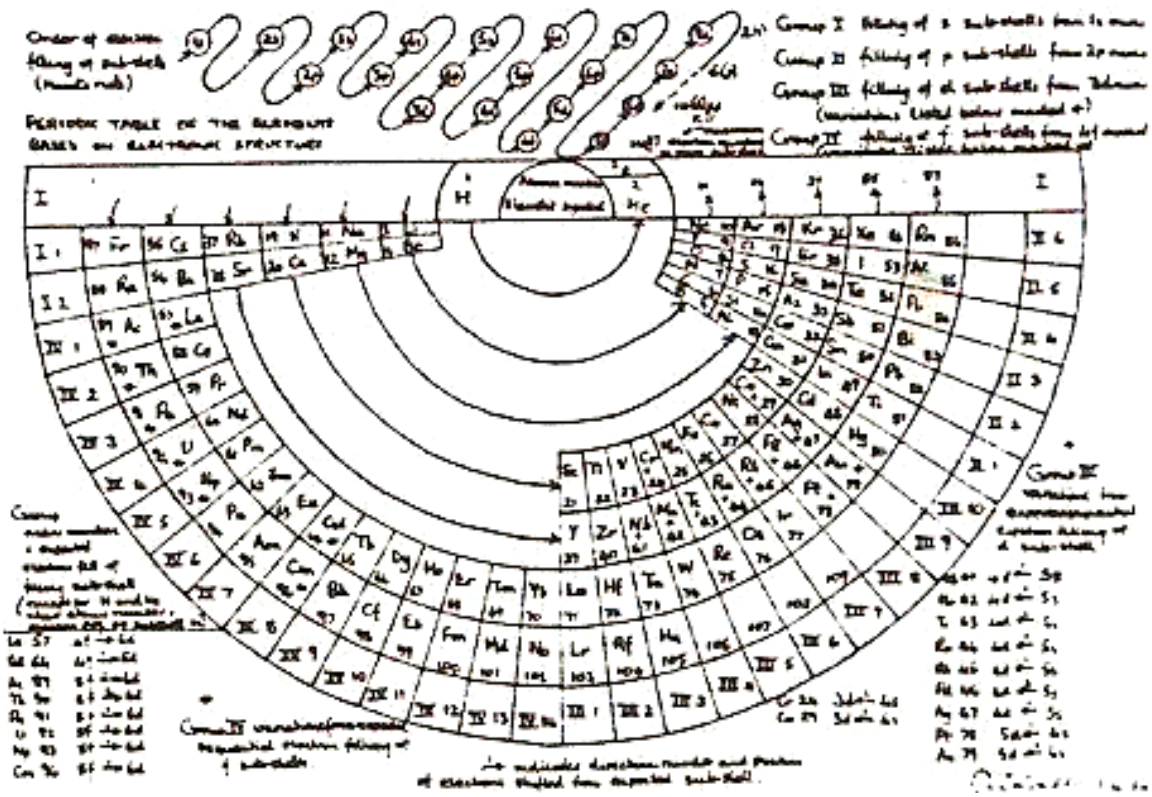
Ill. 3- 18: Regular spiral arrangement of the elements in terms of its 8 columns from Tweed

Emsley's two-dimensional spiral arrangement for the Festival of Britain display at the Royal Festival Hall, London, in 1951 was a centrepiece celebrating the Atom as the basis for Britain's post-war recovery in both science and the arts. This theme inspired a slant in British 1950s design towards sub-atomic orbits drawn on anything from coffee tables to posters and curtains.



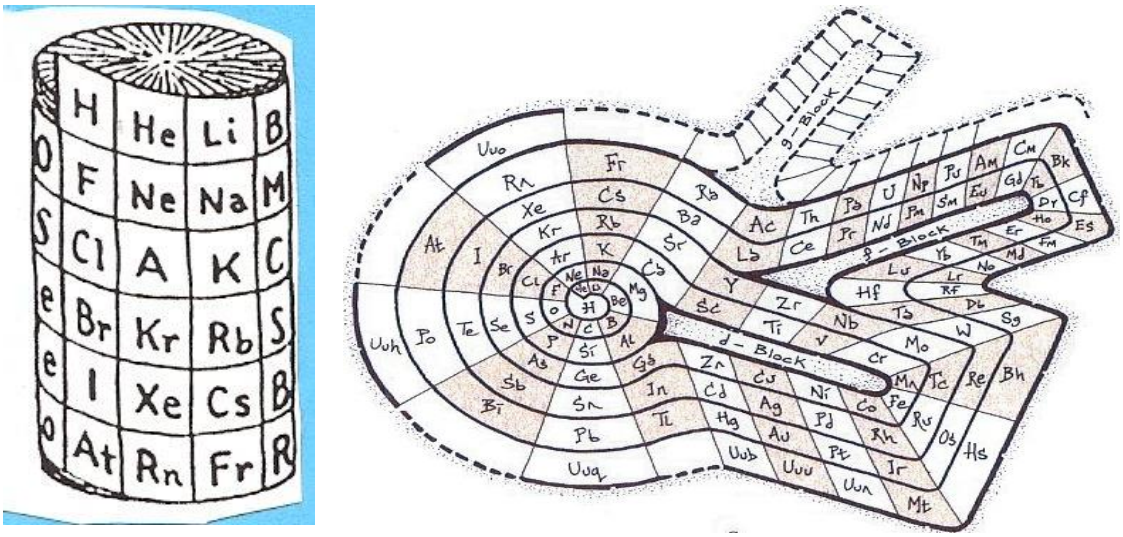
Ill. 3- 19: Spiral arrangement by Emsley for a Festival of Britain display, 1951.

In March 1985 the ***New Scientist*** ran a competition seeking readers' alternative solutions to the ragged layout of the Periodic Table. Many turned to the idea of a spiral arrangement, echoing the Frenchman Chancourtois' cylindrical spiral 'ordonnance' devised as early as 1862 (***Ill. 3- 21*** left). One reader put forward an octagonal staircase with protrusions for the major chains of elements in a series of figures of eight one above the other, while others imagined the process of manifestation from simple to more complex as a pendulum-like boustrophedon motion from side to side) down the 8 levels of the master octave in a fan-like expansion:



Ill. 3- 20: Arrangement showing the fan display sequence

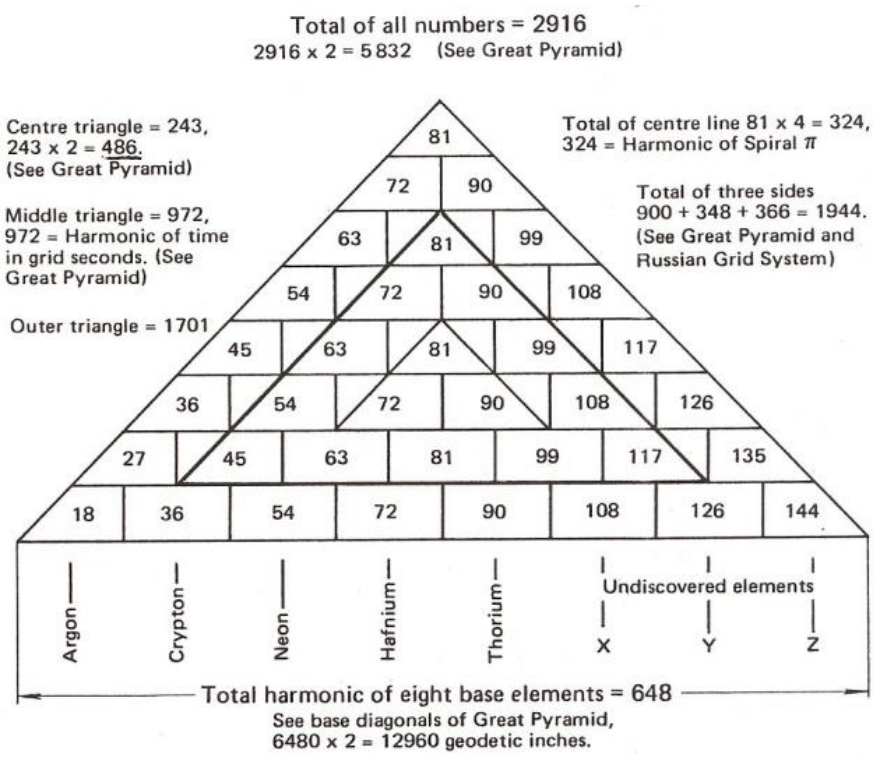
In three dimensions such a process could unfold in a cylindrical version of the 8 columns, in one version of which the three subsidiary blocks are treated as offshoots of the centre block, but all



Ill. 3- 21: Alternative spiral-based models for the Table of elements

still had drawbacks since in places the interrelationship between similar elements broke down.

Some professional chemists took a more numerological approach to the arrangement of the elements – as for instance Bruce L Cathie who attempted in his book, ***The Pulse of the Universe: Harmonic 288*** to fit the Periodic Table into the levels of the Great Pyramid.

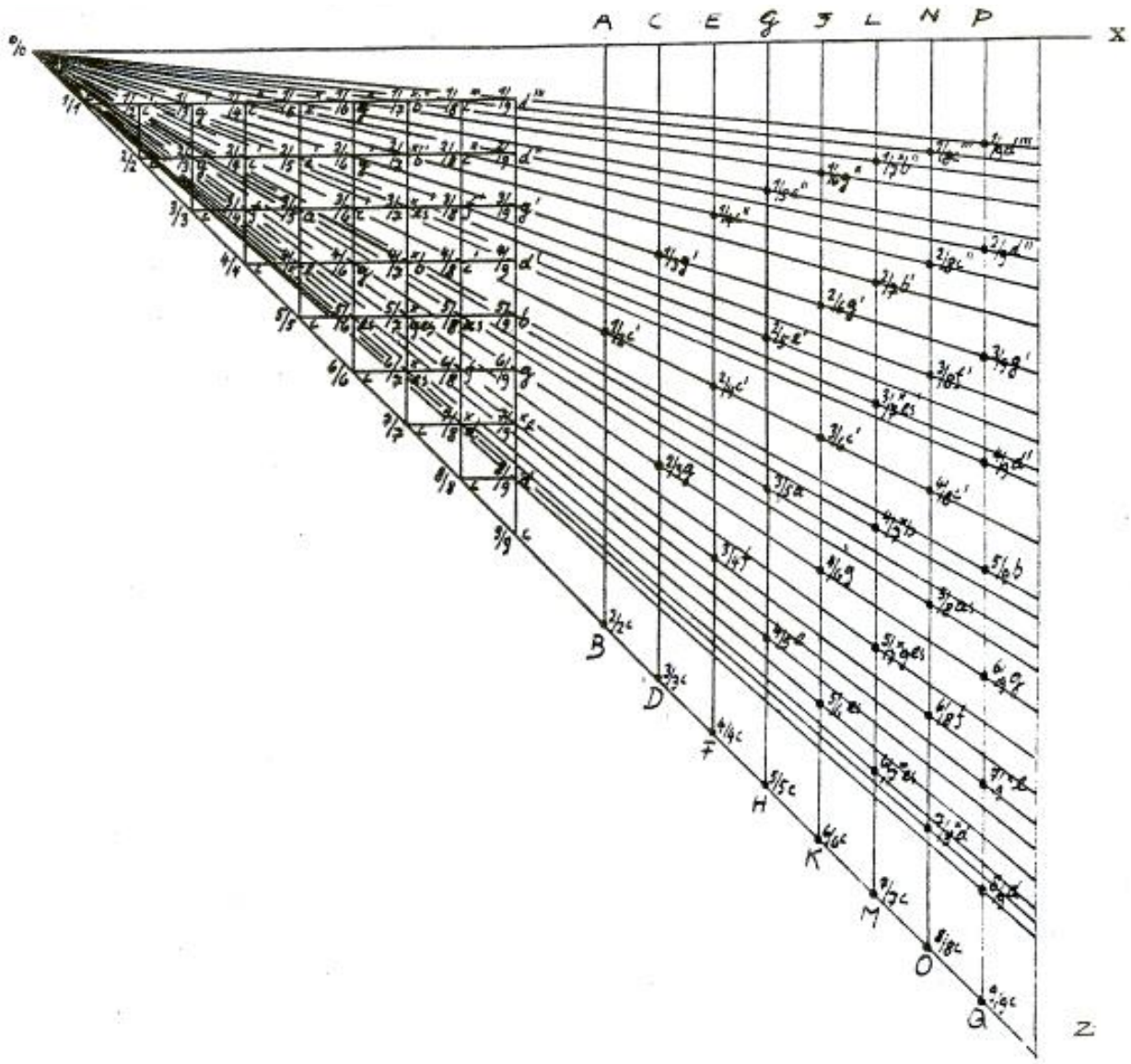


Ill. 3- 22: One side of the Periodic Table fitted into the proportions of the Great Pyramid

As a consequence of Einstein's equation E = MC^2 proving energy and matter are interchangeable in relation to the speed of Light, he saw all physical substances in the universe as formed from harmonic frequencies of light in various interlocking geometric forms. He argued that the harmonics of light are exhausted at the maximum of 144 elements and that the whole series is a repetition of octaves of wave-forms creating ever more complex structures. Furthermore, he believes that each of the 144 elements predicted will be shown to have 6 isotopes each (in other words, each element would in turn have its own octave) so that a full table would consist of 1008 items! He writes, 'Mathematically the progression would create 144 octaves of separate substances giving a theoretical value of 1152. The difference between the total number of substances (1008) and the harmonic value in octaves (1152) would be 144, the *light harmonic'*. Two interesting coincidences to this number can be mentioned here: the ***Book of Revelation*** states that at the End of the World only 144,000 deserving souls will be saved. On a more practical note, Krüger refers to the research of Kiesewetter who wanted to test the truth that a monochord sounds the diapason at exactly the half-way mark. He built a huge monochord 72 inches long and very carefully measured the diapason point. He found that in fact the crucial point was $1/144^{th}$ short of the exact half-way mark.

THE MUSICAL MODEL AND ITS POTENTIAL AS A BETTER ALTERNATIVE

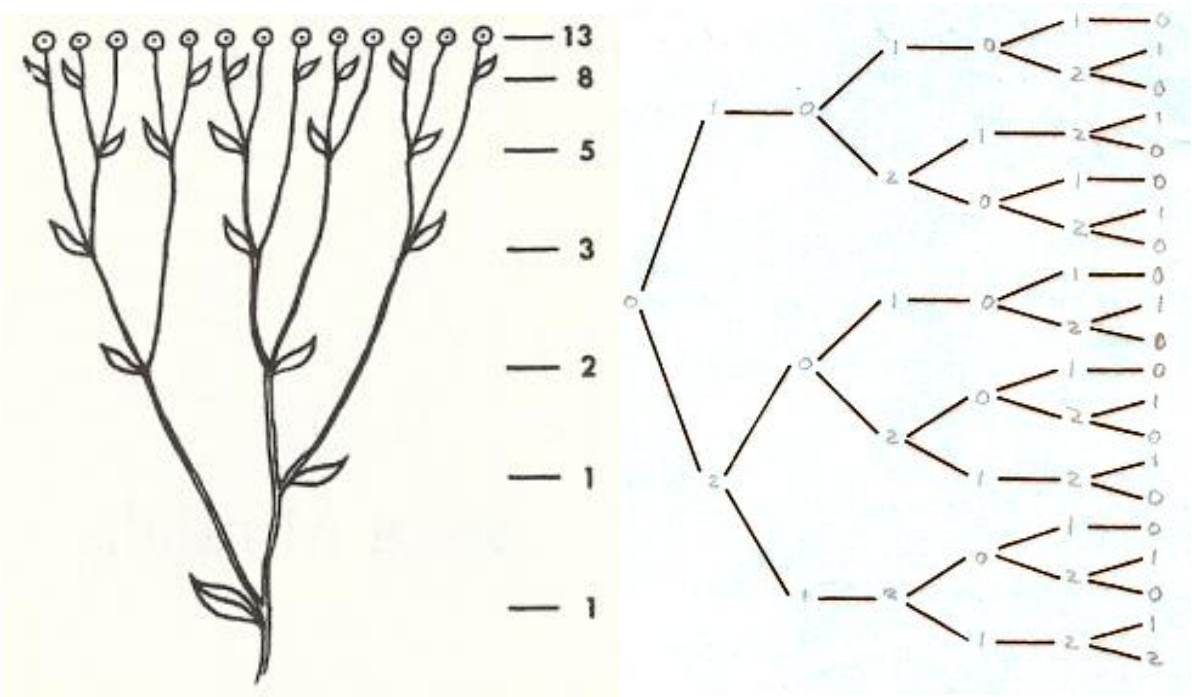
If instead we put forward as a model for the Periodic Table the progressions given in the harmonic series spelled out in Kayser's work on harmonics (explored in ***Book 1*** on ***Music*** and reproduced again on the next page for ease of reference) whereby the elements, too, would



Ill. 3- 23: Coordination and branching of overtone intervals – Kayser Die Form der Geige fig.2

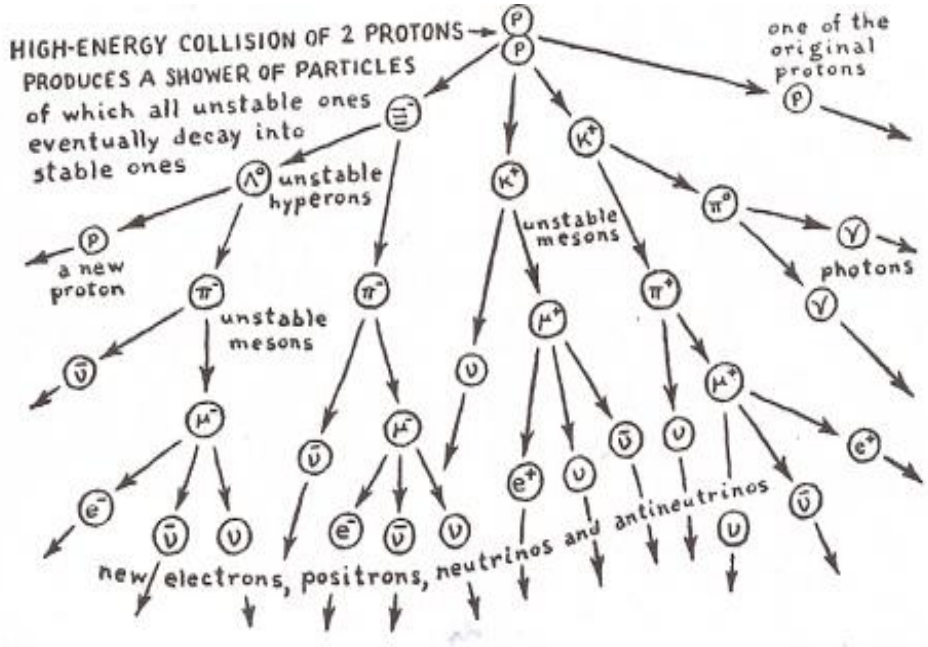
unfold from each other in the cascade of harmonic intervals from Middle C – as in the stages of plant growth that follow the organic sequence of *phyllotaxis* (discussed in ***Book 4*** and shown by Huntley[9] to follow the Fibonacci progressions – see below left), we arrive at an arrangement which has not yet been systematically applied to the elements, though some writers arrived at the idea early on, given the seemingly inevitable structures of harmonic musical sequences. The rows of elements in Periodic Table could be matched against the unfolding of musical notes, and seen as the materialization of successive energy losses running down in a harmonic series, as pointed out by H E Huntley in his diagram summarising the Fibonacci sequence of resonance radiation (below right). A Periodic Table along these lines has great potential for being the optimum arrangement for the different atoms according to their inner subatomic makeup (Guy

[9] H E Huntley ***The Divine Proportion: A Study in Mathematical Beauty*** (1970)



Ill. 3- 24: Phyllotaxis in Fibonacci branching – possible blueprints for a reformed Periodic Table (Huntley figs 12.5 and 12.2 – see a fuller version of the latter under Hydrogen heading)

Murchie's diagram for the progression of subatomic particles



(

Ill. 3- 35) follows a similar pattern). We return to the potential for a musico-atomic version of the Tree of Life the end.

For the time being further work is needed on the best ordering, though surely some time in the future such alternative arrangements as we have looked at above will be seen to have played their part as stepping stones towards the final solution. For that to happen we must understand

the principles of the birth of complex elements out of the simpler ones. So, in looking more closely at a handful of common atoms we now consider some key principles of atomic structure, thence to find out what is certain about any possible music ruling *sub*-atomic particles too.

ATOMIC STRUCTURE

By the early 1930s due to the work done in the Cavendish Laboratory in Cambridge, England, the primitive structure of the atom had been deduced. From his study of cathode rays J J Thomson as early as 1897 had identified *negatively charged electrons* as the subatomic 'satellites' moving round the nucleus, and from 1910 it was his former student, Rutherford, who came to posit the idea that the centre of any atom consisted of a nucleus (its core) that constituted 99% of the atom's weight, and that its positive charge was carried by particles in that nucleus he named *protons.* Already it was understood that electrons determined the atom's external relations whilst the nucleus determined the atom's actual identity. Thus it came about that Moseley, a student of Rutherford's based at Manchester, refined Mendeleyev's Periodic Table by ordering the atoms as determined by the number of positive charges carried by the protons in the nucleus, the basis of the Atomic Number of each element. The Periodic Table was therefore simply numbered according to the number of positively charged *protons* within the atomic nucleus - with some exceptions later explained by the number of *electrons* any element has (without a balance between the two the element would be electrically unstable).

Finally, yet another of Rutherford's students, Chadwick, pinpointed in 1932 the *neutrally charged neutron* as the other particle that, sphere-packed closely with protons, makes up the nucleus, the number of which later proved to determine the variant forms of atoms known as isotopes. Neutrons had been elusive up to then, given they have no charge and leave no trace in any medium. For Ouspensky, this was confirmation of the basic Law of Three at work.

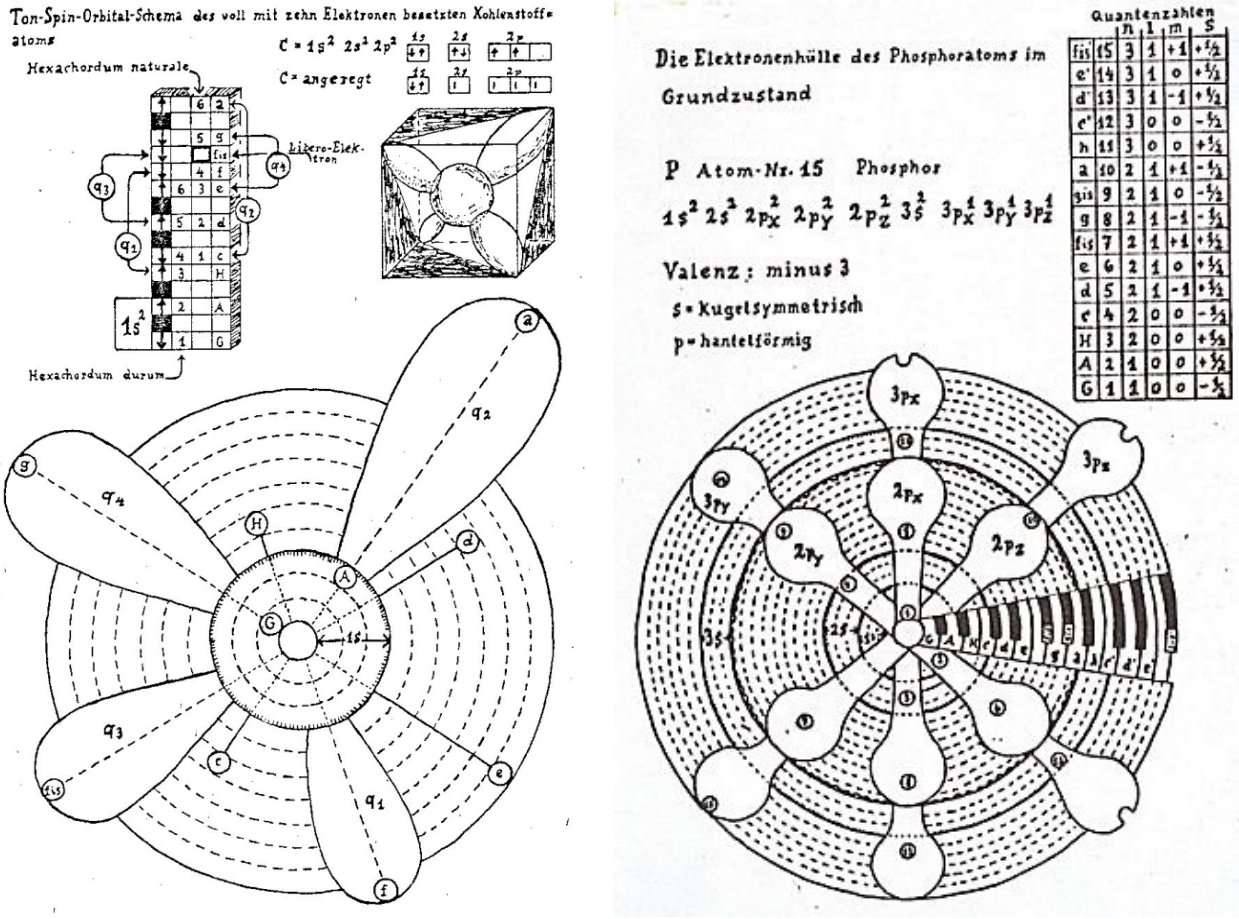
It was a former Professor of Chemistry at Johns Hopkins University who, with his background as a creative teacher, had the originality in a best-selling book[10] to invite the reader in imagination to reduce him or herself to a minute size (like Alice in Wonderland) and 'take a trip inside a Calcium atom to see what is going on in there'. This is a visualisation process often used by nuclear physicists, in fact, in order to understand atomic behaviour ('If I was an electron where would I go?'). It was certainly an approach much favoured by Feynman – as Gleick describes in his biography of the physicist, simply entitled ***Genius***.

What we would actually see, said Andrews, if we were ourselves living and observing at Calcium particle frequency would be a great ball of glowing, luminous fog, filled with waves and ripples much like the surface of a pond due to the movement of particles. Next you hear a strange

[10] Donald Hatch Andrews ***The Symphony of Life*** 1967

music all around: 'From the deepest interior of the atom there are shrill tones dozens of octaves above the highest note of a violin… and this is the music of the atomic nucleus which is like a sun in the atomic planetary picture'. This central nucleus is surrounded by even denser layers of fog, from whose spherical layers you detect certain notes that form familiar major and minor chords, rather like those of an organ. But it becomes even more complex than that, and you can pick out as well many discords, rather like the sounds used in the music of 20C composers! You hear quarter tones, eighth tones and even sixteenth tones, much the same as those in oriental music. Further, you can decipher intervals such as an expert acoustics scientist would recognise as representing some of the irrational numbers in mathematics'.

We could examine other atoms, he says – such as we find in our own flesh – perhaps Carbon, or Phosphorus. Like Calcium, they would have similar rippling fog banks due to the fast motion of electrons whizzing round in their shells. Each will therefore present a different series of notes or intervals – due to the central note of the nucleus and its harmonics. Krüger, too, chose to dwell on the orbits and supposed notes of Carbon, Phosphorus and Oxygen, rendered in diagrammatic form in the next two illustrations. You may not yet be able to get the most out of them until you have made a first reading to the end - so come back to them later.



Ill. 3- 25: Krüger's musical diagrams the shells and orbits of Carbon and Phosphorus atoms (for his classification of the music of all atoms in the Periodic Table see last illustrations)

Krüger worked out that the Carbon atom produced the tone scale C D E F G A, the hexachord of the Gregorian chant. Taking it further, he wrote that 'depending on the saturation state of the atom, *all three* Gregorian hexachords exist in Carbon – the so-called *hexachorum durum, hexachordum molle* and *hexachordum naturale'.* In organic chemistry all structures are based on hexagons composed of different combinations of Hydrogen, Oxygen, Nitrogen and Carbon (Hauschka's Elemental Cross), so no wonder Gregorian chant appeals to the soul, for it is as repetitive, yet organic, as the hydrocarbons.

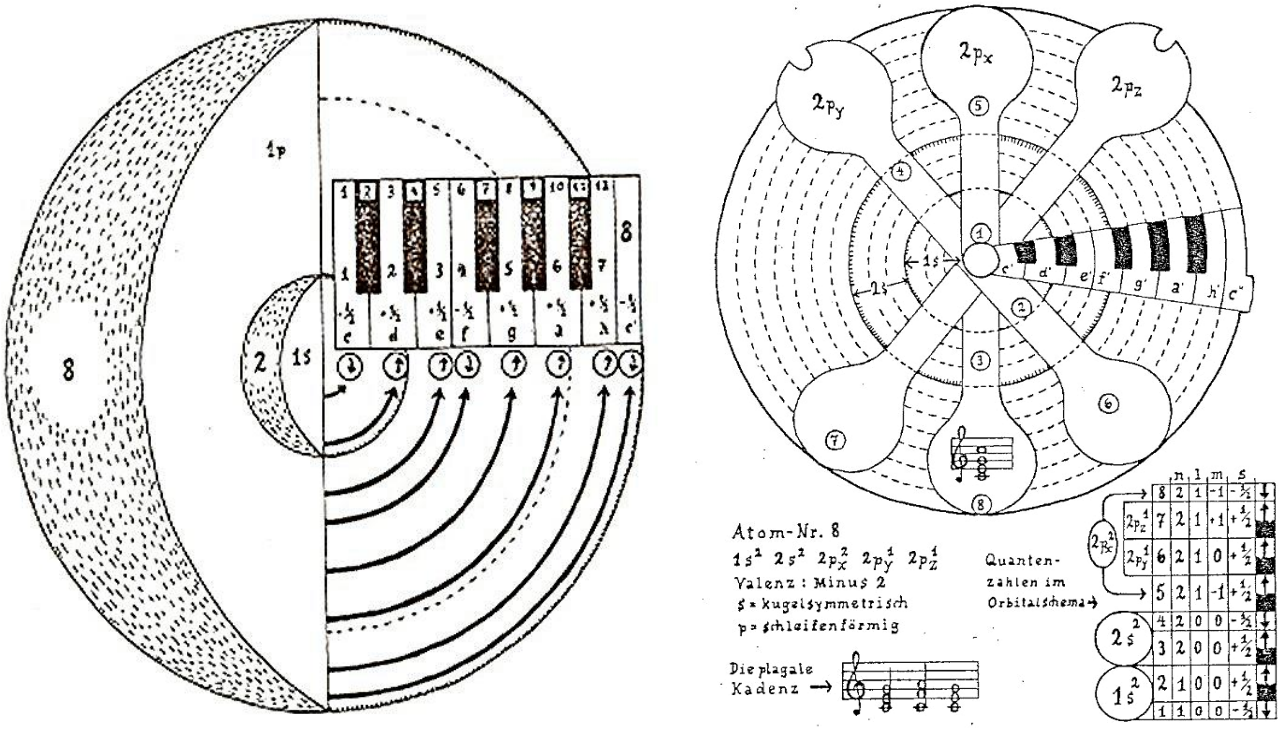
Unusually for a scientist, then, Andrews was amongst the first to use musical terminology to describe atomic activity, and his words help put us in that frame of mind for inspecting two specific atoms in fuller depth using this approach – the two that together create water – Hydrogen and Oxygen, without which organic life would come to a halt. Although the Hydrogen atom is the simplest atom of all, we will need to look at it more closely after knowing more about sub-atomic particles, so at this juncture it is best to go to the exemplary and revealing configuration of Oxygen, for which Krüger's diagram again comes to our aid, inspiring us also to understand the emphasis spiritual teachers put on breath and breathing in self-regulation.

OXYGEN

Oxygen constitutes 21% of our atmosphere: if that proportion goes down below 17% we start to gasp like mountaineers on a high peak, but if it goes up beyond 25% we are liable to burst into flames. Deprived of Oxygen, fires go out: thus it is a type of fuel used by the body to execute many operations, carried round in the blood stream to where it is needed thanks to the assistance of Iron. Certainly Oxygen is crucial for general good health, and this could be because the basic octave within Oxygen provides the main architrave of life, spanning the uprights of diapason to diapason, in this way acting as the main highway to the Law of Correspondences in higher worlds, bringing down or up to a particular level the necessary frequencies that encourage wholeness – hence the use of both breathing and music in healing techniques. Consumed by the animal world which breathes it in, or used in burning processes to extract energy, it is replenished by the photosynthesis of plants during their outward breath in sunlight hours (see ***Book 4***), a truly miraculous daily Gaian renewal process which we take for granted – until its very operation started to be threatened by 'global warming'. But over millions of years there have been other climatic upheavals and Mankind will find its way through this one as it did all the others.

Oxygen (see next illustration) is smaller than Carbon or Phosphorus, having 8 electrons to Calcium's 20 and Phosphorus' 15, and is one of those fundamental 'magic number' elements with 8 protons in its nucleus surrounded by 8 whirring electrons that move back and forth within its 7 orbital shells, so unique in clearly demonstrating the basic octave in an explicit, as well as generally atomic, way. We owe the detailed musical analysis of Oxygen to a thinker

who, already a friend of Kayser, decided to base his whole life on the study of the internal musical arrangement of atoms and molecules – the German, Wilfried Krüger[11], based at Trier. Writing in German, his book has not been translated into English, but his insights are widely quoted in other cult books in English[12]. In his small book he published intricate analyses of the musical arrangements of the 'biological' atoms such as Carbon, Nitrogen and Oxygen, as well as Magnesium and Phosphorus – as also the components of Chlorophyll, (see ***Book 4***). He shows which chords must sound in each atom according to their nuclear and orbital makeup. The detail given on Oxygen alone is so thorough that from our particular angle it must stand for the vast potential that exists for looking into the music of every single atom: hopefully to a large extent the sample images from the copious diagrams he gives speak for themselves and convince us that indeed the atomic realm must be musical above all else (you may need a magnifying glass – his book is a very small, self-published pocket paperback).



Ill. 3- 26: Structure of the Oxygen Atom and its notes – from Krüger

Starting with Doh/Middle C at the nucleus, its seven shells spell out the octave in ascending order, whose notes are expressed by the receptive electrons as they move between them, activated by the 8 originating protons at its heart. Just as the C major scale is the most equable of all, so is the element Oxygen in the world of the elements. Its 8 electrons, orbiting around a nucleus of 8 protons, use up the two positions on the inner shell and six of the positions in the next shell (we will explain shells below shortly). Because there are two positions vacant on that

[11] ***Das Universum Singt*** Berlin 1982

[12] Such as Peter Hamel's ***Through Music to the Self*** (1991) and Joachim-Ernst Berendt's ***Nada Brahman: the World is Sound*** (1987)

second shell, Oxygen seeks to complete its filling, as it were, by combining easily with many other elements such as 2 Hydrogens to form water, or with Iron to form rust or haemoglobin in blood. A host of elements oxidise with it as the ideal bride: hence its versatility in the life process. It is as if, writes Krüger, nature is sending out this scale into the world at large to keep it in equilibrium. Indeed, perhaps we should have explained the Octave from the very beginning by starting with Oxygen in the atomic world – rather than with music – though logically it must be high-octane music that forms Oxygen!

For Oxygen Krüger found that, of the major and minor notes the electrons at the 4th and 8th steps (where in the C major scale F and C^{1} indicate the semitones) were the ones already established by scientists as having a left spin, whilst the remaining major notes moved in a right spin. He finally deduced that the harmonic minor scale represented the vertically oriented forces of the inner atom, which were synthesised with the horizontal forces in its outer region, and whose major scale bound the structure together.

Berendt contributed further insights from his reading of Krüger: 'The concurrence between microcosm and harmonics becomes even more astonishing when one notes that the model of the nucleus of the Oxygen atom *with its protons* [plus 4 neutrons] has twelve steps, the exact number of intervals found in the scale formed by the atomic model. In the normal state, seven of these intervals are filled and five empty, just as the intervals are in the musical scale of seven 'regular' notes, leaving the other five unused. It does happen in music, especially in the process of modulation (change of key) that these five 'irregular' notes are employed. Precisely the same thing happens during the various saturation states of the atomic nucleus, although these have only a transitory function – as does modulation in music'. *So we note here that not only the straight seven-note octave shows up in the subatomic perspective, but so also does the twelve-fold semi-tonal octave - whose natural divisions we do not deal with until we consider the twelve-fold division of the Zodiac in* ***Book 7***.

THE BREAKUP OF MATTER AND THE VIEW OF THE MYSTICS

In the scientific domain itself, as atomic structure and behaviour were revealed to the light of day, a real edge came to bear on understanding the nature of substance, in the most detailed manner ever yet known by mankind – but at the same time it led to huge instability in the average human's sense of his security in the material world, not only because the seemingly stable world was torn apart into a fragile gauze, but also because there appeared to be no Grand Centre drawing it all together that could be focused upon. Compare this state of affairs to the stable understanding of the Universe given, say, in the Elizabethan world view, run on the Four Elements, the 9 Planets and the 12 Signs of the Zodiac with God holding it all[13]

[13] See, for instance, E M W Tillyard **The Elizabethan World Picture** 1963

together. Very few people had the background to fit the new wine of the scientific world view into the old wineskins of traditional religion or philosophy straight away, especially as they were being asked to remain in suspended animation over several decades waiting for the next news about the particle makeup of atoms themselves – whose mapping - detailed in the next few pages - still has not arrived at a final conclusion. We have already mentioned how the painter Wassily Kandinsky was so shocked at the news of the splitting of the atom that he felt it untruthful to depict the exterior world of objects any more.

For him this was a spiritual crisis, but actually this deeper perspective into matter supplied in terms of hard-headed rationalism confirmed the experiences of the mystics about the sense in higher states of consciousness of the dissolving of material things both into each other and into higher worlds. In modern times this was one reason for the advancing drug culture in the West, originally inspired by the example of shamans in primitive tribes who use psychotropic substances to go on 'trips' to gain explanations for situations in every-day life. Such experiments openly shared in the public domain go back to the 1950s when Aldous Huxley put himself forward as a guinea pig after he had moved from Britain to Los Angeles for the second half of his life (which was spent in the pursuit of mysticism to find a solution to the 'horrors' of modern life described in ***Brave New World*** and other novels). He wrote in ***The Doors of Perception*** (1954) of what he saw after taking LSD[14] for the first time as he turned his gaze onto a vase containing iris, rose and carnation flowers, which he now apprehended as:

> *… a bunch of flowers shining with their own inner light …[with] … a transience that was yet eternal life, a perpetual perishing that was at the same time pure Being…*
>
> *I continued to look at the flowers, and in their living light I seemed to detect the qualitative equivalent of breathing – but of a breathing… from beauty to heightened beauty, from deeper to ever deeper meaning. Words like Grace and Transfiguration came to my mind, and this of course was what, among other things, they stood for. My eyes travelled from rose to carnation, and from their feathery incandescence to the smooth scrolls of sentient amethyst which were the iris. The Beatific Vision, SAT CHIT ANANDA – BEING-AWARENESS-BLISS – for the first time I understood, not on the verbal level… but precisely and completely, what those prodigious syllables referred to.*

Such direct experiences of spiritual realities confirmed his understanding of the fundamental unity of all religions put forward in his book, ***The Perennial Philosophy*** (1963), a tenet taken up by T S Eliot from his Church of England standpoint. The baton for forays into looking directly into the nature of the created world as invisible, interpenetrating force-fields was taken up by

[14] Mescalin is the main component in the Mexican cactus, *peyote.*

the next generation – described on a scientific basis by Rupert Sheldrake's experiments[15] and many ensuing books from the 1980s onwards. After early forays into projects connected with the ancient world and lost civilisations, his contemporary, Graham Hancock, in his ***Supernatural*** (2006) describes the interconnectedness of all beings as revealed under the influence of the Amazon Indian substance *ayahuasca*, so well portrayed in visual form by the Peruvian artist, Pablo Amaringo (next illustration). This is how Hancock described one session:

> *I'm surrounded by intelligent plants which seem almost like animals, waving, weaving leaves in dark colours but with their own fire. Then I meet a big boa constrictor… It allows me to stroke it… I see a yellow and black spotted butterfly the size of a dinner plate flitting from plant to plant in the hallucinatory jungle. I follow it until we reach a clearing where a second huge serpent awaits. There is no butterfly now, only this immense yellow and black serpent radiating sentience and magical force. Before my eyes it spectacularly and mysteriously transforms into a powerful jaguar with yellow and black spots and confronts me face to face. There is a sort of telepathy. Then the creature abruptly turns away and vanishes. For what feels like a long while afterwards I*

Ill. 3- 27: Amaringo's vision of the jungle with plant, animal, human and goddess presence

> *continue to sense it presence still out there… They… are not stuff my brain is just perversely cooking up out of some hitherto unknown jungle-scenes image-bank in my*

[15] See, for instance his ***Seven Experiments that Could Change the World*** (1994)

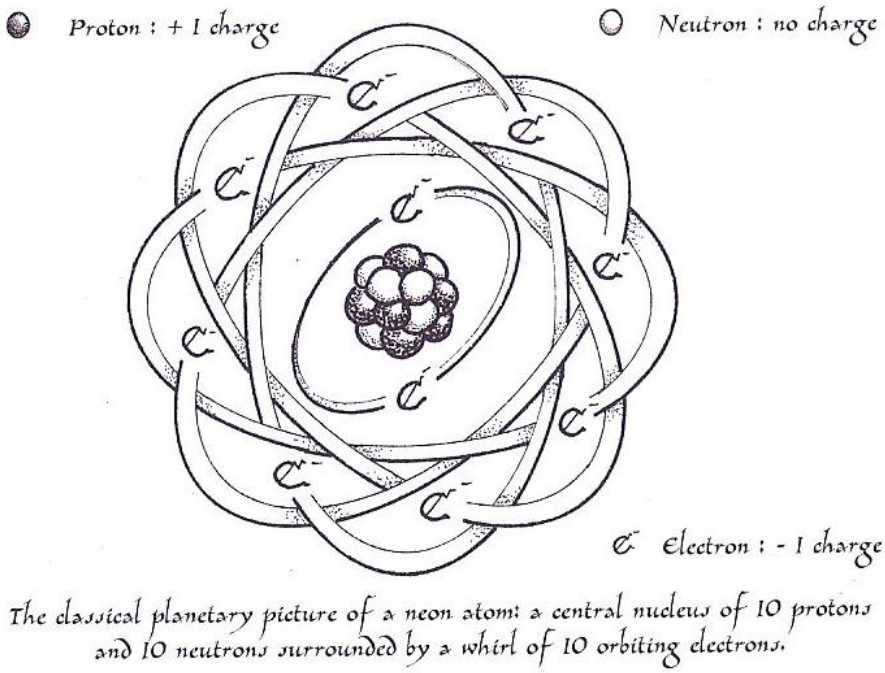
> *temporal lobes, but real perceptions of real beings… Science teaches us to believe the material world is the primary and only reality. But from the ayahuasca perspective this is absolutely not the case:… because these worlds interpenetrate our own, effects in this world may turn out to have causes in the other worlds….*

Did Hancock or Huxley need to know about subatomic structures to have such insights? No, they did not, nor did Huxley need to have the Periodic Table in mind when the doors of his perception were opened. Although intellectuals, awakened in them is what in Hindu tradition would be called The Way of the Bhakta, or direct ecstatic experience and devotion.

The other half of humanity is more predisposed to The Way of Jnāna - of Knowledge and Reason - needing to know the facts and their proofs, and happy to take on the work of scientists unquestioningly, but not always realizing the experiental implications. Let us press on and look at the astonishing detail of yet a further universe of subatomic particles that developed out of the original triad of electron, proton and neutron.

CATCHING THE MONKEY: TRACKING SUBATOMIC PARTICLES

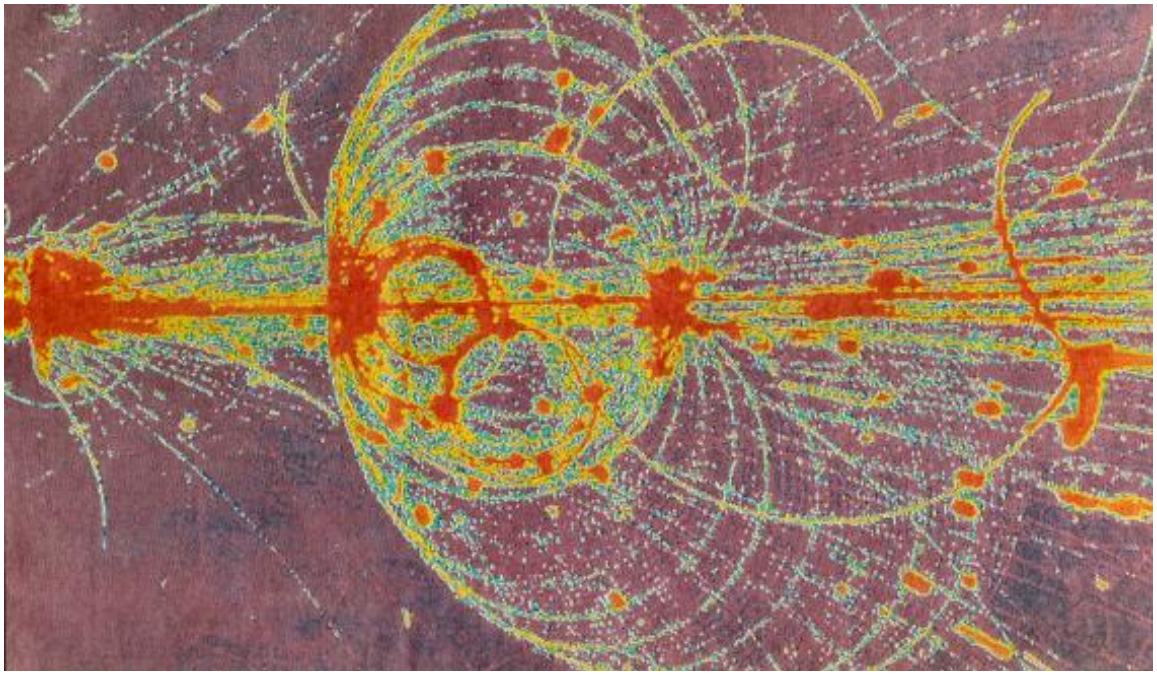
Rutherford was responsible for splitting the atom in 1910 and from then on there was a race to inspect how atomic parts worked internally. At first the triad of nucleus, proton and electron was all that mattered: any atom is constructed out of protons and electrons in equal numbers, and the number of proton-electron pairs determines its nature, being its atomic number. The protons in the nucleus are bound together by neutrons whilst the electrons whizz round it in *seven possible orbits* from inside to outside. Matt Tweed's Neon atom is an illustrative example:



Ill. 3- 28: Orbits of the Neon atom - Matt Tweed

Early on, some scientists soon arrived at the conclusion that each nucleus produced its own note and set of overtones which pulsate outward from the centre in the form of electrons, these pulsations reaching out spherically in space/time. By harmonic resonance the micro-reverberations will travel several octaves above and below their physical range and thus interpenetrate their environment. Andrews in ***The Symphony of Life***, describing the immense variety of waves – gravity, light, electro-magnetic, or colour (see ***Book 0***) stated, 'It begins to look as if the Universe is made up, not of matter, but of music'.

But how was the octave, and any possible Pythagorean order, to be spotted at work in the elusive behaviour of atomic particles? At first it was hard to say, for as the early scientists found out, they are in perpetual and confusing motion, and can only be seen by the tracks electrons and protons leave on other substances – never face to face. The search to take sightings of the mechanics of atomic behaviour continues today throughout the West, and key laboratories in America, Britain and Europe have all contributed to the unfolding scenario. James Gleick in ***Genius***, dealing with Richard Feynman's life as its centrepiece, reveals how penetration to the interior of the atom was a relentless process, outdoing in ingenuity the detective work of a hundred Sherlock Holmes. Since no-one has actually *seen* the structure of atoms it has to be worked out obliquely through bombardment chambers and cyclotrons, and by inference through complex mathematical equations far from Pythagorean in nature. In any case, electronic interference through bombardment does not reveal particles in their natural wave –v- particle behaviour but, rather, aims to hit them like billiard balls, revealing their



Ill. 3- 29: Oxygen bombarding lead – The Times 25 August 1999

presence out of context in a dislocated crisis situation - not in normal mode of operation. Quantum theory is based on appearances, on the tracks left by bombarded particles on

photographic emulsion, in bubble chambers or on computer screens – never of the particles themselves which are at least a trillion times smaller than an electron wave which is roughly one micron wide (in comparison the quantum waves of bright stars range between 10 and 1000 feet). From this arose the experience that cascaded down into society at large, that the ultimate reality could never definitely be pinned down for certain and that nothing is permanent.

Herbert wrote, 'things are particles whenever you look at them… and seem to move around like waves when you don't look'. This means the observer affects his results, by looking or not looking: as one commentator noted, quantum mechanics is the Zen of particle physics: consciousness itself changes reality. In Ouspensky's terms, there is a difference to the Observer and the Observed between being connected - and not. From the 1960s there was a great deal of talk about altered states of consciousness (ASC) and how anyone's understanding of what is observed alters according to their state of awareness. We can all think of everyday situations which bear this out. 'The Observer' of Ouspensky's system would by the ancients be depicted as the Universal Eye, or consciousness (Huxley's SAT) looking down at all levels beneath it. The perspective changes according to whether consciousness places itself in the body, the feelings or in the mind – and the Divine overview is different again, as if from the top of a mountain looking down on a landscape.

Andrews gives a vivid picture of the Rutherford/Bohr view of the atom as particles rather than as waves, but admits that in reality the particle aspect is not easy to locate – in fact, to be exact about the whereabouts of particles at any one microsecond is well-nigh impossible to capture on film, though it has been done with difficulty, some showing the centralised nature of atomic structure and activity, and others its more random nature. On such ambiguity is based the Uncertainty Principle formulated by Heisenberg – a principle which surely provided another excuse for the shifting sands of modern man's sense of insecurity. Now, since reality is regarded only as materially divisible into ever smaller parts, Western culture bases its discourse on the acceptance of physical proofs only – even though quantum theory itself contradicts such a view. The end result can lead not only to relativity of standards, but also a mental and spiritual confusion of the same kind as the inner state of any atom! Other existential problems are *improved* by the atomic vision however, as in the case of Capra, Huxley and Hancock, but it depends on how open anyone is already to higher dimensions. Without a framework to hang such experiences on, the use of drugs unfortunately becomes a dead end.

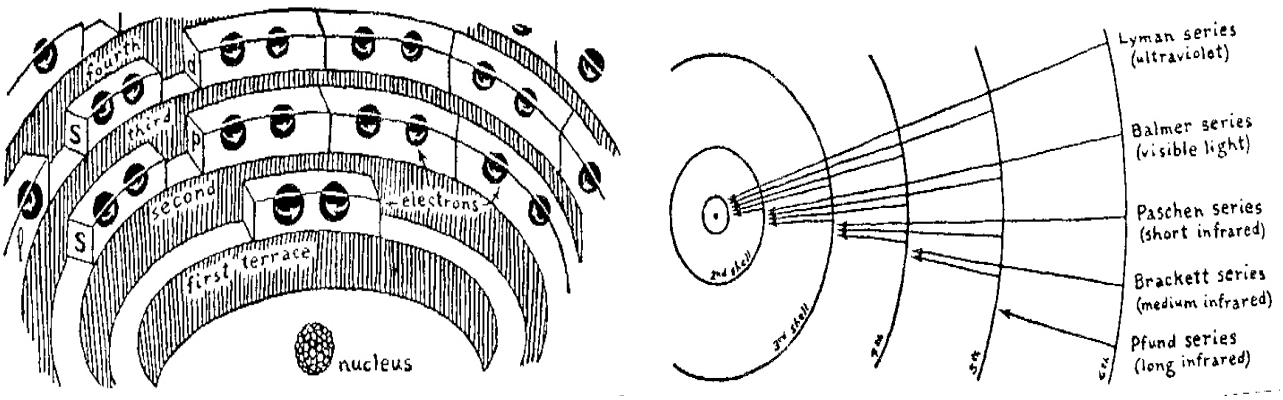
Strangely, people are ready to make a much larger 'leap of faith' in accepting science's findings than those believing in any religion or mythology. As well needing the capability to deal with the math, the greatest particle physicists have had a highly developed ability to visualise (in fact we understand it was Einstein's wife who suggested the idea of moving with a ray of light

to know what it must be like to travel at the speed of light). One such gifted physicist was Richard Feynman, for whom the process of scientific visualisation was a kinaesthetic process. On one occasion he was inspired by the wobble, spin and rotation of a plate thrown through the air by a student in the University of California canteen to realise how the spin of an electron must operate. As Gleick writes, 'His Los Alamos colleagues were sometimes amused to hear him, when thinking out loud, howl a sort of whooping glissando when he meant *'this rises exponentially*; a different sound signified *arithmetically'*. When he had assembled the primitive calculating machines at Los Alamos, site of the first atom bomb test, Feynman 'rapidly discovered that he could program them to clatter out the cadence of well-known songs'. So closely did he identify with the syncopations of atomic behaviour that he was well-known for the constant drumming of his fingers on colleagues' desks, and even took up the bongo drums. At times he identified himself so closely with the imaginative mimicking of atomic activity that on one occasion a fellow student walking into his room found him rolling about on the floor next to his bed, trying to identify himself with atomic activity as he worked out a problem. Gleick rates Feynman's diagrams representing the behaviour of atoms weaving string-like paths back and forth, following what became String Theory (fully established by the 1980s), as 'a prodigy of visualisation at its most intellectually incisive'.

Nonetheless, through all this indirect observation some definite rules about subatomic structure and behaviour gradually emerged.

RULES OF INTERNAL ATOMIC STRUCTURE

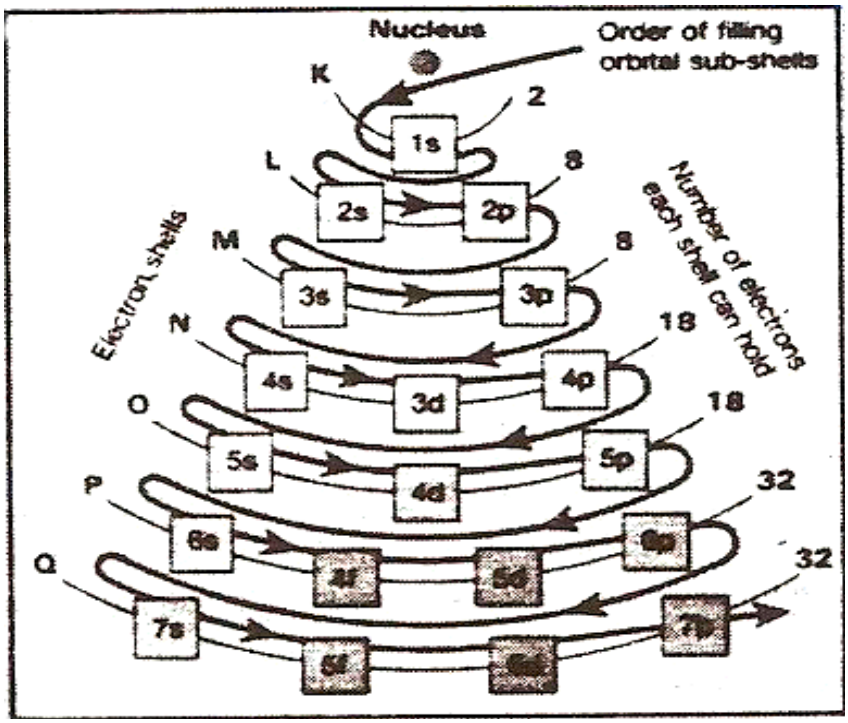
It became plain that most atoms are constant in their structure (otherwise they would become another element), and constant in the proportions by which they combine with each other, meaning that chemistry is predictable in its results. Moreover, if particles are not to bump into each other, their tiny orbits – orbitals – keep to whole number intervals away from each other



Ill. 3- 30: Murchie's visualisation of atomic shells as an amphitheatre, and wavelength bands

in certain set 'runners', or 'shells'. How could it be otherwise? So it is not surprising that the first eminently usable model for understanding the structure of the interplay between nucleus

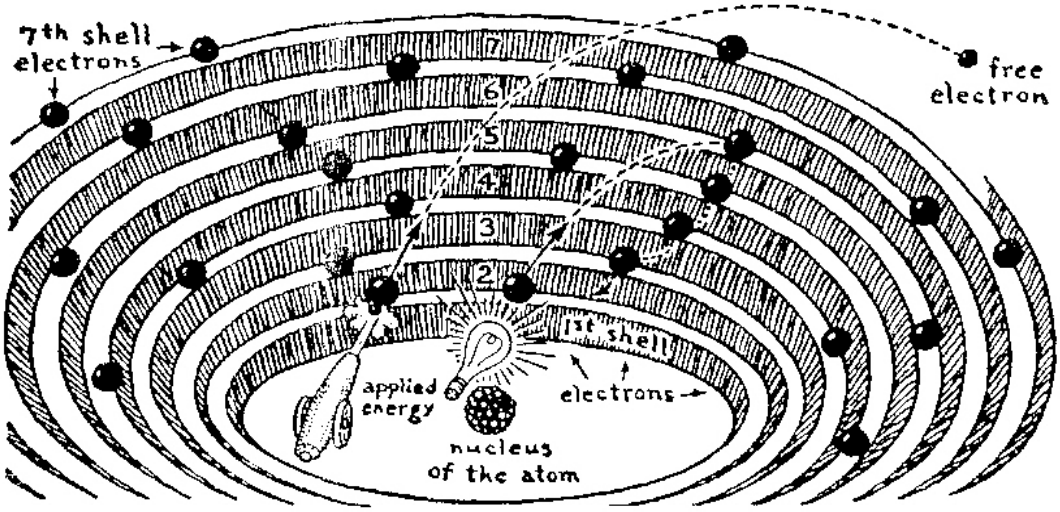
and electrons inside any atom still notionally remained that of a miniature planetary system, given the centre core, or nucleus consisting of neutrons bunched densely together with positively charged protons, did fit the role of a sun surrounded by the encircling planets of negatively charged electrons constantly on the move. Scientists still use this simple model for convenience as a kind of shorthand, and we can start with it too before moving on to non-planetary analogies later. A normal atom has the same number of negatively-charged electrons as it has positive charges in its nucleus, and so overall it is electrically balanced, giving rise to a material of identifiable character. Furthermore, interpacked in the interstices of the already packed protons of the nucleus are what can be imagined as the 'smaller balls' of the neutral neutrons providing stuffing and stability to the active part of the nucleus and its surrounding spinning electrons which fit into available orbits from the centre outwards according to the following pattern, the shells being supplied with the letters of the alphabet from K to Q (in the next illustration note also the forward and backward movement of the electrons between the shells, as visualised by Feynman:



Ill. 3- 31: The order and numbers of electrons filling the seven available orbits K-Q

THE PLANETARY ANALOGY

At the same time as the discoveries made at the Cavendish Laboratory in the first decades of the 20C, the German Niels Bohr (who had worked with Rutherford at Manchester) showed that Kepler's three laws which apply to planetary motion also apply to atomic particles – with a big 'but'. A fourth law comes into play due to the fact that *several* electrons occupy each major orbit round the nucleus, and if they are not to bump into each other, only a certain quantity can



Ill. 3- 32: Murchie's view of all seven atomic shells and a free electron as if shot by cannon across them, the light bulb referring to photons

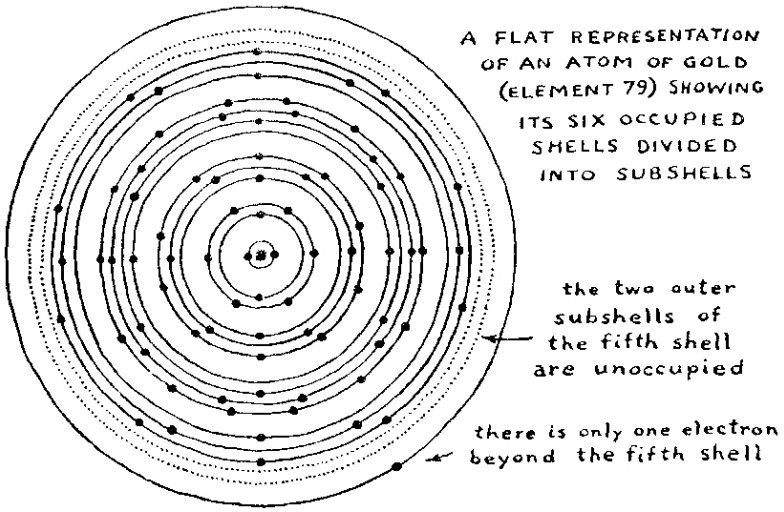
occupy the limited number of invisible, spherical shells arranged inside each other like an octave of Russian dolls. These tiny orbitals within these notional spheres/shells are often indicated in diagrams as loops or spanner-looking shapes, though Murchie imagines them as tiers in an amphitheatre.

Thus right from the start, although scientists found it useful to imagine the atomic system as operating like a Newtonian orrery, we all know that in fact no solar system has several planets in any one orbit, nor do they regularly shift from one orbit to another in quantum leaps, other than in catastrophic circumstances. Moreover, the planetary orbits of our solar system all run more or less on one plane, whereas those of electrons follow looping paths at different angles within notional spheres, each following their own individual direction around the centre, as illustrated above in the Neon atom. Each wave vibrates within its own restricted sphere, maintaining its separate path and orbit, and in its natural state never bumps into the others (named the Exclusion Principle by Pauli). Whether atomic waves can be visualised as spreading in circles, or as peaks and troughs on an endless piece of string, they are all harmonic oscillations rhythmically spaced. Each is a bunch of energy - or quantum - and the electron gain or loss in motion and energy is measurable, from which a picture of any atom can be built up.

The shells themselves were measured with X-rays by the Americans Lewis and Langmuir from 1916 onwards and named, from the inner shell outwards, as the K, L, M, N, O, P and Q shells. The K shell is 1 ångstrom in diameter, L is 4å wide, M 9, N 16, and so on according to the series 1^2, 1^2, 3^2, 4^2, etc. The K shell can only take up to 2 electrons; the L shell holds up to 8; M up to 18; N up to 32, and so on according to the series 2×1^2, 1×2^2, 2×3^2, 2×4^2. Moreover the shells progress from ultra-violet wavelengths at the inner orbit towards infra-red at the outer ones, with the visible spectrum lying in between. The relationship between the two sets of series is close, simple, and Pythagorean in nature, and the link-up with hierarchies of

tiny octaves at different wavelengths really locks the atom into a miniature arrangement of correspondences. The electrons follow their predetermined 'tracks' according to the simple constraint that in successive circular routes around the nucleus more and more can fit in. We thus have an octave of seven shells as the norm, where in the simpler elements not all are occupied and in the more complex they split further into subshells acting as radiant semi- or quarter-tones. Uranium, for instance, has 92 electrons occupying 18 subdivisions of the seven key shells, even more complex than the sub-shells of the gold atom drawn out below.

Pinning down the distribution of such shells and their electrons was helped by Rutherford's experiments: he had fired alpha particles at thin sheets of gold: most went straight through, showing the atoms in the foil were largely empty space but some bounced off, suggesting the presence of other particles. Interestingly, in 1999 the Brookhaven National Laboratory in their subterranean collider ring off Long Island chose gold as the element to bombard due to the high number of particles in its makeup, with the aim of rendering it down to a 'primordial soup' of quark-gluon plasma (***The Times*** 25 August 1999).



Ill. 3- 33: The shells and subshells of Gold, as illustrated by Murchie

As this is not a chemistry text book, to see how these laws apply for each element we must leave it to the reader to check their arrangement in other atoms from a well-presented chemistry book which spells out all the combinations with up-to-date illustrations.

There is then another series of 'shells' to take into account which applies to the number of particles packed together within the *nucleus.* Nuclear shells are not orbits. The analogy to take is of small solid spheres packed together and the number of spheres needed to completely pack in succeeding layers around a centre point, or central sphere, depending on whether the numbers are even or odd. One must imagine that in the interstices between the proton spheres are slipped in the smaller but even more potent neutron balls: it is the 'fit' between the two sets of sphere particles which is called 'the packing fraction' which, if not complete, engenders radioactivity by a gradual rolling into vacant interstices, causing particle seepage (those

interesting in the problems of sphere packing should go back to Keith Critchlow's book, ***Order in Space,*** which gives the geometry and critical numbers involved, completely relevant for nuclear architecture also).

The make-up of proton-neutron packing then gives rise to the particular 'spin' (affecting the note) of the nucleus of any one kind of atom. The reason that nuclear fusion produces more energy than fission is because the redistribution of packed spheres happens in the tightly confined space of the nucleus, with the particles being squeezed into new imploded combinations - under protest, as it were. They follow the Magic Numbers sequence for whose discovery the Nobel Prize for Chemistry was awarded to Jensen and Goeppert-Mayer in 1963. The shell numbers for the nucleus follow the order 2:8:20:28:50:82:126, the reasons for which Critchlow's book makes obvious. Interestingly, here the number 5 plays its part in two of the numbers, though the series falls tantalizingly short of being pure Fibonacci. If any one shell does not have a full complement of particles (comprising the numbers listed above), the element is inclined towards instability or slow inner decay. This means that the most stable and reliable atoms of all, from the proton point of view (referring to the number of protons in the nucleus) are those with the atomic numbers of 2 (Helium); 8 (Oxygen); 20 (Calcium); 28 (Nickel); 50 (Tin), and 82 (Lead) – these also have particularly stable isotopes (see again the sphere-packing diagrams in Critchlow to see why). So far the element with 126 protons, if it exists, has not been physically pin-pointed for long enough to be considered viable.

Coming back to the electrons, we now see that it is the invisible, but restraining electron *shells* (not unlike the concept of the crystal spheres devised by ancient astronomers for the planets) that provide spherical equivalents for the planetary orbits of Moon, Mercury, Venus, Earth, Mars, Jupiter and Saturn round the solar nucleus. Disturb the order of the shell or its occupants in relation to each other, says Murchie, and, due to the laws of the Octave, internal adjustments, sometimes explosive, sometimes calmly redistributive, will take place just as planets would reorder their intervals in relation to each other, should we suddenly pluck one of them out of its path (indeed, we now know that Jupiter, Neptune and Uranus (the gas giants) started off closest to the Sun during the early genesis of the solar system and then moved to outer orbits during the stabilization sequence). Chemical reactions are to do with the redistribution of electrons and, although energy is given off in the process, it is of a different order from the redistribution of core particles with each other. However, both kinds of change follow combinations of simple numbers and their multiples.

In reality, Murchie admits, the electron is much more elusive than a planet or any object in the macrocosm, even if it does have to follow any one of the seven concentric shells or energy states around its nucleus. Because of this strict allocation, electrons never collide but stick to their 'mysteriously inviolable interval ratios according to Pauli's Exclusion Principle for which no

exception has ever been known or observed'. Wolfgang Pauli stated the obvious: that no two *particles* can occupy the same space, and that only a certain number of electrons can occupy any one orbit before being forced to move to the next orbit out from the centre, in a quantum leap requiring a great deal of energy (Ill***. 3- 32***). The rising number of electrons and number of orbits occupied was the first way of accounting for the mass of each element. Scientists ascertained that electrons occupy the shells from the interior outwards in ascending order, and that if outer shells are not fully occupied the element is easily combinable if its spaces correspond in number to the free-floating electrons on another atom's outer shell. With gold it is the one stray electron on the outer shell (***Ill. 3- 33***) as well as the large number of electrons in its other shells, which explains why it has difficulty in finding a marriage partner, given it hardly ever combines with any other element. On the other hand, those elements with just a few electrons in the first few shells are, numerically, going to find it easier to 'fit into' other atoms with nothing left over, and thus form a combination, or molecule. From what we know already of harmonics from music, it is clear the successful combinations must inevitably follow the simple numbers of harmonics. Any chemistry textbook soon bears this out and we leave it to the reader to check on the detail of individual combinations.

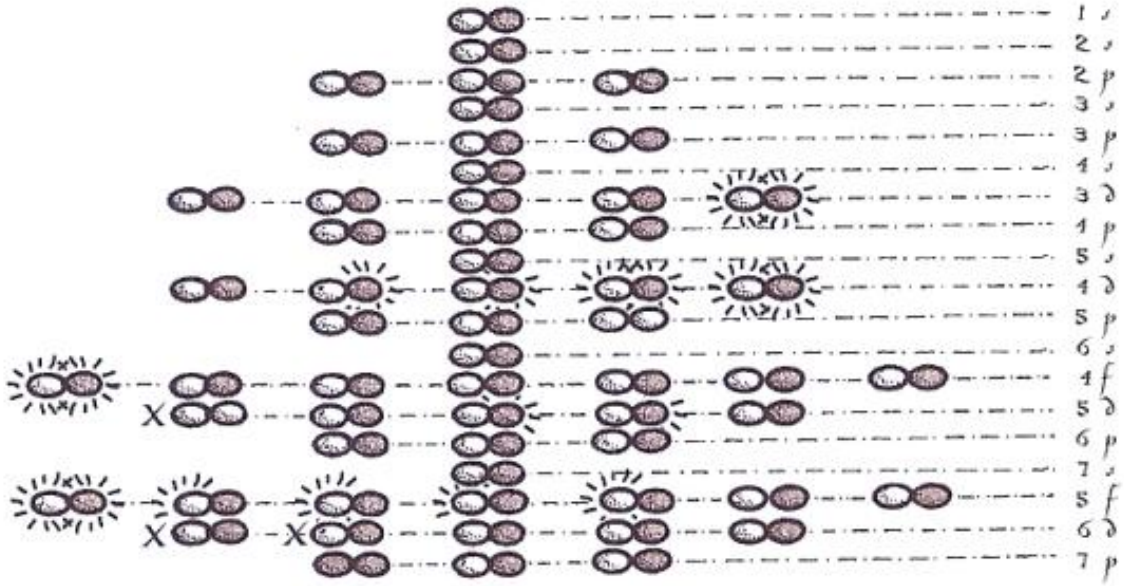
Scientists also saw that electrons by their very nature do not necessarily stay in one shell all the time, since they are liable to change energy level through outward pressures such as temperature change or bombardment by other particles. In actuality they move back and forth between shells – even in the most simple element, Hydrogen. In this process energy bundles (quanta) are given off if the electron jumps to an outer orbit, or are absorbed by the electron when moving to an inner shell from an outer ring. The energy quanta follow proportions which have so far only been measured in the simplest atoms, which we look at in relation to hydrogen shortly. In other words, atoms with only a few electrons have all rings notionally present which from time to time the electrons can 'visit' at higher or lower rates of energy. The lower the numbers, the more common and versatile they are. The process of energy exchange has relevance to humans in that we need to understand our own energy spheres and how to jump to the one we want at the time. There are techniques that help change level in order to tackle different tasks or reach new fields of consciousness. These are unquantified laws known by all great spiritual masters, and follow the electron analogy of access to higher or lower energy spheres. In a nutshell, human life, too, can be lived across several energy spheres and be made fruitful by energy changes – which are better intended than left to chance. This is especially true of changing from physical activity to mental, or from mental to spiritual. Too often we get stuck in a rut, unable to summon the force to leap from one level to another.

RULES OF THE ATOMIC ORBITS

It became clear from a consideration of all the atoms in due order of complexity that in essence each element gains its character from the combination of protons at the centre and the corresponding electrons spinning round it at different distances. Looking at the above illustrations of the orbital shells, read first in the lines below only the text in black:

The first shell/orbit can only hold up to 2 electrons, and the same for the second shell.
Shell three can hold up to 6 electrons **+ 2**, and the same for the fourth shell **+ 2**.
Shell five can hold up to 10 electrons **+ 6 + 2**, and the same for the sixth shell **+ 6 + 2**.
Finally, shell seven can hold up to 14 **+ 10 + 6 + 2** electrons.

However, the 3rd -7th shells have further, submerged **sub-shells** within them (their occupation numbers available are marked green, and *additional* to the black numbers above, meaning you re-read the above 3 lines to take account of the sub-shell numbers). This is seen, for instance, in the Gold atom, where both orbits and sub-orbits are occupied. But these submerged shells are not like one-for-one shadows, but jump back and forth either side of the main shells (following the syncopated numbering in Matt Tweed's diagram below).



Electron orbital sets build in sequence from the innermost 1 s. Each row half-fills with electrons (white blobs) before completing as oppositely spinning pairs (black blobs). Glows around a blob indicate that one or two electrons skip to or from other orbitals, breaking the rigid pattern. Gold, silver and copper are amongst those that share this quirk. X marks the d orbitals that try to fill before the row above gets going.

Ill. 3- 34: Matt Tweed's rendition of electron shell occupation and their syncopated placing

This means that in a cumulative process of doubling back on themselves and including previous phases, altogether there are:

Seven 2-electron shells
Five 6-electron-shells
Three 10-electron shells and
One complete 14-electron shell
(A second 14-electron shell is found in elements with extremely short lifetimes)

When Niels Bohr, who knew Hans Kayser, worked on the behaviour of these atoms in terms of their shells, in the same way Pythagoras studied sound frequencies by a vibrating string, he assumed that any electron, like a vibrating violin string, could be in one of a number of positions related by whole numbers. When an electron jumps from one shell to another, it releases a *quantum* of energy, a photon, on which the entire concept of radiation rests (Planck described radiation as quanta of vibrating energy). It was also found that, for an electron to change orbit, the shape of the orbit has to change, according to its angular momentum, probably directly related to changes of sound.

POPULATION INCREASE IN SUBATOMIC PARTICLES

It was Western war-time research that initiated the sub-particle era of discovery. Einstein's Theory of Relatively and the laws of quantum mechanics still held sway, but over an even more minute realm than heretofore suspected. Given the overriding power of contrast, or balancing (i.e. duality) in the universe – seen as a cardinal law by Bohr - in the tracking down of sub-atomic particles there evolved the dictum that everything definable must have a 'shadow' counterpart: the positron was seen as the anti-particle of the electron, for instance. Interestingly, when Bohr was knighted in 1947 he chose the Ying Yang for his coat of arms. In a lecture given at the Chicago World Fair in 1933 he had said that despite the confusion entailed in measuring atomic behaviour there always remained an underlying principle of complementarity at work, 'an inescapable duality at the heart of things'. Hence anti-particles had to be posited to accompany observable particles if the equations were to work out.

There was debate as to whether the *field* in which particle activity took place was substantial, or non-existent, particulate or wavelike itself – important or unimportant in 'containing' subatomic activity – or whether it was created by the electrons between themselves in the process of energy exchanges on the lines described above. Feynman pointed out that electrons have their own self-energy which has to be taken into account in the overall balance of forces that makes an atom what it is. Every factor of matter or anti-matter was in the end named, and eventually claimed to have been noted physically in the collision chamber: theory and visualisation came before physical proof. Here I must insert as a caveat at this point a few observations on the social aspects of how scientists agree between themselves, before launching into the plethora of new subatomic particles we are asked to believe exist.

THE SUB-ATOMIC GUARDIANS

Sharon Traweek spent many years working with particle physicists in the States and in Japan and made the following telling observations.

> *The physicists see themselves as an élite whose membership is determined solely by scientific merit…. This is underscored by the rigorously informal dress code, the similarity of their offices and the 'first naming' practices in the community. Competitive individualism is considered both just and effective: the hierarchy is seen as a meritocracy which produces fine physics. American physicists, however, emphasize that science is not democratic: decisions about scientific purposes should not be made by majority rule within the community, nor should there be equal access to a lab's resources. On both these issues most Japanese physicists assume the opposite.*

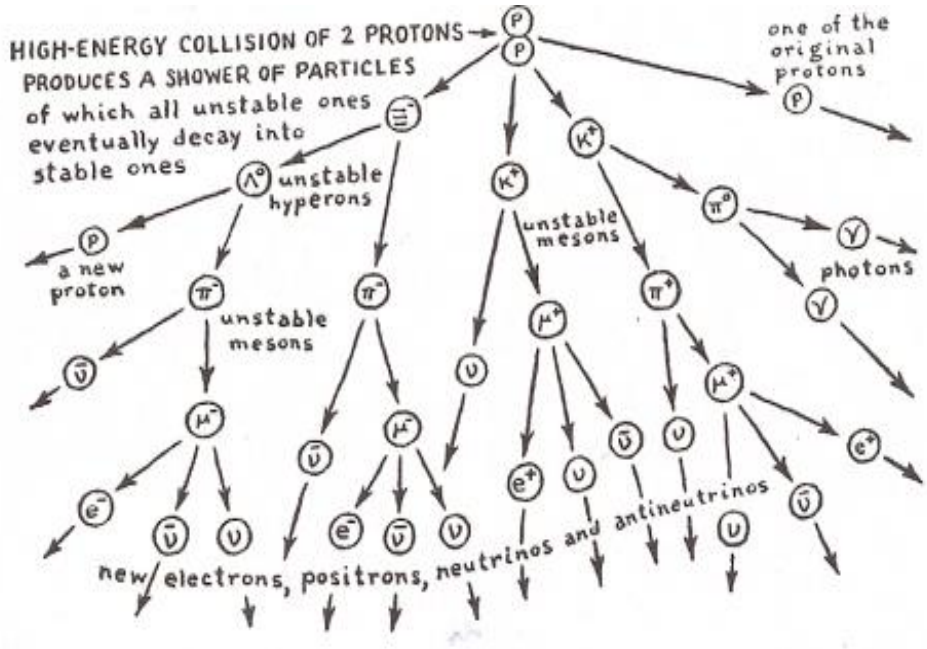
Even anthropologists have studied such groups, finding that the process of change in scientific theory is social, remarking that 'scientific truths are, at bottom, widely quoted social agreements about what is 'real', arrived at through a distinctively 'scientific process' of negotiation'. Philosopher Bruno Latour and sociologist Steve Woolgar comment, 'negotiations as to what counts as a proof or what constitutes a good assay are no more or less disorderly than any argument between lawyers and politicians'. Andrew Pickering in the final chapter of his ***Constructing Quarks*** comes to the conclusion that there is no obligation upon anyone framing a view of the world to take account of what twentieth-century Science has to say, especially the more recent 'fashions' in what is considered worthwhile pursuing. However, Steve Weinberg in ***Dreams of a Final Theory*** came to the conclusion that

> *The 'negotiations' over changes in scientific theory go on and on, with scientists changing their minds again and again in response to calculations and experiments, until finally one view or another bears an unmistakable mark of objective success.*

According to our particular abilities and education, then, we have as much room to sift out what sounds too far-fetched in current views of reality as we do on the ancient ones, and according to the tuning of our own sensibilities, to mix and match together the most helpful map. To me, music, colour and geometry, in plain number ratios, are keys to this sifting process of relevant from irrelevant or plain fanciful. Bear the following statement in mind: at a Dark Matter meeting at Cambridge, Glashow commented, 'We theorists can invent all sorts of garbage to fill the universe'. Have no compunction about throwing out the rubbish – and let the music remain.

THE SUBATOMIC WORLD AND ITS VOCABULARY

The naming of some of the more outlandish particles more recently come to light seem to be attempts to describe levels of reality beyond the physical, and the extraordinary plethora of subatomic particles is perhaps science's confusion between the physical and the metaphysical (a word by definition meaning 'beyond the physical'). As hinted at by outside commentators and



Ill. 3- 35: Pattern of explosion of sub-atomic particles as visualized by Guy Murchie

some scientists themselves, everything would fall into order into the bigger picture if they were only to arrange particles in octaves. Sooner or later the overall confusion of lesser particles should arrive at a true and musical array on the appropriate level, standing on the threshold of non-material realities. Murchie displayed in miniature the process of the creation of matter by proton collisions from Source, unfolding very much along the lines of both Kayser and Huntley's branching views (***Ill. 3- 23*** and ***Ill. 3- 38***) and to some extent fitting in with Ouspensky's abstract speculations on the development of octaves within each note/atom. We believe it is likely that the generation of the full population of subatomic particles must follow an arrangement along these lines, but will need first to study, as we do in later books, the Octave as divided into 12 semitones, 22 quartertones - and the 56^+ microtones cultivated in Asian music - before it becomes possible to gain a sense of how this Telstar music plays out, and try to assign its microtones accurately.

You would think there is a limit to quantifying everything on the material level, just as there must be a limit to the number of elements creatable before they vanish onto another plane of existence not measurable by instruments. Take the search for 'gluons', as reviewed by the ever-reliable Nigel Hawkes in ***The Times*** for New Year's Day 1996:

> *… In what may well be the largest single calculation ever performed by a computer [three scientists from IBM] have worked out the properties to be expected of objects known as 'glueballs'… the things that stick other particles together. The ruling theory of matter – known as the Standard Model – says that everything consists of quarks, assembled in various ways to make the more familiar protons and neutrons. But the Standard Model does not give any indication of what it is that holds the quarks together. That comes from a later theory called Quantum Chromodynamics or QCD,*

> *which proposed the existence of gluons, particles that carry the strong nuclear forces to stick the quarks together.*
>
> *The trouble has been that nobody has ever managed to see a gluon. Or maybe they have, without quite realising it. For the IBM calculation shows that the glueball, which consists of a clump of gluons, may be one and the same as the mysterious theta particle, picked up more than ten years ago in an experiment at the Stanford Linear Accelerator in California.*
>
> *Like all scientific theories, QCD makes predictions about how the world ought to behave. But the equations are so complex that they are impossible to solve without making simplifications, and even then they take a very long time on powerful computers. …The [three scientists from IBM] present the results of a calculation that required 400 million billion operations and took more than two years on a computer using almost 566 chips connected together in parallel so that they could all compute at once. … The latest calculations provide an estimate of the rate at which such a particle ought to decay into quarks and anti-quarks… that annihilate each other, leaving behind the lingering image of the gluons that held them together.*

Even the intelligent public cannot take this seemingly fantasist world on board seriously, mostly sticking at the initial triadic model of proton-neutron-electron, their packing and orbits - which make sense in plain Platonic terms. Indeed, someone like the supergenius, Stephen Wolfram, in his ***A New Kind of Science*** is back again onto the argument that the only unifying theory in science must be based on mathematics. 'The Pythagoreans had this idea – all is Number', he told the ***Daily Telegraph***. 'This was a pretty good idea: it spawned mathematics. My comparable idea is that all is computation'.

In the 1940s light particles had been named *photons* and in cosmic rays its opposite partner was understood as the *meson*, with a neutral particle in this context being named the *pion.* By the 1950s mesons in turn were *theta-* or *tau-mesons* and they were balance by *beta* particles; *pions* could decay into *muons* and *neutrinos*. The sound aspect of atomic activity were particles called *phonons* and the spin factor was also particalised as a *roton*.! The idea of symmetry was important, whether the mirror symmetry of particles that cancelled each other out, the balancing of plus or minus rotational spin with inertia, or isotropic spin whose particles were *nucleons*. V-particles - called '*Y*' or *strangeness* particles by Murray Gell-Mann – made their appearance in the atomic galaxy during the 1950s: the fact that left- or right-hand spin permeated the universe - with a prevalence of right-handedness - brought physicists to the realisation that the universe is not perfectly symmetrical, just as the human body's heart is slightly off-centre to the left of the body, or as the earth tilts away from a notional upright axis.

By 1983 Gell-Mann, Feynman's arch-rival at Caltech, said that he and his colleagues had developed a workable overall theory '*based on color SU (3) and electroweak SU (2) x U (1), with three families of spin half leptons and quarks, their antiparticles, and some spinless Higgs bosons in doublets and antidoublets of the weak isotropic spin to break the electroweak group down to* U_1 *of electronmagnetism'.* He won the Nobel Prize for predicting (due to the

consequence of broken symmetry between left- and right-handedness described above) the *omega minus* particle. He described further qualities to account for *quarks* (briefly called '*partons'* by Feynman) which congeal into protons and neutrons and embody the six directions of space in 'children' sub-particles variously called *top/truth, bottom/beauty, charm|colour*, *flavour*, *up, down* and *strange*, for which there also had to be *antiquarks, anticolours*, and *gluons* to carry colour from one quark to another. All these particles could interchange identity and place with each other.

But it was found that *quarks* in turn have a structure of their own, and cannot be the smallest particle, even though at one stage it was reported in ***The Independent*** of 4 March 1995 that 'Scientists yesterday confirmed the discovery of the last basic building block of matter, the elusive top quark, a subatomic particle that has not existed naturally for probably 15 billion years… this subatomic particle appeared bizarrely to be heavier than an atom of gold'. The difficulty in detecting it had been the fact that it existed for only a hundredth of a billionth of a billionth of a second. This is difficult stuff for the average man in the street to take on board: explaining the Universe in terms of mythological stories is more intelligible, especially when at the end of these assurances it is then said of quarks, 'In fact we can't even be sure they exist and are not just mathematical conveniences' and that 'scientists may possibly catch a glimpse of these elusive fundamental components of the universe'.

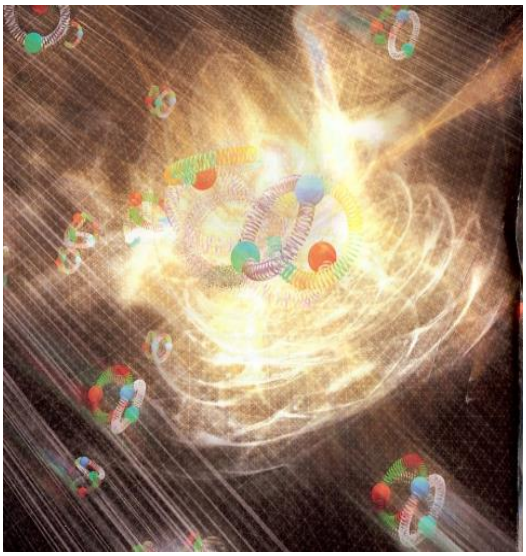
When it came to the search for even further particles *within* the sub-atomic particles, the plot thickened. Neutrinos appeared on the scene, well explained in this review by Nigel Hawkes in ***The Times*** for 9 October 1995:

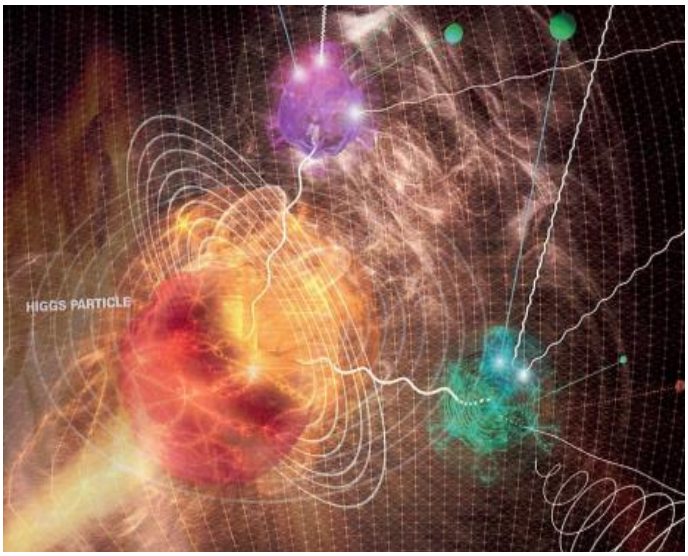
> *The neutrino was long believed to be a massless, chargeless particle, a mere fragment of nothing, but present throughout the universe in innumerable quantities. Because of its evanescent quality, it can pass through anything without being noticed. Hold out your hand and ten thousand billion neutrinos from the Sun will pass through it in a second. Neutrinos are real, despite their ghostly qualities and come in three different kinds: electron, muon, tau. … Neutrons can transmute from one kind into another, a process that would enable them to evade detection. But if they can transmute, or 'oscillate' as the physicists put it, then they must have mass…. The experimental statistics are fragile and open to more than one interpretation…* '

THE HIGGS-BOSON PARTICLE

In the quest for the ultimate structure of matter, Leon Lederman termed the *Higgs boson 'The God particle'* because so central, yet so intangible. The giant atom-smashing collider CERN was finally able to 'prove' its existence: the recent ***National Geographic*** article on 'the hunt for the God particle' usefully devised a double-page graphic showing (below left) the 'trillions of protons in collisions at 99.9999991% of the speed of light … the quarks and gluons inside them exploding with enough energy [to release] the elusive Higgs (visualised above right). We are

reminded that each proton is imagined as consisting of three quarks held together by 'massless gluons' (visualised in the left illustration as interpenetrating rings with red and green blobs on





Ill. 3- 36: Visualisation of atom bombardment (left) and appearance of the Higgs-Boson particle[16] (right) - National Geographic March 2008

them). On 4 July 2013 the ATLAS and CMS experiments at CERN's[17] Large Hadron Collider announced they had each succeeded in isolating a Higgs particle, for which the theorists who predicted it were awarded the Nobel Prize for Chemistry, including Higgs himself.

But did it bring people any nearer to God? All we are told is that 'the bosons are particles that make it possible for leptons and quarks to interact with each other in four kinds of interaction: gravitational and electromagnetic for which there is one boson each; the weak interaction, for which there are three bosons; and the strong interaction for which there are eight bosons, making 13 bosons in all ('Curioser and curioser,' said Alice). At the end of it all 'there is still the possibility that there may be particles that are neither leptons, quarks, nor bosons but fit into different categories altogether…'. Would the Mad Hatter have ever dreamed of thinking he could get Lewis Carroll to believe all this? It would probably have made the Red Queen hysterical in the usual way, as it does us.

We should not leave out the 'light' factor, seen by physicists as a stream of photons, also subject to forces such as the strong and weak nuclear forces and a kind of intermediary particle that carries electromagnetic force between electrons and their quarks which (we are told) can be broken down into a quark –v-antiquark pair though we are not sure at any one moment whether the photon is in particle or wave mode (their transformability would account for what in the past would be termed miracles). We are also told that quarks can be red, green or blue,

[16] Calculated to have a life-time of one million million million millionth of a second.
[17] Note that the underlined acronyms are links to their respective sites.

tending to group in threes (hence the way they are illustrated in the reconstruction above), leading to a new branch of particle physics, quantum chromodynamics, QCD).

THE 'STANDARD MODEL'

Gell-Mann by 1961 proposed a unifying scheme, worked on through the 1960s and 1970s, that came to be called The Standard Model whereby to arrange and classify all these new particles in groups of eight, as with the eight octaves of the Periodic Table itself, likening their existence to 'the eightfold way of Buddhism' (music was not mentioned). Certainly this 'eight-fold' approach enabled the prediction of a variety of particles not yet been detected, but ultimately all located during the 1960s. (Buddhism was an acceptable religion in California for scientists and film stars, since there is no need to bring in God.)

The Standard Model decreed that matter is made up of a canonical six quarks (the up, down, strange, charm, bottom and top) and six leptons (the electron, muon and tau, plus their neutrinos) - *and* their corresponding anti-particles making 12 of each in all. Leptons congeal into a variety of particles of which the most familiar and important is the *electron: muon* and *tau* particles are heavier types of electron, and these three types of electron exist in *neutrino* form. In other words, quarks engender six main types as do the leptons, creating two sub-atomic octaves if they themselves are included as the originating Doh. We have yet to ascertain whether these can be translated as the ultimate up and down octaves, or major and minor scales connected to going with or against the Prime Energy Field in their spin. To complete the trinity, the neutral GAUGE BOSONS (see below) must be present behind these infinitesimal octaves to transmit the forces of any interplay between them. So we are back to an interplay between positive, negative and neutrally charged entities operated ultimately through an underlying Law of Three, as Ouspensky would put it.

ATTEMPTS AT SIMPLIFICATION

Since the 1980s there are signs some scientists are trying to 'boil down' the plethora of particles into the beginnings of a meaningful hierarchy. This depends, they say, on which of the main forces of the Quadrupole/Cross of Existence they 'carry', and thus are divided into four 'families'.

First comes the **GAUGE BOSON FAMILY** which consists of variations of the photon – particles which are vehicles for *electromagnetism,* running from particles for the very short gamma rays through ultra-violet, the colour spectrum (which has wavelengths ranging between one 50,000th of a cm at the violet end and one 20,000th of a cm at red), infra-red, heat, micro-waves and the comparatively long radio waves which range between 1cm and 1km in length (light itself ranges between 0.00035 and 0007mm in wave-length - see ***Book 0, Ill. 0-35***). The second family is the **W & Z PARTICLE FAMILY**, whose particles carry the *weak force/radiation*, that transmutes

the nuclei of radioactive atoms by converting neutrons into protons, electrons and neutrinos (see ***Book 0, Ill. 0-36***). Then comes the **GLUON FAMILY** whose particles hold the *strong force* that binds protons and neutrons together and therefore holds atoms together. Finally a fourth family is predicted as gathering round **GRAVITONS** to convey *gravity*, but this has as yet been hard to measure. Here at least there is an attempt to link groups of particles to energy fields: the view amongst particle physicists in the 1990s was that two ultimate particles engender these **QUADRUPOLE TRIBES**: the quark and lepton points of energy.

As yet scientists say they have succeeded in seeing the relationship between the first three families, but how gravity fits in still eludes them – it is because the bosons are seen as the particles giving a matrix to all these forces. The big effort, through particle physics, is to arrive at a Grand Unified Theory (GUT) which will finally relate quantum physics and field theory into One Law of the Universe – possibly as needless a quest as the alchemists' to become Midases, given the model used is only couched in physical terms.

As of 2013, quoting from another ***National Geographic*** article in the March 2008 issue entitled 'The God Particle' Joel Achenback, during his tour of the CERN and ATLAS sites that concentrate on isolating subatomic particles, wrote of the Standard Model that it is now 'widely viewed as unwieldy, like a contraption with too many loose ends and knobs and dangling bits'. It now includes 57 fundamental particles, which we could possibly read as microtones (we know there are 56 in an octave). But without a musical paradigm there appears little rhyme or reason to many of the numbers describing how the particles interact – let alone their anti-matter 'other halves; (squarks –v- quarks or smuons –v- muons), to which the Higgs Bosons provide mass (we are told). Having got to this ridiculous situation, we just have to assume that overall, subatomic particles - whatever names might be given to them - are likely also to unfold and interact in musical ways, following the main intervals of the Octave in its smallest divisions. We all know the tale of the result of peeling off the layers of the onion, one by one. It ends in a void at the centre, and one cannot analyse that void in terms of ever more parts. We simply have to live life on Earth's wavelengths and agree with George Smoot that 'Every day I go to work I'm making a bet that the Universe is simple, symmetric and aesthetically pleasing'.

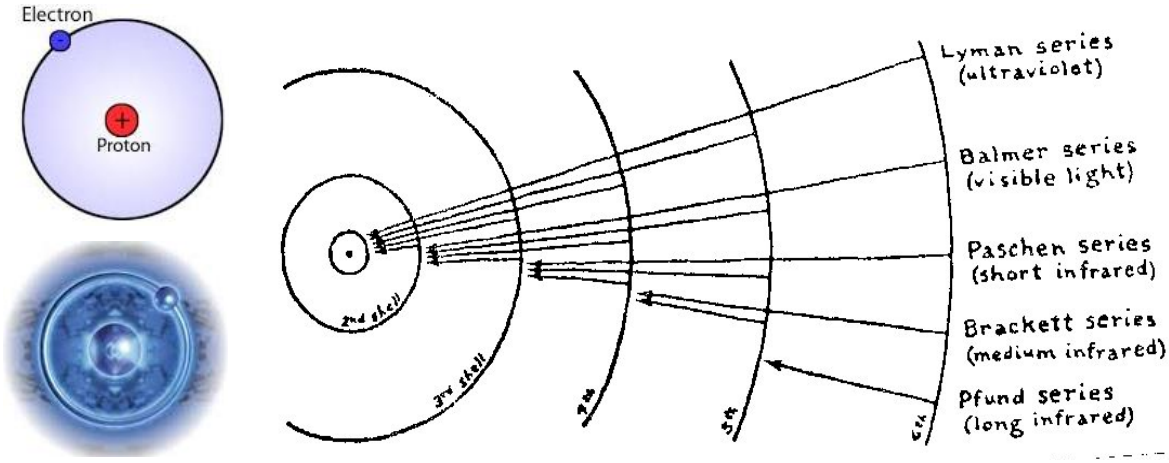
Certainly the terminology of the initial triad of subatomic particles has become embedded in mankind's world view: it is a genuine realm of existence that needs to be integrated into more general cosmologies. Certainly we can say so far that seeing the Law of Three at work, the Seven Spheres of atomic structure - and the Octaves of the Periodic Table (even though requiring fine-tuning) - all open doors of certainty onto the hidden machinery of matter (some primitive tribes opened up to it, using different vocabulary, millennia ago). In the final pages we will take a look at Krüger's suggestions for the notes of most atoms in the Periodic Table, along the lines of the ordinary 8-note Octave, but for sub-atomic music we need whatever extra

data is ultimately gleaned by the scientists working in this field if we are to be in a position to bring into relief any tell-tale patterns within the Standard Model more definitively.

In this section we have gone round in circles reflecting on the unfolding story from recent decades of the host of emerging particles whose reality we are being asked to accept – as a current mythology without meaning – and no Gods. We turn to the inspection of one specific atom in the light of this foray into the sub-atomic world to see whether further musical simplicity could rescue us from the scientists' jargon.

HYDROGEN: ENERGY EXCHANGE AND RESONANCE

It was not until Kayser and Krüger made direct links between atomic and musical numbers for specific elements and scales that systematic and precise connections started to be established between notes and atomic structures, as conveniently shows up clearly in the structure of Oxygen (***Ill. 3- 26***). To gain insight into further aspects of musical ratios at work in the atom we turn to look at the wave motions of electrons within another exemplary element, Hydrogen, the simplest atom of all. As we already know, Hydrogen is also the most available element, and the energy exchanges between its spheres easiest to calculate – hence its position at the very beginning of the Periodic Table. Even for the first element the process of measuring energy exchange through spectra from each shell as its electron journeys between them is complex, and it has not been possible to pin down the process in many others yet – those for Hydrogen are shown in the right-hand drawing below by Murchie – but from such a simple beginning the principles can be established for at least the theoretical calculation of the more complex ones.

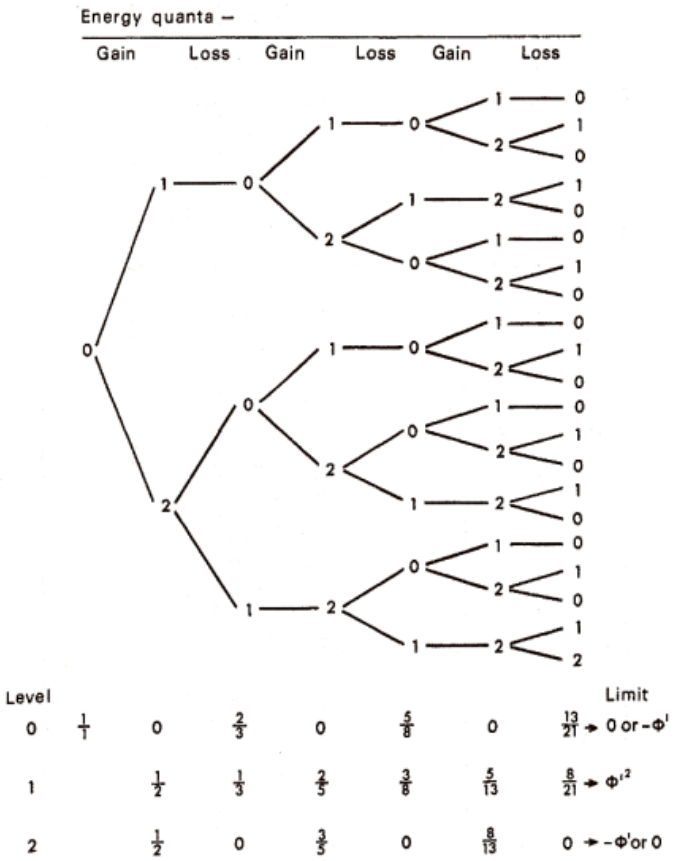


Ill. 3- 37: The Hydrogen atom has a single proton nucleus orbited by one electron (left): though a gas, as a two-thirds part constituent of water, it is shown in the lower graphic as watery; (right) wavelengths of atomic shells summarised by Murchie – see Spectra heading

H E Huntley in his small book on proportion[18] - referred to briefly in ***Ill. 3- 24*** - tried to map the energy exchanges between Hydrogen's electron shells, arguing that the progression of energy states of the one hydrogen electron visiting other shells follows the Fibonacci series (1, 2, 3, 5, 8, 13, 21 etc.) as energy is deflected and dispersed or drops back, and that there appears to be a 'balancing out' mechanism so that energy expenditure is exchanged in constant quantities between each level (next illustration).

In the same way, with his thorough grounding in the ratios of music (***Ill. 3- 23***) Kayser realised that harmonic numbers or their multiples would be recognisable when they occurred in atomic calculations, or visually as spectra. Thus he could make sense of the information provided by Niels Bohr that in those first four shells/orbit zones of the Hydrogen atom, the waves of its one electron moved at 2160khz per second in the first shell; 1080 in the second, 720 in the third, and 540 in the fourth – it was losing energy proportionately as it moved outward – numbers that recur in other atoms and the first evidence of the reverberations of the Octave operating in the atomic makeup. You will recognise these as familiar harmonic numbers, relating at 1.5 to each other. Thus we have two octaves (2160: 1080 and 1080:540) and two fifths (1080:720 and 720:540). If the numbers are presented in reverse order from 540 to 2160 they are in the ratios 3 : 4 : 6 : 12. McClain would translate these into the musical notes G (540); D (720); G^1 (1080) and G^2 (2160). Altogether, Bohr's figures were clear evidence of the impact of the octave working within the atom, and these ratios recur throughout atomic behaviour. No matter what the number of the wave frequency, a wave will always behave like a wave and have an overtone series along the lines of Kayser's piano experiment (***Book 1, Ill. 1-15***) - if the wave motion is to proceed without the parts jarring with each other it could not be otherwise.

[18] H E Huntley **The Divine Proportion: A Study in Mathematical Beauty** 1970

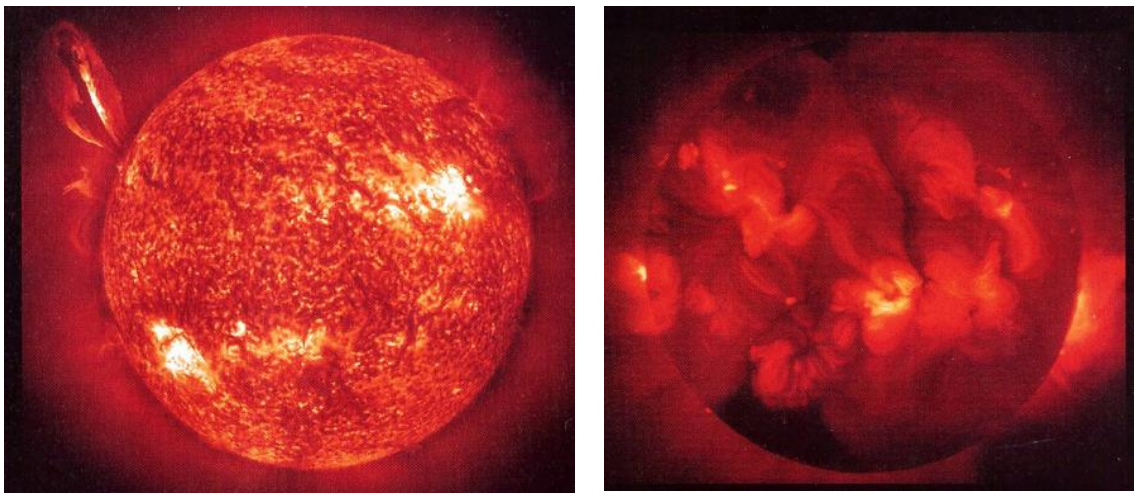


Ill. 3- 38: Electron and energy exchanges between Hydrogen shells – Huntley fig.12.2

Huntley's illustration also showed that even where energy is deflected, the Fibonacci ratio of 8:5 and the more precise expression of it in the Golden Section (1:1.618) are found at work behind the quantum jumps between energy levels of simple atoms of Hydrogen gas rising and falling in the air and of its electrons in different shells. The number of possible different histories in the positions of the electrons jumping from one state to another and falling back to their original stage exhibit the same ratio – as mapped in his diagram - since 'where the gas gains radiant energy all the atoms in state 1 rise to state 2; half the atoms in state 0 rise to state 1 and half rise to state 2. When the gas loses energy by radiation all the atoms in state 1 fall to state 0; half those in state 2 fall to state 1, and half to state 0'. He points out, too, that the proportion of atoms in the intermediate energy level remains constant at 38.2%.

The process of manufacture of further elements from those first two elements in the Big Bang itself is displayed in miniature in the Sun, composed almost exclusively of Hydrogen, with some of it converting to around 25% Helium and a small fraction developing on to other elements. The energy released by these reactions causes its radiance: in fact the energy given off by the fusion of single hydrogen cores with each other to form Helium with double cores is far greater than that caused by nuclear fission. This continuous generation and fusion of Hydrogen atoms in the Sun, without whose radiance organic life would end, goes on unceasingly before our eyes. As Gleick explains, it was a model to the physicists of Los Alamos working on the atom

bomb: 'Energy diffuses outward from the roiling solar core toward the surface, particles scattering one another in tangled paths until finally, as the hot gas thins, the likelihood of one more collision disappears. That creates the apparent edge, its sharpness more an artefact of the light than a physical reality. Using the language of statistical mechanics, the mean free path



Ill. 3- 39: Two filtered photographs of the Sun's internal activity (left) by Fred Espenak and (right) Institute of Space of Japan – From National Geographic July 2004

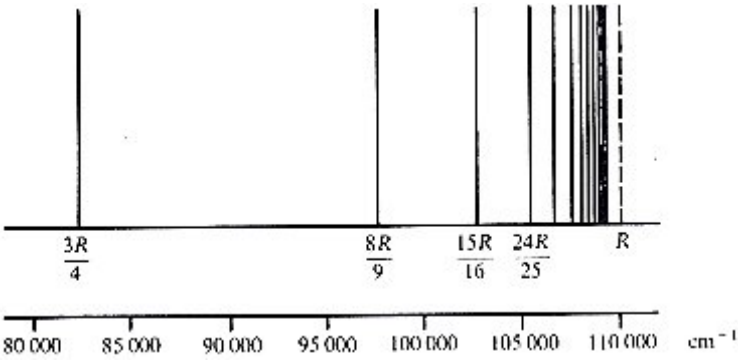
– the average distance a particle travels between one collision and the next – becomes roughly as large as the radius of the Sun. At that point photons have freed themselves from the pinball game of diffusion and can fly in a straight line until they scatter again…'.

In other words the fusion of Hydrogen nuclei with each other produces a continuous Hydrogen bomb, and on its model the H-bomb was devised. As we said, far more energy is emitted from the fusion process than from fission, and scientists today are finding ways to produce cheap electricity from a 'heavy' water fusion process involving the Hydrogen constituent of water (ridiculed at first by the Establishment but heavily sponsored in Japan and the USA), with the aim over time to supplant nuclear fission power generation which requires rare and dangerously radioactive elements. Those countries joining the nuclear race more recently have in fact missed their opportunity to jump ahead of the game and go direct to fusion.

THE MUSICAL COLOURS OF ATOMS

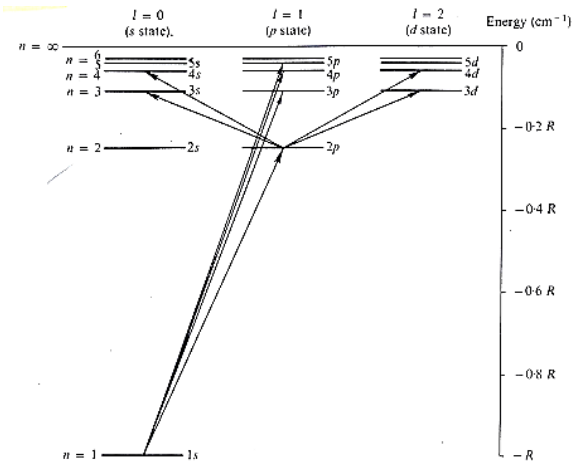
Perhaps most exciting, and important for the development of modern cosmology due to the law of correspondences between octaves of vibration already established in the introductory books, is that every atom emits a spectrum of colours arranged in lines that differ according to the disposition of the electrons making up its individual force-field. The essence of spectroscopy in the infrared is radiation frequency with harmonically radiating signals and overtones. Thus every atom has its own 'bar code' consisting of varying combinations of lines of the colours of the spectrum. Banwell in his A Level textbook, ***Molecular Spectroscopy***, whose illustrations

we use below, discusses energy exchange between atomic fundamentals in terms of 'overtones', unusual for a text book scientist! In his description of spectral analysis of energy levels in simple electron organisation in the Lyman and Balmer ranges of the Hydrogen atom (see also ***Ill. 3- 37*** right) he also uses other words such as 'combination frequencies'; 'fundamentals'; 'resonance phenomena'; 'modes'; and 'simple harmonic motion'. In the ratios Banwell observed for Hydrogen in the Lyman range of the Hydrogen spectrum, only the ratios



Ill. 3- 40: Part of the Lyman series of the Hydrogen atom - from Banwell (see also Ill.00)

10:9 and 256:243 do not appear, which may in itself be a pointer to the nature of Hydrogen. Being a clear example of how resonance works through energy exchange, he compared the process to the ripples on a pond created by a thrown stone which eventually become more evenly spaced as they move outwards, giving energy back to each other until they die away.

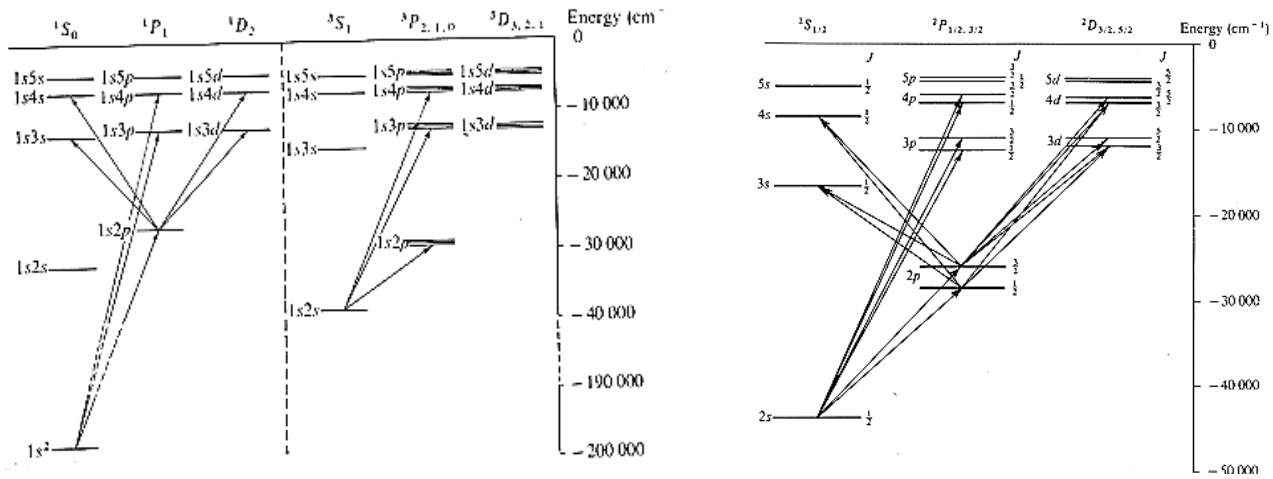


Ill. 3- 41: Graph of spectrum measurements for Hydrogen in numerical terms – from Banwell

As early as the mid-nineteenth century Kirchhoff and Bunsen had detected through their spectroscope the lines for Barium and Strontium in the flames of a fire raging at Mannheim ten miles away, and surmised they could in the same way identify the elements in the Sun by directing their spectroscope in its direction. Inspired by this Huggins in London in the 1860s trained his spectroscope on the bright stars of Aldebaran and Betelgeuse, finding spectra for Calcium, Magnesium Bismuth, Sodium and Iron in them. Then at the turn of the century scientists like Moseley began to record the spectra patterns for almost all the atoms in the

Periodic Table then known, up to Gold. His collection of patterns from this previously invisible realm showed tantalising glimpses of an overall order whereby the elements seemed to relate to each other in a hierarchy, an important stage in the process of looking at what distinguished one atom from another. The electron moving between each sphere of the Hydrogen atom gives off its own mini-spectrum, as do the next two most simple atoms, Helium and Lithium (illustration below). Helium is the progeny of highly agitated and pressurised Hydrogen atoms, becoming an atom with *two* protons and two electrons – and so on with succeeding elements. In 1919 Sommerfeld wrote that 'what we hear today in the language of the spectra is a real music of numerical relations of the spheres of the atom, a concord of whole numbers and progressive order and harmony of all diversities'. Indeed, Sommerfeld's pupil, Werner Heisenberg (so much admired by Frithjof Capra), was interested in Pythagoras and the Tetraktys and was not shy to emphasise the importance of small whole-number ratios.

All atoms have electron diffraction patterns that vibrate when the atoms pack together as seen 'from the outside' forming the fabric of any material that shows up when exposed to X-rays, as our two illustrations show, and at higher magnification through photography via the field emission microscope still versions of inner electron arrangements for any one atom can be observed. No single actual atom has actually been seen from the outside as a spherical entity other than through the few photographs that, because of the incredibly high magnification



Ill. 3- 42: Spectra for Helium and Lithium – from Banwell

required - and the constant motion of the atomic fabric - are still disappointingly blurred (see, for instance, the Silicon atom of ***Ill. 3- 9***). Therefore most of our reconstructions of any atom are partial and imaginative, based on data secured by indirect means, one being spectroscopy. Its lines of colour, Andrews surmised, are simply overtone equivalents of the note emitted by the nucleus and the band patterns can be read off for any element exposed to a spectrometer geared to read off the bands of colour, informing us exactly of its identity through the variations in colours and lines characteristic of each element. (As we know from the most recent popular crime story series on TV, this particular instrument has transformed the

interpretation of evidence left behind by criminals, leading to many an arrest on chemical spectrum identification that in former decades would not have been possible.)

It is not difficult to find good colour examples of spectra in any general science book, or google a spectra dictionary on-line. We can accept, I hope, that every element radiates its own rainbow, with the colours spaced in differing proportions and heavy and light lines dividing the zones. Here again octaval activity betrays itself in miniature, viewable only at high magnification. Of spectra the physicist Sommerfeld wrote in 1919, 'In the final analysis all whole number laws of the spectral lines of the atom are derived from quantum theory. It is the mysterious organ on which Nature plays the music of the spectra, and according to whose rhythms it controls the structure of the atom and its nucleus'. For ease of reference, a reminder of the basic correspondences between the main seven notes of the octave and seven huesof the colour spectrum are reproduced from Book 0 in *Appendix A*.

Banwell also uses the analogy for atomic energy exchanges of two pendulums swinging from a common bar which, when their frequencies are out of phase will oscillate independently but which, when similar, will readily exchange energy. When they are in resonance they will enhance each other's action, and oscillations given to one will transfer to the other in the same way two violins exchange energy if one is activated by a swept string, activating the same string on the other violin in sympathy (described in the Piano Experiment). The laws of resonance at work on the atomic level is of course highly complex, and we can only take 'snapshots' here and there when the patterns are clear for a split second – one could indeed see all of life as a massive process of minor and major energy exchanges.

Daniélou in his ***Introduction to the Study of Musical Scales*** (studied more closely in our books considering the octave in microtone form) gives a diagram showing the octave in its tiniest Hindu divisions. Whether or not scientists can discern octave ratios within atomic spectra as Banwell did for Hydrogen, Helium and Lithium, with time and patience the potential is certainly there to link them with such microtonal scales. Banwell makes it plain that, no matter what the complexity of an atom or molecule, 'harmonic' conformations cannot but be observable. The essence of spectroscopy is radiation frequency, and if of frequency, then of harmonically radiating signals and overtones, each radiating from centres or secondary centres. Bohr had proved just before World War I that the coloured lines of spectra correspond exactly to the quantum intervals of the electron shells within the atom, the first shell of the Hydrogen atom being one ångstrom in diameter, the second 4, the third 9, and the fourth 16, mathematically reducible to the series 12, 22, 32, 42 and so on. The Hydrogen electron energy states from the shell giving the Lyman range follow a process of self-reduplication rather like that of the Lambda, following harmonic progressions as logical as those worked out by Kayser for the violin. The bridge made by Kayser and Bohr between the worlds of music and particle

physics is highly significant because dependable - given they were both experts in their field and really knew what they were talking about!

Should I have given you each octave of the Periodic Table in colour, both vertically and horizontally - and should I have painted the seven atomic shells in rainbow format? I have decided to wait until we deal with molecules and astronomy to make a version of Cosmokrator related to the full Periodic Table, and will leave it to you, the reader, to photocopy, enlarge and colour in any illustrations in this book using what you have learned in ***Book 0*** about the octave notes matching the rainbow sequences. The fact that we now know each element has its own rainbow/octave means there is potential for representing even their coloured semi-tones and microtones in a Christmas decoration set-piece of myriads of tiny rainbows of differing barcodes but their precise musical matches are yet to be analysed in future books in our series, and we must put on hold their precise matching to the more refined levels of the atomic and subatomic universe until the right obsessive individuals turn up to undertake such a task!

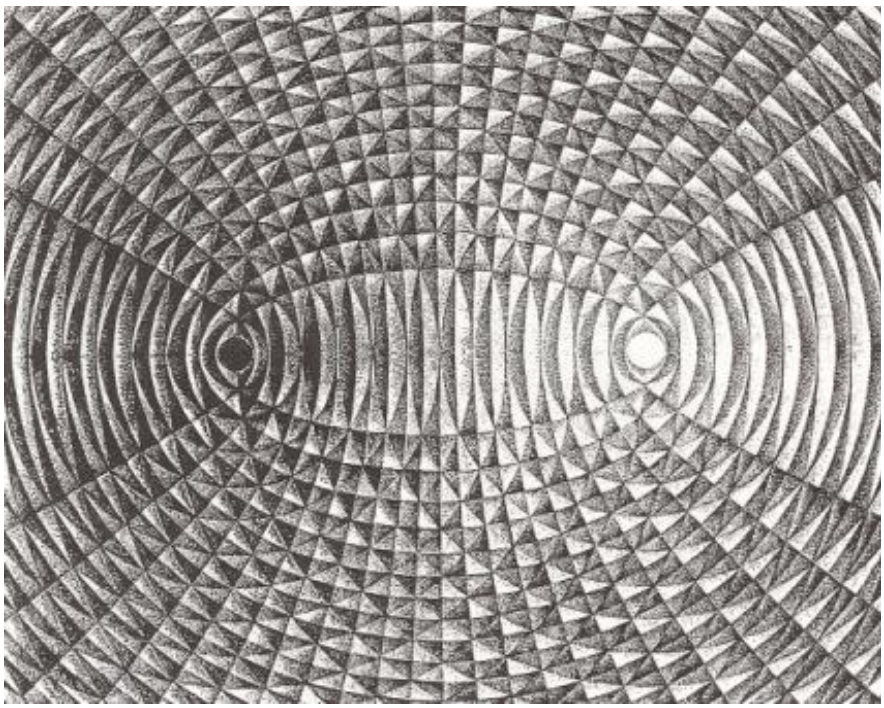
Only a few atoms have one distinctive exterior colour in solid form (as opposed to their spectrum), since most in the table are operating at wavelengths where visual colour is not their outstanding characteristic. Copper, for instance, shows up in several compounds as a turquoise-blue, Iron as red, or Potassium as violet - and their stable salts are the pigments requisitioned by artists to use in their pottery glazes, painted walls and canvases. The less stable colours used by them oxidise over time and fade, leading to that overall brown look of unrestored 'Old Masters'. A huge number of elements are simply white/grey/black (white Lead or black Carbon being the more distinguished – and also used by artists in the right compound). But to represent the atomic universe by representing on Cosmokrator only those elements used in artists' pigments is would not fully represent the reality of the atomic hierarchy - hence our constant reversion to the musical analoties to represent what is going on.

WAVES, RADIOACTIVITY AND THE CREATION OF NEW ELEMENTS

To understand the outreach and concatenations of any force field, any medium in flux within the scope of the naked eye gives us some analogy whereby to understand the processes going on inside atoms within spherical fields. We take a rest from analysing numbers and minute particles for the moment and sit back to experience unfolding displays of radiation in a medium easy to look at – water - so often mentioned by scientists as a pointer to wave activity in atoms. People looked at wave motion before Leonardo da Vinci, but he is an early example of someone fascinated enough to record in drawings the waves and countercurrents of moving water and air. We can find ourselves looking intently at sea-waves, river ripples or bath-water going down the plug-hole. We may also have seen how from day to day on beach sand, ripples

Ill. 3- 43: Leonardo's drawing of moving water falling into a still pool

change, and how it is sculpted by wind-waves in deserts. Snow in the same way is pushed into drifts one way, then another. There is a rhyme and reason to all waves, whatever the wavelength, revealed only by their impact on matter. Most of the patterns we see are not one-way, but the result of other waves interfering with them from other directions or wavelengths. When we throw a pebble into a pond we see before our own eyes the process of the controlled interactions, refraction, restriction, diffraction – all the result of the radiation of simple quanta, or energy pulsations, from that original act. A wave in water expanding without interruption will



Ill. 3- 44: Two interpenetrating sets of ripples - from Doczi's The Power of Limits fig. 183

go on in an orderly way until its impetus is spent. It will then die away due to a gradual loss of energy, or entropy. But a wave expanding freely then meeting up with the ripples of a second

pebble will be deflected back on itself, as will the other wave, and the complicated pattern of interspersed waves will result, not only in entropy (a complete running down of energy), but before then in a state of interference and break-up (the above picture is a simple example), called *loss of accord* by the scientists – an important concept for understanding atomic phenomena, again with the evident musical counterpart of discord within harmony.

When it comes to atomic interradiation we have to remember the wave pulses are taking place in three dimensions, but in the same way outgoing waves thrust in and out of each other as diverted by outside influences. The loops for Carbon and Oxygen in Krüger's drawings indicate the orbits of electrons around the atomic sphere that run in different directions so as not to bump into each other, any stray particles released from the nucleus or introduced from outside acting as 'dropped pebbles', causing countervailing ripples which lead to a more destructive loss of accord, where particles do start colliding into each other, leaving the atom running down in the form of radiation or even explosion. No-one needs telling here that a nuclear bomb artificially creates radiation through disruption of the neutrons inside the atomic nucleus, bringing about lethal loss of accord levels since radiation and heat loss are so fast and high that normal octaves are violated. This leads to further scrutiny of atomic radioactivity.

THE NATURE OF RADIOACTIVITY

It is a well-known fact of atomic behaviour that when subject to bombardment by light, at the critical wavelength, elections start to get dislodged from their shells – at first slowly and then faster, and in the process the shifting of other electrons takes place in order to readjust the balance with, as already described, a high amount of energy given off in the process. An even higher amount of energy is given off if the nucleus itself is bombarded with neutrons, setting off a chain nuclear reaction. In the case of Plutonium, where the removal of a particle from an already unstable element leads, not to an orderly fall of the pack of cards, but to a massively explosive disintegration, it is the changing numbers of the particles at the centre which leads to an intolerable situation, explosively rectified to re-establish balance. This fast process of radiation was first measured by Becquerel with X-rays, and the Curies with Radium.

In stable atoms the natural breaking down process is so slow as to be barely perceptible, but the elements at the end of the Periodic Table are decaying fast all the time, with an element such as Radium emitting three types of particle ray, meaning elementary particles are discharged so fast that the energy given out is dangerous to human cell structure (but useful if harnessed in the cause of curing illnesses) - and known as radioactivity. From the basis that normal atoms have an equal number of protons and electrons to balance each other - and a number of neutrons within the interstices of the nucleus which varies according to the packing between them - when radioactivity starts, sub-particles of paired protons (meaning they are in fact Helium nuclei) are emitted in wave form as alpha rays; speeding electron particles from

decayed neutrons inside the nucleus are emitted as beta rays; and finally, also from neutrons, come the fastest moving rays of all, gamma rays, about 100th as long as X-rays and hard to detect because neutrally charged. So, again, there is a trinity at work within radioactivity.

Not surprisingly, given the disastrous fall-out of Nagasaki and Chernobyl, the layman almost superstitiously dwells on the minor potential for nuclear danger, rather than on the overwhelming stability of harmonic patterns we rely on daily, within which nuclear power could play a part. After all, there are naturally-occurring radio-active elements buried in the earth, vibrating beneath protective layers, and only in certain instances coming up through geological filters to be exposed on the surface. How many such elements may exist at internal depths within the earth we do not know precisely, but what loss to the biosphere is incurred when we deliberately dig them up and turn them into bombs we have only too well found out.

Despite the dangers of radioactivity, natural or man-made, the use of nuclear power generation is a way or providing energy to an ever-increasing population with the least effort, compared to expensive, low-yield 'green' mechanisms such as wind or sea-wave farms – or the use of methane from animals. All forms of energy generation have their dangers and there is no reason why, with the obsessively high level of care taken at nuclear power stations, these should not be acceptable to the public – as it is as a matter of course in both France and China. Nuclear Electric in Britain in the 1980s issued an information leaflet explaining a few basic facts the non-scientific public are often unaware of: that the human body can sustain earth-generated radiation in everyday, unprotected circumstances. A visit to any granite-bearing area such as Scotland or Devon means that a person is exposing himself to high doses of natural radiation given off by these stones that originally erupted in molten state from the inner core of the earth. People who scaremonger about nuclear power stations actually have more cause to fear these rocks - and their daily cup of coffee, also mildly radioactive. Anyone who flew by Concorde at supersonic speed between Chicago and London knew they would be exposed to high levels of radiation since radiation rose dramatically when the aircraft reached supersonic speeds in the stratosphere. For a passenger one trip would not make a noticeable difference but Concorde airline pilots had to work the hours of nuclear power station workers because the radiation risk to their health was assessed as *high.*

Natural radiation from beyond Earth also occurs as a stream of stray subatomic particles raining down from outer space as cosmic rays, in swathes of photons and stray subatomic particles pouring in every second. Most of the subatomic particles are atomic nuclei stripped of their electrons, and since photons cover the whole spectrum of electromagnetic rays from gamma rays to radio waves, when they hit the earth's atmosphere they generate secondary radiation due to their fragmenting effect on the atoms and molecules of that region: most of the resulting free-floating particles come down in rain, with humans oblivious they have been

exposed to their penetration, so ultra-inobtrusive is the process. Most of the particle showers falling on earth seem to originate from galaxy cluster M27, in the constellation of Virgo, said to have a Black Hole at its centre. Basically, if the numbers fit, humans can bear the bombardment but if they become dissonant and the delicate biological balance is overstepped (as through the tear in the ozone layer of the Antarctic that is allowing in more high-frequency radiation than organic life can bear), then sheep in New Zealand or the southern tip of South America go blind, or are even born blind and similar consequences for humans have to be borne in mind.

Radiation and radioactivity are natural or artificially induced processes of self-disintegration and loss of accord, which is registered by humans all the time from *all four worlds* – not the physical world alone. The coarsest form happens when they are exposed to radiation in a disaster such as the Chernobyl nuclear power station explosion in Russia in the 1980s. Any human has an individual set of force-fields and as well as at the atomic level their entire megaspectrum will impinge on and be impinged upon by everything in its vicinity, to be radically altered not only by substances, but also by surrounding thoughts and moral climates. In a way, all is radiation (in its natural form, *morphic resonance*) and to survive in a normal state we need to expose ourselves as much as possible only to benign radiance and understand the seriousness of breaking up the succession of numbering at the heart of the atom deliberately, given that even natural cosmic radiation is itself is now treated as a burning fire pouring in through the torn curtain of the ozone layer that used to protect us. It sounds astonishing to say so, and instinctively protestors against the nuclear bomb understood this, that by allowing each atom to keep its harmonic integrity without mankind's interference, a coherent and ordered society should result – but there is always a population of humans somewhere (especially irresponsible countries who have newly adopted aggressive nuclear policies) who are not learning from early mistakes made in unleashing atomic power.

ISOTOPES

As Rutherford had found that knocking out or introducing protons to the nucleus of any element changed it into another element, so his successors found that knocking out or adding *neutrons* created a variation on the basic element, known as an isotope. After Rutherford had penetrated the atomic nucleus in 1910, in ensuring years his student, Soddy, went on to show that it was the number of neutrons in the nucleus that determined isotopic variations, many of which are radioactive because their nuclei are unstable (the interstacked spheres of protons and neutrons do not, as it were, lie four-square, but in positions that allow them to roll out of place).

Some isotopes exist naturally in the earth or the cosmos at large, such as Lead 206, 207 or 208 for example. Looking up Lead's atomic number (82), this means that it has 82 protons and electrons, with alternatives of 204, 105 or 106 neutrons to give its isotopes. Some isotopes are stable, others extremely unstable, so that Uranium 238 (92 protons and 146 neutrons) is stable,

whereas Uranium 235 (92 protons and 143 neutrons) is highly radioactive and used in the atom bomb. Nineteen of the elements of the Periodic Table so far seem to have only one stable isotope: all the others up to Lead have one or two other isotopes. Several elements have five or six variations, as predicted by Cathie, such as Thoriuim 232, which also exists as Thorium 234, 227, 228, 229, 230 and 231. Tin has ten stable isotopes: 112, 114, 115, 116, 117, 118, 119, 120, 122 and 124. As its atomic number is 50, it has a strong pentagonal flavour in its manifestations. Even the common elements have isotopes, such as Carbon 12 and 13 (and the decay of Carbon-14 is used in archaeological dating) - or Oxygen 16, 17 and 18 (with 8, 9 and 10 neutrons respectively, the balance of the nucleons being protons). It is the proton-neutron mix that also determines the overall *spin* of the atom.

Even Hydrogen has two, perhaps even three, isotopes. In the case of water made with Hydrogen 2 (often called heavy Hydrogen, or Deuterium, since it has a proton *and* a neutron in its nucleus) although tasting the same, seeds will not sprout in it and rats drinking it die of thirst. Hydrogen 3 (consisting of 1 proton and 2 neutrons) is radioactive and sometimes called Tritium - demonstrating just how crucial the inner neutron-proton ratio in atoms is for major qualitative differences.

Many isotopes have been created artificially in the laboratory through manipulation of the nucleus of closely related elements and, indeed, it was only in 1948 that the entire Periodic Table was completely filled in up to atomic number 92 (Uranium) because elements 43 (Technetium) and 61 (Promethium) do not have an isolatable *stable* isotopic form and do not actually exist naturally, so had to be created through the numbers game artificially. Many of the isotopes' particles disintegrated because of the nature of their minute sphere-packing, resulting in radiation or the natural, self-induced dismantling of the nucleus. Most radioactive elements will tend to revert to elemental forms earlier up the scale as the packing of their nucleons (protons and neutrons) changes when some of them leave, but the end point for those which follow that journey is Lead. Lead at no. 82 is the final product of radioactive disintegration, providing a proverbial Saturnine 'stone wall' between the radioactive world and the earlier elements on the other side of it.

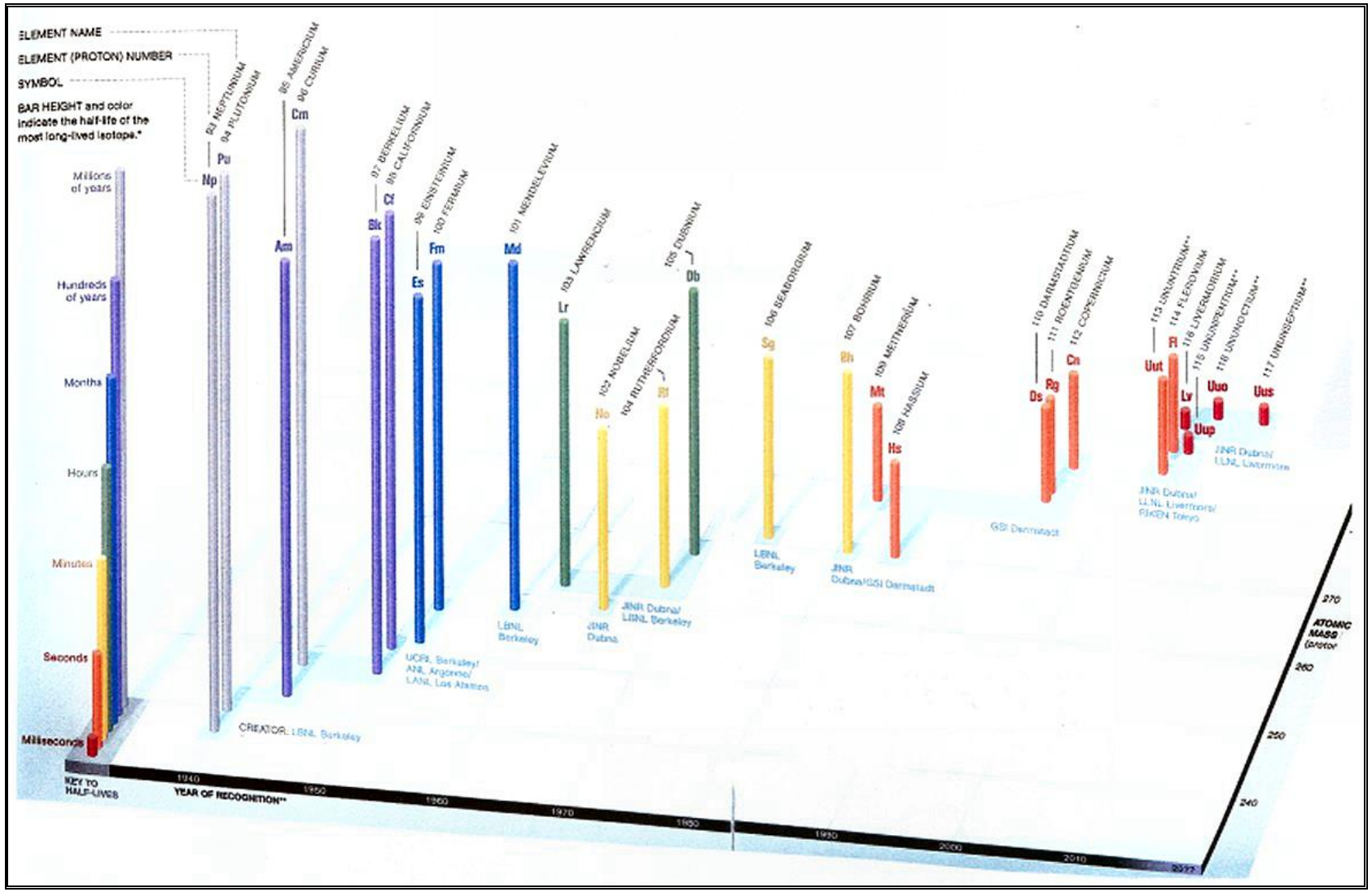
We cannot yet see an overall pattern to the array of natural elements and their isotopes, though it is tempting to think that each element (as Ouspensky posited) may well have its own octave of variations and that some (as in the case of Tin mentioned above) might even manage to have semitonal variations. Knowledge of the unfolding pattern of harmonic progressions, as laid out in the earliest Cosmokrator books are of help in deciding the ultimate arrangement of known, and as yet unknown, substances – as we discuss at the very end. It is the unfolding patterns of harmonics that could provide the definitive predictive blueprint. We mentioned earlier how Cathie believed the full number of elements would be 144, and that in time each

would be found to have six isotopes – giving 1008 elements in all! In other words, each element may be seen to consist of a miniature octave of variants. Ever more isotopes for most elements are indeed now becoming known and registered, so Cathie could well be proved right. His arrangement of the table of main elements onto a pyramid (***Ill. 3- 22***) is one of the many alternative versions put forward over the years and we will shortly note that Krüger used it too.

THE MANMADE ELEMENTS

The increasing number of electrons inhabiting vacant positions within the seven orbits thus accounted for the different nature of each element, and scientists started to realise that, just as the substances of the Universe had evolved in this way from Hydrogen and Helium by the sequential addition of electrons to the orbits to create all the elements, so could Man take the process further by forcibly introducing further electrons into the outer orbits, in just the way the alchemists of old sought to transform one material into another. (Sir Geoffrey Wilkinson was the first to create gold by bombarding platinum at CalTech in the Lawrence Radiation Laboratory in the 1940s and could perhaps be dubbed the first truly successful alchemist!)

Twentieth-century science has by now charted up to 126 different elements as physicists and chemists from Thomson, Rutherford and Einstein onwards have stood on the shoulders of their Victorian and Edwardian predecessors. At the time of writing the Commission on Atomic Weights and Isotopic Abundances continues to officially admit new elements. For a time, beyond no. 103 they were temporarily named by Latin versions of their atomic number (e.g. Unnilquadium for 104, etc.) though 108 was also unofficially, but aptly, nicknamed Pandaemonium (see the importance of the God Pan in ***Book 9***). Incredible power struggles and disputes have since occurred between key world laboratories in the USA and Russia to give the main discoverer's name to these later elements (during the Cold War days in the 1950s these were mainly made at Berkeley California; Darmstadt Germany and Dubna in Russia). The discovery of Americium, a silvery, shiny metal easily degraded on contact with air, moisture and acids is denser than lead and required a redesign of the Periodic Table by Seaborg. He and his co-workers then pinned down Berkelium, Californium, Mendelevium and Nobelium, whilst element 106 was finally itself given the name of Seaborgium, usually only awardable on the death of a candidate. From Darmstadt, at the decree of the International Union of Pure and Applied Chemistry finally Bohrium was given to atom 107, Hahnium to 108 and Meitnerium for 109 which did not necessarily fit the element to its discoverer, annoying Darmstadt who felt the discoverers themselves should 'have the right to name an element'. The ***Fortean Times*** reported yet another discovered at Darmstadt in August 1996:



Ill. 3- 45: Manmade elements: Key to life-length by colour in the stack on the extreme left (zoom to see clearly) – National Geographic May 2013

> *Element 112, the world's newest and heaviest, flashed briefly into existence at 10.37 p.m. on 9 February at the GSI heavy ion research centre in Darmstadt, Germany. With an atomic mass of 277, it is the sixth super-heavy atom discovered at the Centre since 1981. Five billion billion zinc ions were fired at a speed of 30,000km/second over a 3-week period at a target made of lead. This created a single atom of element 112 which existed for one-third of a millisecond. It then decayed to element 110, discovered in 1994 and through four other short-lived elements to Fermium (element 100), where the scientists lost its trail.*

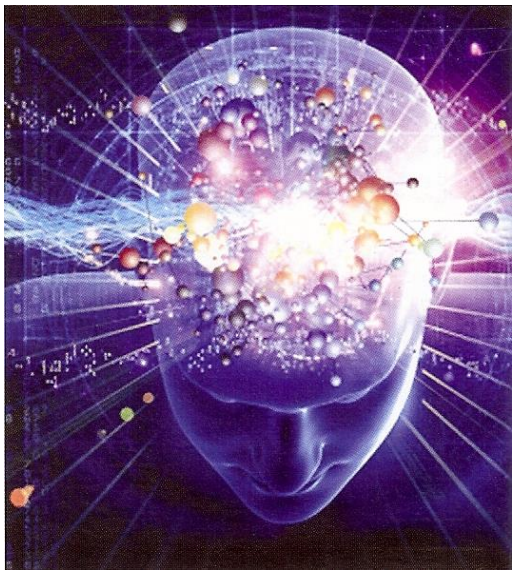
You get the picture: to check the current status of all newly discovered elements as of 2013, the revised edition of Emsley's book gives the most up-to-date information up to element 126.

A recent ***National Geographic*** article from May 2013 (from which we have the summary information given in the 3-D graph above) featured the present activities of the Dubna Laboratory in Russia by interviewing Yuri Ognessian and colleagues there (still with an old copy of the Mendeleyev table pinned to the wall) - where new elements are still being made both by bombardment and by *fusing* old elements together. Dubna was decreed a new City of Science immediately after WWII, but although an ally of the West during the war, in its aftermath the Cold War set in and Flerov, founder of the laboratory deduced from the cessation of flow of papers on radioactive elements from the West they were 'on to' the nuclear bomb - and the relationship started to freeze over into a stand-off on the subject. Seaborg, whose Berkeley Lab had discovered Plutonium, had indeed been recruited to the Manhatten Project. Both labs claimed they were the first to find elements 102-6 but in the end only 105 was named Dubnium (in Krüger's time given to Bohrium). Overall, opinions vary on the validity of the number of elements remaining that can successfully be pinned down, for from Uranium onwards the elements are so unstable that through natural radioactivity they revert back to simpler elements higher up the hierarchy as the above ***Fortean Times*** story describes so well.

Making the manmade elements involves firing protons at atoms, displacing their electrons sufficiently to occupy further outer orbits, thus creating further elements in the sequence – the further down the line, the more ephemeral their life. So unstable are the new elements synthesised, that the further along the line in atomic weight they fall, the shorter their life – often no more than fleeting milli-seconds – so what actually could they be used for?

The later additions to Mendeleyev's Periodic Table extended the number of rows and columns, indicating the crossing of the threshold from the eight-fold to the twelve-fold octave, opening up for humanity a heretofore semi-forbidden, often dangerous, realm of fringe atomic realities that include radioactivity and interchangeability. There is a protection in the basic octave ending at Lead/Saturn, at the note just before the return to Doh. Leading up to it are the elements of a world governed by logical rules: beyond lie radiation and the irrational. Such

developments beyond the protective barrier are paralleled by the opening up of the discipline of astronomy/astrology, where the number of planets that have now come into full human

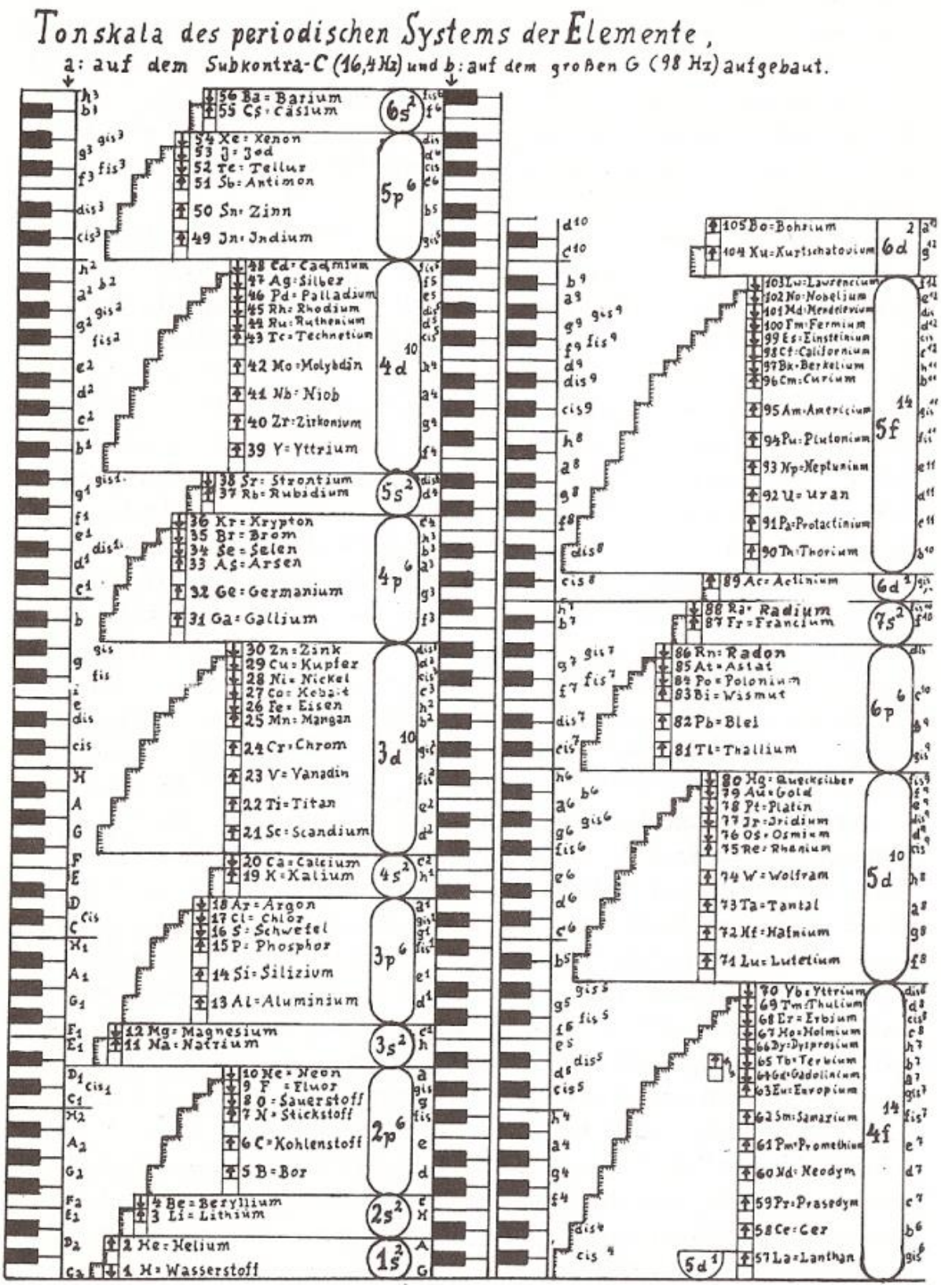


Ill. 3- 46: Extension of atomic and planetary fields enters human consciousness

consciousness now exceeds the traditional Seven by the addition of the trans-Saturnians that have massive fissile or fusible implications. Uranus, Neptune, Pluto, Vulcan and Pan now complete an entire twelve-tone scale of one planet per zodiac sign (***Books 7*** and ***9*** on ***Astrology*** and ***Astronomy*** explain further, as also do explanatory sections of the Cosmokrator website). As far as influences on Planet Earth is concerned, these five planets' respective explosiveness, confusion, annihilation, shamanism and all-inclusiveness have in the same way broken through the protective crust Saturn used to give to the inner solar system. With the addition of the radioactive, isotopic and unstable manmade elements, the Periodic Table is crying out for further rearrangement to show that same reality, and surely will not for ever elude us. For the time being the new rows straggle after the main table, awaiting proper integration but as new elements continue to be added it is temporarily open-ended, awaiting a satisfactory definitive order now ripe for crystallisation.

KRÜGER'S PERIODIC TABLE

The one person who has seriously attempted, at an obsessional level (which is what is needed), to link musical resonance with atomic structure and behavior was Wilfried Krüger, who benefited from his friendship with both Kayser and Bohr. For those with the time to peruse his diagrams packed into a tiny paperback) there is no avoiding reading his entire book, ***Das Universum Singt*** and combing through them (with magnifying glass and German dictionary!). He took a literal musical approach to the Periodic Table, listing its main twelve natural octaves juxtaposed against piano keyboards representing ever-ascending scales as far as element no. 105 – then named Bohrium.

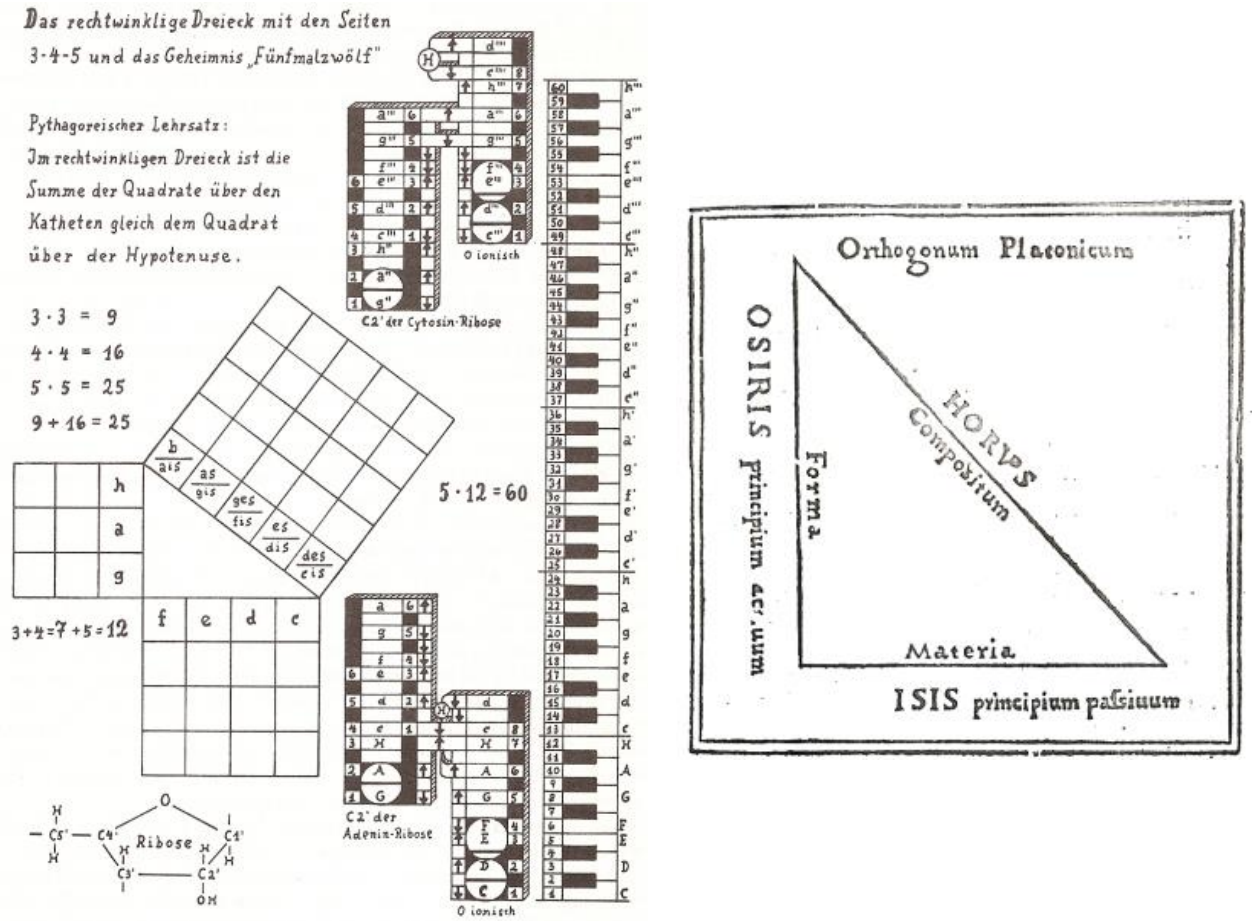


Ill. 3- 47: Arrangement of the elements in Octaves up to 105 (start bottom left) – from Krüger

Rudolf Hauschka would have agreed with this arrangement, though without precisely assigning notes and scales as Krüger does in the chart above:

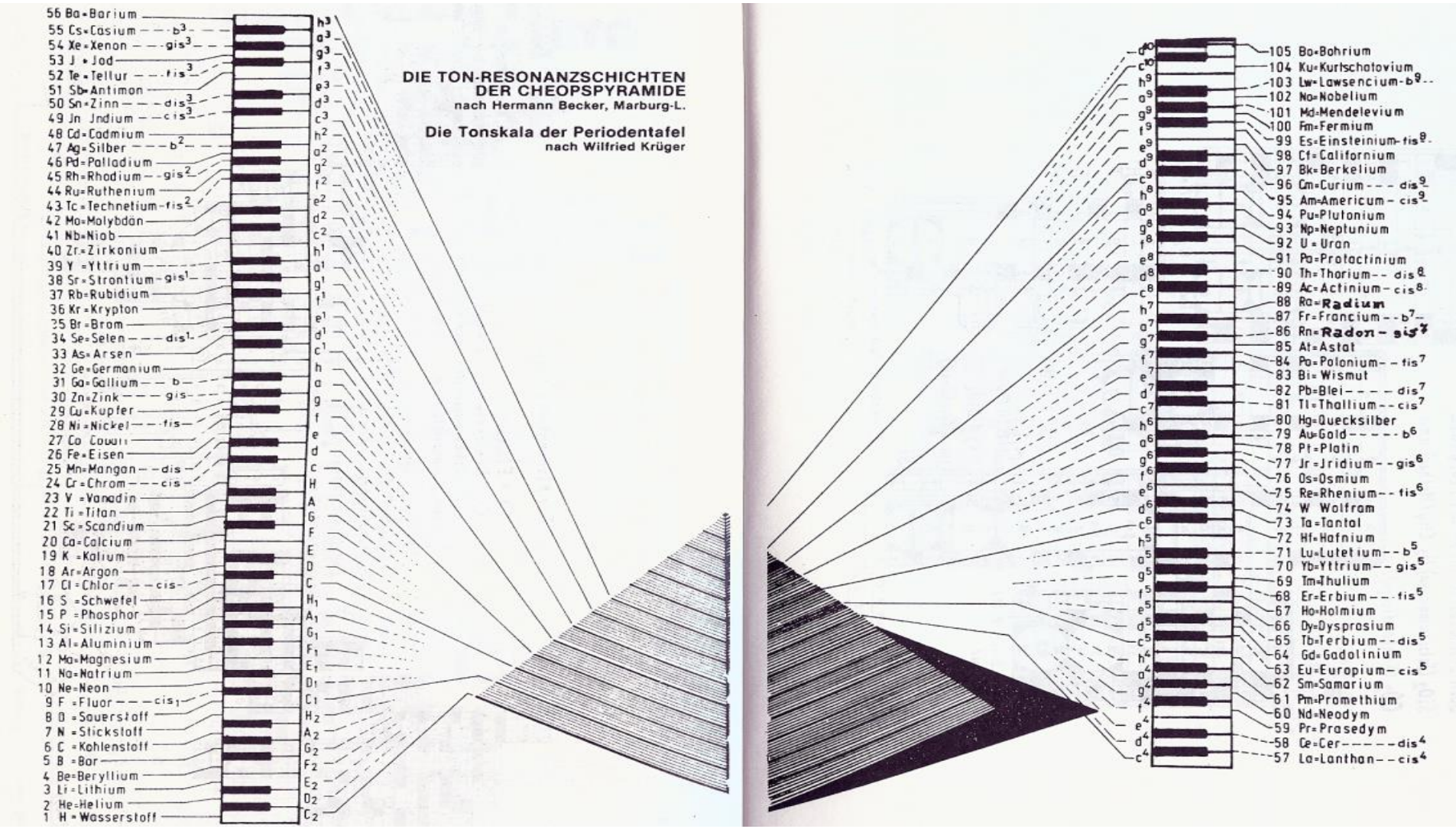
> *If we proceed through the whole list we find twelve such octaves…. The significant fact discovered in the series is that matter is subject to a rhythmic ordering…. [BUT] …. hypothetical pictures of the nature of substance, developed in theorising about atoms and electrons, are to be considered simply as mathematical expressions of physical aspects of matter: the reality underlying the physical has to be grasped intuitively…'.*

Krüger saw these twelve octaves together as expressing the mystery of the Pythagorean 3-4-5 triangle (that the square on the hypotenuse is equal to the sum of the squares on the other two sides – being a synthesis of the twelve octaves of the elements as *Funfmalzwölf or 5 x 12*) - in Egyptian mythology seen by Athanasius Kircher in his 17C book on ancient Egypt, ***Aegyptiaca***, (below right) as expressing the mystery of Horus/*Matter* as child of Isis/*proton* and Osiris/*electron*, thus bringing us back to the primacy of the Law of Three arising from Duality.



Ill. 3- 48: Krüger's association of the Ribose molecule with the mystery of 5 x 12 and the genesis of Horus, child of Isis & Osiris as 3-4-5 triangle, described by Kircher (right)

What could be more appropriate, therefore, than that Krüger should end up (next illustration) allocating the Periodic Table in full three-dimensional form (compare with Cathie's version) to the ascending degrees of the Great Pyramid based on its many significant mathematical and geometric proportions calculated by Hermann Becker, (explored in ***Book 11*** on ***Architecture***)?



Ill. 3- 49: Arrangement of the elements in Octaves in the 3-D format of the Great Pyramid – from Krüger

The entire unfolding of the Periodic Table should be seen as morphic resonance in frozen form. In California during the 1980s, the work of people like Kayser and Krüger was used and followed up by a group of scientists, musicians and thinkers from all disciplines on the West coast of America interested in the implications of Resonance - such as Ralph Metzner, Charles Musès, Ralph Abraham, Nick Herbert and others whose magazine ***ReVision*** published their views. Many of these believed in the judicious use of psychotropic substances to help open up a direct experience of these worlds, much as water wings help in the early stages of swimming. We should include in this field of work Frithjof Capra's bestseller, ***The Tao of Physics: An Exploration of the Parallels between Modern Physics and Eastern Mysticism*** (1975): having conducted research in high-energy physics in both European and US universities, tellingly his book is dedicated (amongst others) to Ali Akbar Khan the Indian musician, Carlos Castaneda, Werner Heisenberg, Krishnamurti and Alan Watts. Of course, meditation and prayer in all the great religions, accompanied by aids as mild as incense, wine and music, are meant to help humans to open up to such awareness but drugs gave a strong kick-start to opening the doors onto higher worlds, whose presence needed confirmation. Timothy Leary of 'turn on, tune in, drop out' fame was indirectly linked with this group but unfortunately became a prophet associated with the more irresponsible hedonism and over-use of drugs by university students and hippies at Berkeley - and Glastonbury in Britain.

One aim of those senior academics working on ***ReVision*** was to try to bridge the gap between science and the arts: one of its early contributors, Rupert Sheldrake, in his later, by now well-known, books such as ***Seven Experiments that Could Change the World*** (1994), or ***The Sense of Being Stared At – and Other Aspects of the Extended Mind*** (2003 – all continually in print since) demonstrated that far-reaching awareness is actually a normal faculty still awake in animals and plants but deadened in modern urban man. He used the scientific method to demonstrate through simple experiments how all life forms are interconnected by awareness in extended memory fields stretching not only to great distances spatially, but also far back in time (his book, ***The Presence of the Past: Morphic Resonance and the Habits of Nature*** (1988, reprinted 2011) dwells on these truths. He shows how resonance operates in simple everyday life situations (detectable without needing drugs!) in plant, animal and human interaction: wild birds sense straight away, for example, when a human, or animal predator, is staring at them, or hurriedly make an exodus from an earthquake area days before it strikes.

On the ever-attractive link with the ancient Egyptian religion, it is worth noting here how pivotal someone like Clesson H Harvey was in binding together modern chemical realities with ancient Egyptian texts (in its own language Egypt was known as *Kemet*/the Black Land - from which the world *alchemist* is derived). A science and chemistry teacher graduated from the Berkeley Campus of the University of California, he died only in 2012, having also taken university

courses on ancient Egypt and Tibet. In his five-part blog on the Graham Hancock site referring to the activation of the Eye of Horus and the power of the Memphis Nine Gods in the Egyptian ***Pyramid Texts*** (click on the link in footnote 1) he writes, 'in 1926 Erwin Schroedinger discovered a strange quantum mechanical equation which turned out to have just such a set of Nine prototype solutions for the electron energy structures of the Hydrogen atom'.

CONCLUSIONS

Inevitably there is both light and shadow in the human uses of science - but the discipline has surely earned its place as a subject that *must* be taught in schools as an added member of the Seven Liberal Arts (when we get to ***Book 10*** on ***Great Paintings*** we will know that Leonardo da Vinci argued for the introduction of Painting and Drawing as an eighth member – so we should vote for Physics, Chemistry and Philosophy (as bound together in musicality) as candidate for the '*ninth* member'!

RELATIVITY OF VIEWPOINT, AND FITTING LOWER WITHIN HIGHER ORDERS

The 'guardians of reality' to follow are those who open up all worlds – not simply the world of matter. There is no need to ditch the ancient theories of the Pythagoreans - that all substance consists of the overarching five elements of Aether, Air, Fire, Water and Earth. Nor do we need to regard as old-fashioned Plato's arguments in ***The Timaeus*** putting forward the idea that the Universe runs on harmonic numbers and their interrelation. What we know about atoms today simply supplies some fine detail on these general principles, providing particular case histories and revealing the undertow of Resonance at work beneath it.

In other words, there is no contradiction at all in inserting the atomic world into the overall schemes we have looked at so far in Books 1 and 2 concerning Music, Geometry and Number. It may have its own sub-sets of laws, but they are still governed by the plain principles of the Octave, which from the evidence put forward in this book are starting to appear not only *inevitable,* but also the key to the Theory of Everything, pinned down already by our ancient ancestors. Indeed, we have mentioned how the existence of certain elements not yet observed was *predicted* in advance, on the basis of the musicality of the Periodic Table.

The change from a clockwork view of the universe to the concept of a sea of particles and waves has required massive adjustments in human awareness which is still filtering down to all levels of society, with both healthy *and* unhealthy results. From the outset a handful of scientists felt that observation of atomic behaviour was bound *a priori* to be organised harmoniously, otherwise its results could not be sustained over time. The musical proportions are all perfectly preserved on the atomic scale, where the electrons and their 'shells' are the functions of the nuclear oscillations and vice versa. They act as a kind of double chorus playing alternately their particle and wave ratios, operating in the same way at minute or massive

levels. Arthur Eddington was one such who believed all levels of life were organised by the same proportions throughout, though his work on the subject remained unpublished on his death. His thinking is passed down in other people's books, such as Ellis in ***Number Power*** who commented that Eddington believed the ideas of Pythagoras and Plato were still acceptable despite the odds against their survival in modern times seemed – but passing Time does not alter basic principles.

As we have shown from our exploration of vocabulary used to described the sub-atomic world, it is existentially meaningless to take such esoteric terminology on board as the only framework for life, especially as it describes the elusive shiftiness of the first stages of physical structures which are occurring at high speed on high notes beyond our ken. Yet mankind has always intuitively started to alter its self-awareness and attitude towards the world according to the perspectives of science. Here it is important to realise that different angles on the same object of scrutiny are simply angles. Somewhere all these angles meet at a point that gives that object's full truth. Relativity theories have loosened Man's sense of lasting truths about anything but, gradually by a blend of ancient theories of permanence with new fluctuating realities, it is possible to see that any angle (wave/particle, mental clarity/emotional identification) supplies a useful *facet, or viewpoint,* on the lasting infrastructure. For a sane and all-inclusive view of life it is vital that people learn how to move up and down the levels of existence, much as electrons move between shells.

Reawakening that innate human resonance which directly experiences the wholeness of life - still alive in primitive tribes -is difficult to maintain in modern conditions, and requires a retreat now and again back to virgin nature – if only people would take that kind of holiday. In terms of human types, some people are more particle-minded – others more wave-oriented in their mentality. In their analysis of life the gnostic wants to know intellectually and precisely the structures involved, whereas the *bhakta* is happy to go along with the general 'feel' of things. Here we should bear in mind the downside of each of these approaches, identified by Réné Guénon[19] as faults of the 20C western mind: its lapse into sterile rationalism on the one hand, and uncritical religious sentimentalism on the other The fact that matter and energy have been proved by science to be interchangeable and that all matter is variations in light whose density and wave motions are ordered by Number is an entirely Pythagorean world view in modern garb. This truth points the way to deliverance from duality - that separation rationality makes between Spirit and Matter, when in fact they interpenetrate.

This is important, since it is the atomic mythology accounting for the nature of Life which has brought the Western mind into a state of uncertainty about Cosmic Law – not only about the

[19] See 'La réforme de la mentalité moderne' originally written in 1926, reprinted in his collection of essays (ed. Michel Valsan) entitled **Symboles fondamentaux e la Science sacrée** 1962

immediate material world but also how to take on the chasms of Outer Space surrounding us. This is because the elements are at work, not just on Planet Earth, but also account for the creation of stars and intergalactic space. We do not study the subject of conventional astronomy until ***Book 7***, which traditionally provided the framework in mankind's mind for the order of the heavens, but suffice it to say here that, true as it may be that the material of the entire physical universe is made up of the interaction of atoms, *we must not leave out the viewpoint of people living on Earth who look up at the sky every night and notice recurring patterns in the movements of the planets against the stars* that can be used to clock the passing of Time and give order to daily life. Again, such a viewpoint need not be thrown away, since it is important not to take out the human observer from the equation: this is an instance of taking on a relative angle because it is meaningful. It is not a matter of choosing either ancient astronomy or modern astro-physics, but of putting them in tandem with each other for different purposes.

Modern culture tends to hold an uncritical belief in anything couched in scientific terms, limping about in the tight shoes of physically based evidence, forgetting that the existence of correspondences between the octaves opens out to the invisible truths we experience in wave form. Have we yet identified an idea particle or an emotion particle? We don't even think to have to do so. Physical proof has been shown by particle physics itself as merely one form of energy, its other wavelengths simply out of range of the human senses, but nonetheless there, and real. Thus from its more fruitful perspectives science surely validates the mysticism people such as Dawkins scorn! A strange kind of juggling now goes on where large sectors of society participate in a low-level 'scientific' world view, at the same time juxtaposing it with a New Age compensatory resurgence of interest in the ancient myths, meditations and wisdoms taken out as separate units from the body of the Great Traditions. Knowledge of the Octave puts all such ranges back together, so that nothing need be given up if homogeneity is the goal. Feynman himself said that it is the overall picture, the balance of harmonics as a whole, that matters, and learning to change dimension is something we must all learn the skills for, and this takes practice. Otherwise there is a danger of large sectors of society becoming robots who spend their entire lives at the computer screen, operative in an ant-hill-like techno-society who barely make use of the entire gamut of experience lying open to them if they would only step on the ladder.

THE ATOMIC UNIVERSE AND COSMIC ANALOGIES

We cannot yet see an overall pattern to the array of natural elements and their isotopes, though it is tempting to think that each has its own octave of variations and that some even manage to have semitonal variations, as tin seem close to having. The unfolding patterns of

harmonics could provide the predictive blueprint – already we have some interesting clues pointing in that direction.

Moreover, with the huge increase in the world's urban populations and if we penetrate more deeply into mankind looked at as one organism then the sub-particles of society in the West are individuals who find it hard to integrate with any one group without loss of identity. Until we have an overall perspective on how subparticles fit together these individuals too will suffer from not knowing how they fit in to the larger picture, given that the old structures of society have disintegrated under a tide of devastating new radiations. In its present stage of irresolution such a world view compares badly with those myths and stories mankind used to live by – the classic fairy tales, the mythos of the Resurrection of Inanna/Osiris/Christ, the story cycle of King Arthur and the Holy Grail – or even the Trinitarian model of the atom that was its beginning. If these long-standing stories do still come into the picture, the bias is again material – the *physical* Tomb of Christ has to be identified (otherwise He is not deemed to have really existed) or the *actual* Grail Cup must be hunted down in the Cathar country of southern France (forgetting the True Grail is the spiritual goal of Enlightenment, placed high up on the Kabbalistic Tree of Life, and a long climb)! Scientists scorn myths and parables as without objective basis in evidence – meaning physical proof – and yet quantum physics itself is a science of the unseeable, working with intangibles as elusive as The Mysteries of pagan or monotheistic religion, and resorting to imagined models such as planetary orbits or terraces that only hold good up to a certain point. The average terminology of particle physics stretches average human credibility beyond its tether, and, moreover, it has no obvious moral as the search for the Holy Grail does. But Koestler in ***The Act of Creation*** proved how common it is for science to proceed as much by intuitive inner visualisation as by actual physical testing or abstract mathematical calculation (in fact the image often *precedes* the testing stage). Those who take on the images given us by science are equally taking an entire mythology on trust - mythology being a story which explains by analogies facts as they actually occur that are ungraspable by the human mind and senses. There is no other way to handle the universe: mankind has always coped with life through symbolic stories and models.

THE DEFINITIVE PERIODIC TABLE YET TO BE DESIGNED

Coming back to Krüger's work, then, we have the strongly viable suggestion of his systematic arrangement of the elements into octaves, backed by his many predecessors who had sensed this was a valid approach. But a model that retains their *interrelated* layout as in the columns and rows of Mendeleyev's Table (a key reason for why it has not so far been abandoned) still awaits a eureka moment from someone brooding on such matters. I myself would vouch for the Harmonic Tree suggested by Huntley, Murchie and others of like mind, some of whose thoughts are woven into this small book. Pythagoras' Octave and its harmonics seem to provide the most

satisfactory Grand Unified Theory of all, because it is both simple and comprehensive, yet flexible and natural. It needs someone grounded in music who also has the detailed scientific background to spell out where each element fits within the Fibonacci branching of such a Harmonic Atom Tree or Subatomic Particle Tree.

I therefore put my money on a definitive, *three-dimensional* Periodic Table which would be a combination of Krüger's detailed octave assignments to fully three-dimensional Atomic Tree of Life - a combination of ***Ill. 3- 17, Ill. 3- 23, Ill. 3- 35*** and ***Ill. 3- 38*** [20]. But it will need a 'Son of Krüger' to apply the octaves and notes in full detail onto its bare branches in a way that maintains the interrelations between like atoms in its octaves as laid out in the main Mendeleyev Table! Anyone interested in making such a trial model and posting a picture of it as a further appendix to this booklet (duly acknowledged in the caption of course) is welcome to send me a JPEG at asia@cosmokrator.com.

The groups of elements and their groups of particles can also be expressed on the Cosmokrator model: this will emerge in due course, in relation to later books dealing with the finer subdivisions of the Octave.

[20] Remember, a click on any picture reference in bold takes you straight to the picture concerned.

APPENDIX A: REMINDER OF THE CORRESPONDENCES BETWEEN NOTES AND COLOURS

0	1	2	3	4	5	6	7	∞
Note	C	D	E	F	G	A	B	=
Solfa	Do	Re	Mi	Fa	So	La	Ti	Do¹
Indian	Sa	Re	Ga	Ma	Pa	Dha	Ni	Sa¹
0	1:1	9:8	5:4	4:3	3:2	5:3	15:8	1:2
Vowel	A	R̥(l)	E/Y	I	O/W	U	H(m)	Union with God
⊕	♂	☿	☽	☉	♀	♃	♄	π
Day	Tues	Weds	Mon	Sun	Fri	Thurs	Sat	Week
SILENCE								HARMONY
Day	Earth	Mon	Tues	Weds	Thurs	Fri	Sat	Week
	4	3	1	2	6	5	7	∞
	4:3	5:4	1:1	9:8	5:3	3:2	15:8	1:2

Ill. 3- 50: The seven basic notes of the Octave and the rainbow of colour correspondences - as established in Book 0