

'God be in my Heart and in my Thinking': Towards Self-awareness in Maths and Science

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'Nel mezzo del cammin di nostra vita ...' In the middle of the road of our life' - this is how Dante begins the 'Divine Comedy'. When we come to consciousness, we never start at the beginning. We always start in the middle, from where we are. We find ourselves in the middle of life, in the middle of our world - our hugely heterogeneous, ambiguous world. We only ever see beginnings from the outside.

- We are always in the middle.
- If we take this seriously, i.e. choose to live coherently, congruently with this understanding, then there are implications for our maths and science.
- We need to base ourselves in the awareness of this 'middle' position, the one in us who is aware of being aware, aware of being conscious, in Vedic or Buddhist terminology, the witness.
- This is a turn of the spiral on Descartes' self-questioning. Descartes wanted certainty, absolute certainty. He wanted to build an edifice of certain knowledge. So he took a few basic premisses, clear and distinct ideas, and built. We have been living in that building in the centuries since.
- It is of the essence of the acceptance of the 'middle' position that absolute certainty of knowledge (in the sense of sapere, savoir, wissen) is not possible, but a lot of very useful, temporary (maybe centuries, millennia long) knowledge, science, is.
- Knowing (cognoscere, connaitre, kennen) has been sadly neglected. It is time to make amends.
- The witness is aware that all language is limited, all spoken truths are not the truth (Tao).
- The Cartesian position depended on splitting body and mind. We have been living with the results of that – splitting upon splitting.
- The witness position makes a more holistic knowledge (sapere and cognoscere) possible.
- The witness position is one of self-awareness. Our witness notices what we notice and observes us noticing. Our

noticing always has a slant, a spin which comes from our education and motivations. (To the optimist, the glass is half full. To the pessimist, the glass is half-empty. To the engineer, the glass is twice as big as it needs to be.)

- The aim is to develop knowledge from the witness position. This was Pythagoras' teaching. His holistic mathematics is '*ta mathemata*', 'those things which have been learned'. Later on part of maths was abandoned, philosophy, ontology, wholeness. The quantitative aspect *logistike* took over.
- When we look at the maths and science which have been created on the basis of the body-mind split we see that we are technologically proficient, and ethically irresponsible.
- How do we start again now, beginning again in the middle? Starting from the 'middle' position, we recognise that the pursuit of knowledge is a human endeavour. We are concerned with what we as humans might know about this universe and our place in it, not what absolutely is, nor simply what we can make the world do for our venal desires.
- We need to review our existing maths and science as a product of human endeavours.
- To develop self-awareness in the act of doing science or maths, is a psychological development, not just a matter of technical expertise.
- We need to start from the awareness of the profound gift of human life on this beautiful, amazing planet.

It is a chimaera to think that we can ever know the ultimate [sic] beginnings of this world, or the absolute foundations, in the sense of possessing them, being able to write them down. We can attempt to move towards such goals asymptotically, and learn along the way.

The linguist, George Lakoff, in 'Women, Fire and Dangerous Things', speaks of a conceptual middle, namely, first level categorisation which corresponds to the level of action and interaction. Roger Brown, in 'Social Psychology', lists various properties of this level:

it is the level of distinctive actions
it is the level which is learned easiest and at which things are first named

it is the level at which names are shortest and used most frequently

it is a natural level of categorisation, as opposed to a level created by 'achievements of the imagination'.

This level is intermediate between abstract generality and high specificity, e.g. 'dog' lies between 'animal' and 'great dane'.

Euclid coined the term '*koina*' for this natural level of categorisation in mathematics, the initial terms which we all have a basic idea of, which we can roughly agree on, but can not define precisely. It has been and is, a major mathematical endeavour to examine these terms, deepen our understanding and refine our terminology in these foundational (or quasi- foundational) areas.

Euclid himself did not go down this path. He carried out the encyclopaedic undertaking of recording all the extant Greek mathematical work with demonstrations of the theorems according to axiomatic, deductive logic. It was this method, the demonstration form, that was revolutionary. It created the model for all subsequent mathematical proofs and became the cement for the construction of the vast mathematical edifice which followed.

Descartes took this method as the inspiration for his rationalist, foundationalist philosophy, wanting to create a system of certain knowledge, based on 'clear and distinct ideas'. But it does not actually generate new mathematics, it only checks the validity of mathematical theorems once they have come into human consciousness. Imre Lakatos argues in *Proofs and Refutations*, that the heuristic value of the proof is more important than any certainty factor; it is in the process of attempting to prove and disprove theorems that we discover where our ideas are unclear, and new ideas can come into being.

We might picture this by imagining the *koina*, our normal level of discourse, as the surface of a sphere. We can choose to excavate towards the centre, or build outwards into space. Interestingly, the analogy could work with excavation being either to more specific, individual instances or towards more generally applicable, deeper concepts.

As Sylvester said (1876), "*a mathematical idea should not be petrified in a formalised axiomatic setting, but should instead be*

considered as flowing as a river. One should always be ready to change the axioms, preserving the informal idea." Here we return again to Dante's middle: we are here now between past and future.

So we are always in the middle in (at least) 2 ways, conceptually and temporally. If we take this seriously, i.e. choose to live coherently, congruently with this understanding, then there are implications for our maths and science.

When we recognise that we are always in a conceptual middle, we see that to deepen our understanding of life, of reality, we need to investigate our *koina*, the undefined terms, the intersubjectively agreed basic terms of discourse, to uncover assumptions of which we are otherwise unaware.

When we recognise that we are always in a temporal middle, now, between the past and the future, then to the extent that we wish to be more responsible as people, we look to the past to see what we have learned, what mistakes we have made, in order to make informed decisions about the future. We do this as individuals. Businesses, institutions do this. But academic disciplines, such as maths and the sciences, are more nebulous and this reviewing role within the discipline itself does not exist.

There are academic disciplines of history of maths and science, and of philosophy of maths and science, but they are epiphenomenal. They retrospectively describe what the actors, the participants, are doing. They are an audience. They do not take an active part in the unfolding drama. They have no impact on the decisions that are made on a daily basis around the world. This is not a responsible, grown up way to go on!

As regards the conceptual middle, it is important to recognise that the sphere of discourse concerns not only the external world but also ourselves. We do not understand the external world and we do not understand ourselves. We are attempting to understand both better. And these are not separate tasks.

We see the external world through the filter of our concepts. 'Beginner's mind', 'a child's view', 'thinking out of the box' – these are what we need to reapproach this amazing world afresh. We need to question our questions. Our verbal questions are already framed in the concepts that we want to liberate ourselves from.

Our very perceptions are culturally determined. We learn to use our eyes to focus on physical objects very early on when we emerge from the womb. Clearly this ability has important survival value, but we stop ourselves seeing in other ways; we make assumptions in the act of seeing physical objects,

As Lawrence Wright says in *Perspective in Perspective*,
"We prefer an ordered world, regular patterns, familiar forms, and when flaws or distortions occur, provided they are not too gross, our mind's eye tidies them up. We see what we want or expect to see ..."

"... We never see the whole of any solid object at any given moment; even to see the whole surface of so simple an object as a sphere, six successive viewpoints are needed ... But we accept at a single glance that it is a sphere: we complete it on the assumption that it is a consistent shape, and the simplest possible one. In fact it might be any one of countless forms that are only partly spherical. There is a fountain court at Granada where visitors are told the story of a Moorish Caliph about to appoint a Grand Vizier. He invited the candidates to identify an object lying or floating in shallow water. All but one promptly said it to be an orange. One picked it up, and identified it as half an orange; he got the job."

So what can we do now? Where can we stand? To act in accordance with the 'middle' position, the awareness of the limitations of our normal, everyday concepts, we need to base ourselves in our awareness of being aware: in Vedic or Buddhist terminology, the witness stance. These traditions have disciplines to help people develop this faculty. Given the spiritual, esoteric nature of the Pythagorean school, this was probably part of their training also, and hence at the roots of our mathematics.

The literal meaning of the Greek word, 'esoterikos' is 'inner'; it came to have its present meaning from the nature of the inner membership of the Pythagorean brotherhood. Postulants had to wait around on the outside for some time (being one of the 'exoteriki') to show they were serious, before being allowed to enter and become one of the 'akousmatiki' (listeners). After some further proving period they were allowed to participate, becoming one of the 'esoteriki'.

It was Pythagoras who originally coined the term 'mathematics'. The Greek word is '*ta mathemata*' which means literally, 'those things which have been learned'. Given the mystery nature of the Pythagorean school it is unlikely that '*ta mathemata*' was simply a matter of learning external formulae (times tables or the like). It is much more likely that it was a holistic learning, of which the formulae were part and possibly represented more than might at first be seen.

To begin to rediscover, or invent self-awareness in maths and science now will involve a number of areas of work. One area is to look at maths and science in historical, social, political contexts, the temporal threads, and ask intellectual history and social psychoanalytic questions. We could see maths and science as a form of cultural dreaming and ask what might the various mathematical and scientific ideas tell us about our consciousness, the nature of the consciousness that created them (as distinct from what they say about physical reality). We could look at mathematical and scientific ideas in relation to the social and political contexts pertaining at the times of their arising and ask what might the ideological content be?

Another aspect of self-awareness is awareness of our motivations. What is the motivation for scientific inquiry? Roger Penrose called his recent book on the history of science, '*The Road to Reality*'. Probably most scientists would assent to the notion that science attempts to discover what is fundamentally real in the world around us. But there are many assumptions in this notion of reality which we start to see when we observe that another way of stating this now would be, 'how things work'.

This languaging is indicative of the attitude to nature now. There was a major change in attitude from the scholastic period to the Enlightenment, from the desire to understand nature to the desire to control nature. Nature had successfully been established as inanimate by the Inquisition which chose brute force over verbal argument and either killed those who thought otherwise or scared them into silence. The Enlightenment motivation was epitomised in Francis Bacon's famous dictum, '*Knowledge is power*', published in 1597 in his '*Meditationes Sacrae*'.

Our current science, which came from this motivation, has been very successful in developing technological power. But this has

begun to backfire. The lack of self-awareness has resulted in a lack of responsibility and a lack of the precautionary principle, and we are seeing the dangerous results, in planetary pollution, climate change and escalating weaponry, of the work of a sorcerer's apprentice, of knowledge without wisdom.

The present notion of physical reality as separate from us, comes from Descartes' creation of a rigid duality between *res cogitans* and *res extensa*, the infamous mind-body split. We can not know reality in an abstract, separate-from-reality way. We experience reality. This is a process, and we are in it. As Schopenhauer said, "*...materialism is the philosophy of the subject who forgets to take account of himself.*"

We are in the world, in Life. We are part of a greater wholeness, whether we call it the Universe, Bohm's implicate order, or God. This is the other side of self-awareness. I can be aware of myself as a conscious entity with respect to some thing or being or process that I am investigating. I need also to be aware that I am in some thing, being, process, greater than myself. We are always in the middle, in between. We are wholenesses within a greater whole. We are not split mind-bodies. We are spiritual (which can be taken as 'awareness based'), corporeal beings.

To act in accordance with the awareness of our 'middle' position implies attempting to develop self-awareness in the very act of working mathematically and/or scientifically. So what kind of maths and science might correspond to the awareness that we are in and of this world, not separate, objective observers? Our awareness of the world is not just head awareness, it is a body, sense awareness and a heart awareness. We feel the world with our hearts.

*God be in my head, and in my understanding;
God be in mine eyes, and in my looking;
God be in my mouth, and in my speaking;
God be in my heart, and in my thinking;
God be at mine end, and at my departing.*

The 16th century Sarum Primer prayer articulates beautifully the scholastic stance to knowledge. 'God' here (for the agnostics, or (God forbid) the atheists) can be taken to mean Bohmian wholeness, or a state of oneness with the whole. '*God be in my*

head and in my understanding': 'standing under' is a receptive stance; whereas in '*God be in my heart and in my thinking*', thinking is active. The prayer (very interestingly) states the desire for our active thinking to be based in our hearts, in oneness, and for our heads to understand, to be receptive, in oneness.

Stephen Harrod Buhner, in 'The Secret Teachings of Plants' describes in detail the physiological events involved in heart-brain entrainment. For example, "*Sympathetic and parasympathetic nerve pathways and the baroreceptor system directly link the heart and brain, allowing information and communications to flow freely. Messages from the heart to the brain during this shift to coherence, significantly alter the brain's functioning, especially in the cortex, which profoundly affects perception and learning.*"

This is an empathic form of thinking. When we start down this path, we allow ourselves to open to the deeply different wonders of so many worlds within this world. Barbara McClintock who won the Nobel Prize for her work on transposons and corn genetics, said that it was the plants who told her what to do. Temple Grandin is a Professor of Animal Science. She considers that it is her autism, which allows her to empathise with animals.

This is very different from the materialist stance of Cartesianism, strengthened by the power of Leibniz' and Newton's subsequent differential calculus to describe mechanical change. Ironically being part of a greater whole was a reality for Newton. The greater whole was God. Newton, like Paracelsus and Tycho Brahe, was an alchemist. He needed to keep this hidden for fear of religious oppression. Alchemy was a scientific practice albeit a very different form from present mainstream. Goethe developed his own different form of science, which recognised the importance of the witness position, but this was largely overlooked in the mainstream thrust of materialist science from the 18th century on.

By the beginning of the 20th century, mechanical, materialist science was reaching some limits. The emergence of quantum physics could be seen as Nature suggesting that it was time for humanity to develop some self-awareness in its investigative approach, politely pointing out that at some levels, observation is an intervention, a sharp prod even.

We need to take into account limits of different ways of thinking. Aristotle was clear when he first enunciated deductive logic, that it was only true within limits. We've forgotten this. We've not asked what are the areas of validity of our different mathematical ideas. Instead we've been attempting to scientise all areas of human inquiry by importing quantitative maths, as if this will somehow make them more valid.

It may be time to attempt to develop various theories of different wholenesses, rather than one theory of everything. Natural philosophy as a philosophy of nature would include a philosophy of life, of living beings. Wholeness is one of the key attributes of living beings, going down to the level of cells. Materialist scientists have ignored the importance of wholeness, believing they could discover the nature of matter by breaking it up. Many people have pointed out the weakness of this approach: David Bohm simply states that "*fragments are not the same as parts*".

I've characterised science as asking what is the reality of the world around us, Is there a corresponding question which maths is asking? Nowadays there are many different views of what maths is. Removed from its esoteric origins, the external part became such an increasingly powerful activity that under the Baconian paradigm its ontology was scarcely questioned. Nowadays maths is generally defined by extension rather than by essence. But such definitions usually include a reference not only to number, space, pattern etc but also to truth. In fact in the absence of a belief in God, mathematical truth became a kind of godhead, a refuge, the locus of permanent certainty.

In the late 19th century, doubts arose about maths as the home and guarantor of truth and certainty for science, as a result of strange things that had begun to emerge in maths, non-Euclidean geometries and the like. This generated a concern to establish mathematical foundations.

Bishop Berkeley and others had, much earlier, raised concerns about the lack of philosophy and ontology in the development of mathematics, but Girard voiced the prevalent, pragmatic mood of mathematicians and scientists, when he stated that he used irrational numbers even though they were meaningless, because they were useful. Centuries later, the Copenhagen interpretation

of quantum physics was similar: in layman's terms, 'We don't know what it means, but these are the equations that work'.

A lot of work went into mathematical foundations and a lot came out of it - Russell and Whitehead's Principia, and Wittgenstein's, set theory et al. But eventually Gödel proved that Hilbert's dream of establishing the completeness and internal consistency of mathematics within mathematics was impossible. Foundations are a building metaphor. We do not build houses on themselves. We always need some agreed *koina*. What was important in this foundational work was what came out of it – not an increase in certainty but a deepening and broadening of ideas.

Between the 13th century and the 18th century in Europe, much larger scale human institutions came into existence. In the political sphere, nation states organised around capitalist economies, replaced feudal systems. Hierarchical social organisation remained the norm; similarly in the realm of ideas. It is only in the late 20th century that the idea of the possibility of non-hierarchical organisation has arisen.

In the hierarchy of present day materialist mathematics and science, mathematics and physics have been the rulers. But this mathematics is only the quantitative part of the original Greek discipline: '*logistike*', the discipline for dealing with number as quantity or '*hule*'. '*Arithmetike*' was the branch concerned with the '*eidos*' or form, or qualitative aspect, of numbers: part number theory, part numerology and aspects bridging these. (Interestingly Vanessa Hill's recent Pythagorean 'Nature's Code' is rooted in biology)

It is not a simple matter to return to the Pythagorean oeuvres to rediscover their wholeness of mathematics. We do not have any extant Pythagorean texts because it was a mystery school. But also our cultural context is so different that it is extremely difficult to comprehend what a fuller import of that mathematics might have been.

Vedic mathematics has become known in the West recently as a very powerful method for mental calculation. This is because it works more in the way our minds work with numbers, i.e. heterogeneously, not just following one method for all numbers. It uses the fact that we have a number system base 10. Vedic

mathematics is effective not only in the path of knowledge of the external world, but also psychologically, spiritually. Unlike the Pythagorean case, Vedic texts are still extant, which gives us the possibility of investigating these mathematica for their wider and deeper meanings.

The Pythagoreans insisted on the difference between one and oneness. Oneness is a wholeness and the distinction between one and oneness is at the core of holistic mathematics. Furthermore oneness and no-thingness are one and the same.

In incarnate reality we can only apprehend a nuance of oneness, sometimes in approaching sleep or through meditation. Experienced practitioners may reach nirvana, but that's not oneness. To get a sense of oneness we may begin by sitting in a relaxed, upright posture and closing our eyes (when our eyes are open, visual information is generally responsible for approximately 70% of brain activity). We are advised to allow thoughts to flow through our minds, not to fight them, but simply parenthesise them with the thought– “That’s a thought”. We then focus on sound, and attempt to listen without naming (or judging). This is an extremely interesting, challenging exercise, designed to bring us more into now. The approach to now is through infinitesimals, moments, discrete, non-zero infinitesimals.

When we listen to music or language our minds perform time packaging. Each phoneme, for example, ‘p’, is a sound shape, a shape in time. Words are shapes of shapes. When we learn to speak however, we understand words, the meaningful wholes, before we grasp the notion of individual phonemes. We approach these much later when we learn to write and read. Similarly with music, we first hear melodies (whole musical forms) and only later can we separate out the individual musical (pure) tones. We humanoids appear to be hard-wired for wholeness, meaningful wholes.

Bohm’s implicate order is one take on oneness, the great wholeness. In oneness, there are no distinctions, so no things. As soon as there is a one, then there is the other, the complement, which makes 2 things, and the distinction between them, which is a 3rd thing: they are heterogeneous, of very different natures, but one can not exist alone. Interestingly Peano’s set theoretical derivation

of the integers, which was intended as a simpler foundation, involves summing heterogeneities.

No-thingness, the full emptiness, is a fundamental concept in Eastern thought, Vedanta, Buddhism, Taoism, but not in western monotheist thought. The confluence of Hindu and Arabic thought whereby the Hindu symbol for zero, the Arabic numerals, and place system from the abacus, gave rise to our present decimal number system, was key to the 16th and 17th century developments in maths and hence the technoscientific (aka industrial) revolution.

In Europe before that, they used the hugely cumbersome Roman numeral system and it was a considerable mathematical endeavour to calculate when Easter should fall (being a lunar festival, unlike the solar, fixed Christmas). The symbol for zero was a technical import which galvanised mathematical progress. But the Eastern philosophical notions did not accompany it. So the huge, mathematical leaps forward were seen as alien, which appears in the names, 'negative' and 'imaginary' numbers, as well as the fuzzy thinking around infinitesimals in differential calculus.

There has also been a long-term confusion about one and oneness, which has been ignored, because wholeness has not been of interest in the philosophy of mathematics since ancient Greek times. Hubristic positivism has been the main stance towards ancient Greek views, i.e. 'now we understand what they didn't understand'. This is to overlook the fact that when we learn something new, we mostly forget what it was like not to know it. We do not remember how it was not to speak, not to see physical objects etc.

It is much more difficult to try to get inside earlier or different mindspaces. How did they understand? And given how they understood, what did they see? What was that reality like – qualitatively? What might we learn from them?

In the meantime when we just accept ones (but consciously), accept multiplicity, which is where we mostly live and love and have our being, then, when we start adding all these homogeneous ones, $1+1+1+ \dots$ we get the natural numbers, 1,2,3,4,5,6,7, ..., and we discover all this extraordinarily beautiful patterning – odds, evens, perfects, triangles, squares, Pythagoras,

Fermat and hey presto!, the primes even appear to be connected with quantum reality via the Riemann hypothesis.

Is mathematics Rilke's unicorn in the Sonnets to Orpheus?

*This is the creature there has never been.
They never knew it, and yet, none the less,
They loved the way it moved, its suppleness.
Its neck, its very gaze, mild and serene.*

*Not there, because they loved it, it behaved
As though it were. They always left some space.
And in that clear unpeopled space they saved,
It lightly reared its head, with scarce a trace*

*Of not being there. They fed it, not with corn,
But only with the possibility
Of being. And that was able to confer*

*Such strength, its brow put forth a horn. One horn.
Whitely it stole up to a maid, to be
Within the silver mirror and in her. (transl. J.B.Leishman)*

Rilke contributes here to the debate about the nature of mathematical existence. The unicorn enters the mirror of self-reflection and the anima, the soul; this offers the possibility of self-awareness. 'Poem' and 'fact' have similar etymological roots: 'from the Greek *'poiein'*, 'to make'; 'fact' from the Latin *'facere'*, 'to make' and 'to do'.

Praise be for this beautiful, mathematical world, this unicorn. An interesting question arises: to what extent can we be aware of the unicorn and aware in our sensory, personal being in the world? For example, if I count potatoes to make sure I am cooking the right amount for the guests at a meal, how aware am I of the individual natures of each potato? This is an important question for the development of human wholeness.

Abstract thought is the product of head thinking. It is immensely valuable and powerful, and potentially dangerous. Logic is amoral. We in the Western world have grown up in a society permeated by materialist ideology. Even if we had a spiritual and/or religious upbringing, materialism and rectilinear *logistike* lives in our

architecture, our technology, the entire social fabric of our lives. Our lives are ruled by quantitative or meaningless numbers, National Health numbers, National Insurance numbers, passport numbers, credit ratings. From birth we are taught to see and name physical objects, so we forget how to see other things. We are trained to orient our senses in specific ways outside; we are discouraged from developing inner awareness. The subject-predicate form of Western language structures our head thinking. So how can we begin to develop other ways of thinking? Can heart thinking and body awareness help?

Stephen Harrod Buhner, having developed heart thinking in his herbalist studies, is sceptical about the possibility of heart thinking in mathematics. I disagree: I think that many, if not most significant mathematical advances have probably come as a result of mathematical heart thinking, from opening the heart, from love.

When we dream we allow our hearts to cocreate with our heads and pure mathematicians have been allowed to dream more freely than scientists. Scientists dream as well, Kekule's discovery of benzene rings is the most famous example. Still there are more constrictions on science in daylight thinking. Materialist forms have dominated science for 3 centuries now. Someone said recently that after Descartes scientists thought of the workings of the world as complicated clockwork, whereas the teachings of quantum physics suggest we need to think of the world as mind. The implications of this are enormous, but this change in attitude has not become mainstream.

When we open our hearts, we allow space for the realities of other beings; we enter conversations, rather than interrogate. It's part of interview technique to ask open-ended questions. What?, how?, why?, encourage people to talk about themselves, whereas when?, where?, how much?, etc. are closing questions: you get one word answers and you don't get very deep. At first it looks as if science has managed to get pretty deep with its persistent, closing approach. It's certainly managed to achieve a lot, from space travel to nanotechnology. But human beings who live in and with and under this technoscience continue to make war on each other and other Gaian species, with increasingly effective technoscientific weapons. The arms industry, the herbicide and pesticide industries are all killers.

As David Bohm says, “*Nature will respond in accordance with the theory with which it is approached*”. Climate change is a result of 3 centuries of approaching her with a mechanist, materialist theory. The time has come to approach Nature, a greater whole of which we are part, with respect, to be interested in her being, not what we can make her do for us.

In craniosacral therapy, we adopt a witness awareness, a listening stance. Our bodies are universes of billions of intelligent cells, organised in intelligent communities, tissues, organs. The essence of craniosacral therapy is to do as little as possible, not to try to put things right, rather just to be present as simply and deeply as possible, to witness, to listen to the body’s stories. I’ve called it both psychotherapy for the body and homoeopathy of touch. I attempt to allow my attention to be directed by the intelligence of the client’s body. In this way it can use the energy of my attention (homoeopathic input) to do what it wants to do. Startlingly deep healing can occur. If there is a scientific explanation of this phenomenon, it would surely be at a quantum physical level where an observation is an intervention. Attention is our finest energy.

In complementary approaches to healing we are concerned with the specifics of cases more than general theories, with qualitative, holistic assessments more than quantitative measurements. Western medicine like other forms of Western science can do amazing things, but the cost is huge. The pharmaceutical industry whose stated aim is to cure human ills, is the 4th biggest killer of people in the US and UK and the side effects of these drugs on Gaia’s flora and fauna, through effluents, is also lethal.

The overarching paradigm of complementary medicine is wholeness: this is the etymological root of ‘healing’. The greater wholeness contains both polarities, specificity: generality and quality: quantity. Here we are coming to the advaitist core of the Bohmian stance: advaita is at the heart of Vedic philosophy; literally it means non-duality.

Our culture has elevated the general over the specific and quantity over quality. This has been at a great cost to our individual lives. Alienation, the Western 20th century malaise, is not feeling at home in ourselves, in our inner lives, in our bodies. This is not surprising when we’ve been brought up to believe that only what is outside and measurable, is real.

We see the cultural dominance of the external over the internal, in that, when we speak of 'the 5 senses', we mean only the 5 externally oriented senses and we ignore our internal senses, including proprioception, our most fundamental physical sense, which gives us our primary experience of wholeness. Body awareness includes the external and internal senses. This dominance of the external and general goes hand in hand with a dominance of the visual sense over the others. Vision sets the bar for measure of the external world; it measures continua. Hearing gives a different, discrete kind of measure. It relates to counting, beginning with the rhythm of now, now, now, ...

The ancient Greeks separated geometry, dealing with continuous lengths, from *arithmetike*, dealing with whole numbers. Geometry corresponded to visual space; *arithmetike*, to music, 1:2, 2:3, 3:4, being fundamental tonal relationships. Centuries later when *logistike*, quantitative mathematics, came to rule supreme, the two were conflated and there was no philosophical questioning of the meaning implications.

For Pythagoras and Plato, wholeness was paramount: numbers were whole numbers; lines were lengths which could be measured practically as fractions, but were considered by mathematicians as ratios. There was a beautiful wholeness to the system including, of course, the harmonic musical ratios. The square root of 2 did not fit into this system, and the wholeness was shattered. It was over 2,000 years before the ideal of wholeness again came into mathematical purview in Hilbert's programme, only to be broken by Gödel's work. (I've written about this in more detail in '*Who Carved up the Integers? They Never Died*'.)

Our current mathematics and science is based on the visual sense, in that it is primarily quantitative, and on the Cartesian, real number line, which emerged from *logistike*. This mathematics and science is powerful in the external world, and beautiful. Are there ways that we can reclaim the human, sensory connection? Michael Atiyah has suggested that algebra relates more to hearing, as it relates to time and rhythm, more than space and lines. Topological ideas have connections with touch. How might we begin to develop mathematics relating to other senses? What might it be like?

We are corporeal, sensory, spiritual processes in continual interaction with each other and our worlds, with nature. We are fluid, changing interfaces. Present day science still views humanoids as intelligent, biological machines. To develop mathematics and science in keeping with the spiritual, organic beings that we are, we might consult Vedic wisdom. There the senses appear as dyads, organs of reception correspond to organs of expression or action. Some seem straightforward to us, for example, hearing and speech, others less so, for example, seeing and moving.

We can also return to proprioception as our key starting place. We find ourselves, in the oneness of our individual bodies, in the middle of a multiplicity of heterogeneous sense information. What would this mean to begin our numbering here? We could also note our human form which has 6 orientations rather than 3 dimensions: left – right, up – down, front – back, are not simple opposites; they have qualitative differences.

If we begin to reclaim mathematics as a human activity to help us orient ourselves in the world, many more things are possible and many more things begin to make sense. Our 5 external senses are described in the Vedas as organs of reception. There are complementary organs of expression. In this system, movement corresponds to seeing. We could investigate the mathematics of movement. Traditional Indian dance is highly mathematical.

If we begin to develop self-awareness in mathematics, we could think of movement in its meaningful aspect, as gesture. We might begin to translate the beautiful abstractions of the vast architecture of existing mathematics into human life experience. Rudolf Laban in the 20th century developed a human movement analysis related to the cube. This is an extraordinarily complete explication of human movement and effort – gesture.

Counting is a gesture; it is a rhythm, a beat – now, now, now, The rhythm of our hearts begins when we are embryos, in the circulation of blood cells. The heart comes into being from the flow of blood: the flow creates the structure. Measuring length is a gesture, a different gesture, one of extension, a continuity stretching from here to there, from here to here.

Jaap van der Wal, has pioneered the investigation of gesture in our embryonic phase. This is one of immense becoming – huge flux, structures forming, being destroyed, new ones coming into being. All such changes take place in the dark, in a contained space. We humanoids begin this adventure in the holy whole, the hole of the womb. Early embryonic developments all occur by first creating holes. To imagine (or remember) these changes is awesome, sensuous topology.

In recent years, there have been a number of experiments with dancing mathematics, Marcus du Sautoy, Françoise Chaitin-Chatelin as well as Indian mathematical dance. The point is not merely for dance to be a mathematical educational tool. The movement is part of the mathematics. The Fibonacci series lives in plants. Similarly music is a form of applied mathematics.

Mathematics is clearly our most abstract language, the purest metaphorical language. Unfortunately, in the absence of trust in the great wholeness of which we are part, we've been desperate for some kind of certainty and have got very hung up on mathematical proof. It's important, but as Imre Lakatos pointed out, the real motivation of attempting to prove theorems, is not to establish ultimate certainty, but rather to reveal ideas hidden in our initial *koina* and thus grow mathematics.

To do mathematics, create mathematics is to discover and abstract pattern, order, structure, processes from phenomena and discover the relationships between these abstractions. This is a form of meaning making. Meaning is a process. In mathematics, we define terms using the *koina* and return to excavate for deeper understandings within those *koina*. This is not just mathematical development but an inherent part of human growth. As Viktor Frankl writes, making meaning is an essential human characteristic.

We probably need more practise in these initial ways before we can really begin to imagine a mathematics that recognises equality between beings, or a non subject-predicate based mathematics. We need to find ways to unlearn as well as to learn (thank you, Lewis Carroll). (The membrane of the sphere could serve as a metaphor here as well.) For example, in order to understand and manipulate numbers and other mathematical expressions (and alphabet letters), we have had to numb ourselves to their reality as

symbols. Marie-Louise von Franz devotes a whole book, 'Number and Time', to the symbolic meanings of the numbers 1 to 5. Again the question arises, as with counting potatoes, of the possibility of dual awareness. The polarities are: abstract complementing sensory/ intuitive; and general complementing specific.

The possible directions I am suggesting for mathematics and science involve radical change, but they are really only a continuation of the Pythagorean mathematical telos and the Goethean approach to science. The changes have already begun. From early in the 20th century quantum physics and Gödel's incompleteness theorems demanded shifts in the philosophy of mathematics and science away from materialist positivism. As C.S.Lewis said, *"We all want progress, but if you're on the wrong road, progress means doing an about-turn and walking back to the right road; in that case, the man who turns back soonest is the most progressive."*

When we allow ourselves to recognise the validity of the many different wholenesses in our world, to recognise that there are different forms of relationship within them and between them, then we open to a greater plurality of mathematics. We can begin to look at the different forms they might take – different theories for different wholenesses - wholenesses of cells, of organs, of tissues, of organisations, of minds, of processes, of buildings, of stories, of plants, of animals. We can look at the mathematics of the in-between spaces, even between specific and general.

We live in interesting times (as the Chinese might say). There is huge flux. A few years ago the number of people on the planet reached the same number as cells in a human brain. It's time to review our deeply held cultural ideas, and be open to envision, and intuit, what ideas need to come in, to grow, if we humanoids are to develop or even survive. Our mathematical ideas and ideas about maths are important ones to reconsider.

Greek mathematics was a mathematics of stasis. Plato's reality was a timeless space outside of consensus reality. Their mathematical discoveries (pre-irrationals) corroborated this thesis. They developed a calculus, but an integral calculus, one of summation, not of change.

The Renaissance, then the Enlightenment, brought a very different world view. The differential calculus is the pinnacle of the huge mathematical advances of that time: the introduction of a sign for zero, the Hindu-Arabic decimal number system, the idea of the number line, the Cartesian grid, and equations with variables. This calculus allowed mathematical description of change. This was world changing. The following three centuries were dominated by an unfolding of, actualisation of, those ideas.

V.I. Arnold characterised this mathematics as “*divided into three parts: cryptography (paid for by CIA, KGB and the like), hydrodynamics (supported by manufacturers of atomic submarines) and celestial mechanics (funded by military and other institutions dealing with missiles, such as NASA)*”. This was not wholly tongue in cheek.

The change that was mathematised in the differential calculus, was quantitative change between measurable variables. It modelled mechanical change, not qualitative change or emergence. It was only in the 20th century that the latter idea appeared in systems (aka complexity) theory. The possibility of non-hierarchical organisation was a necessary precursor.

Mae Wan Ho discovered a living example of this when she looked through an electron microscope at a worm and saw dancing rainbows. She subsequently discovered that these were caused by the harmonious quantum activity between all the living tissue of the worm. These are individually free, yet harmoniously related activities at multiple levels. She calls it a quantum jazz ballet.

It would be a worthy goal for present day maths and science now to attempt to envision such a possibility at our macroscopic level: individual freedom combined with harmonious relationships with other beings, beings around us, within us and the greater wholenesses within which we have our being.

We are now in a position to begin to contemplate other kinds of mathematics, mathematics of becoming and relating, mathematics whose telos is to seek the meaning of the whole wherever there is duality, and to discover and create beauty and harmony.

A project for mathematics and science now: to research the nature of becoming human in this richly beautiful, conscious universe.