

THE CLOUD OF UNKNOWING & THE ITSY QUBITSY UNIVERSE

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ABSTRACT

It is impossible to give an assured answer to questions concerning the relationship between Information (for example in the form of BITS) and the physical Universe at the fundamental level (IT). Information is an artifact of human thought imposed on Nature to describe some of its aspects. Nor can experimentation resolve such questions: An observer using an imaging instrument such as a telescope or microscope sees only the final image. There is a Cloud of Unknowing obscuring the true nature of Reality because signals carrying information about physical processes at fundamental scales get distorted, dissipated and subjected to noise in the channel or medium they pass through until they are finally observed at macroscopic scales. A similar Cloud obscures Reality when these experimental results are subjected to fallible logical and mathematical analysis. There is a necessity to examine our philosophy of knowing. By their very nature our best theories are merely our best guesses, and there is no guarantee that better theories may not be discovered contradicting present assumptions and/or presenting new ones. Nevertheless speculation and model-making is allowed. In analog computing devices such as the abacus, a bead is both a thing and a number. Reality may be like that at fundamental scales where its physical and informational content can be regarded as one and the same thing. Rather than BITS being the units of such information however, it is more likely that some sort of physical Bloch-Sphere-like QUBITS making up an ether are the building blocks of radiation and matter, and carriers of zero point energy making up the vacuum. In the theory of everything IT=QUBIT may be the paradigm of choice.

“When I say 'darkness' I mean a lack of knowing, just as whatever you do know or have forgotten is dark to you, because you do not see it in your spiritual eyes. For this reason, that which is between you and your God is termed, not a cloud of the air, but a cloud of unknowing.”ⁱ

- from the 14th. c. Spiritual classic *The Cloud of Unknowing*

“It was an itsy, bitsy, teenie, weenie, yellow polka-dot bikini that she wore for the first time today.”

- from Bobby Darin's lyrics of the popular 1960 song

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1. MISINFORMATION ABOUT INFORMATION

The Foundational Questions Institute essay contest asks “IT from BIT or BIT from IT?”ⁱⁱ IT being Nature at its most fundamental level – call it Reality - while BIT is the familiar digital two-sided coin of trade of our information age – call it Information. This chicken-and-egg Question was asked because everything looks like a nail to a person holding a hammer. Surrounded by our computers in this Information Age, we are tempted, as Wheeler was in his *It from Bit* essay to regard the physical universe-IT- in terms of BITS - binary 0 and 1 answers to yes-no questions.ⁱⁱⁱ This was rejected by Barbour : “What we experience can be explained by the assumption of an external world governed by law. On this basis, Wheeler’s aphorism should be reversed: ‘bit’ derives from ‘it’”.^{iv} My initial response to the Question was that on the human scale, BIT from IT seems to apply, but far more significant is what happens on the scale of subatomic particles, the zero point vacuum, dark matter – and eventually on the scale of the presumed Planck length. On that fundamental level the Question would be ill posed partly because it limits Information to BITS when QUBITS are the more likely discrete unit of quantum Information, and for other reasons and for other reasons as will be discussed below.

A more interesting train of thought followed – that in order to answer properly two wider related topics had to be addressed. One that I already answered elsewhere is whether Reality is digital or analog? – it may be a bit of both.^v The second topic making up the substance of this essay concerns the necessity of examining our philosophy of knowing. How do we know what we know about Nature? In the past physics was known as Natural Philosophy when scholars were careful to set their theories within a philosophical framework. Newton for example was obsessed by theology and believed that he could understand the mind of God through mathematics. Einstein's philosophy is now described as a “synthesis of elements drawn from sources as diverse as neo-Kantianism, conventionalism, and logical empiricism”^{vi} These days however, most of us working in physics (including this writer until recently) would deny that physical theory has or needs a philosophical underpinning. Yet such a philosophy does exist, a deeply flawed one, unconsciously hard-wired into the thinking of physicists today, and its misapplication is seriously hindering progress: There is a widespread belief, almost amounting to a malaise - that not only is our knowledge of Reality relative and uncertain, but that Reality *itself* is relative and uncertain. This unstated philosophy is due to the subjective observer-centered theory of Special Relativity and also to the Born Rule – the probabilistic interpretation of the quantum world.

The human brain evolved over millions of years from primitive cells made of molecules that are identical to those making up the rest of the Universe^{vii}. Do we have a fair chance of understanding Reality at its own level and to answer questions such as “It from Bit or Bit from It?”? Ancient cultures knew very little about the physical laws regulating the workings of Nature. They were in awe of Reality, but did not easily seek or presume to know it . They relegated that quest to the imagination, to myth and to religion. Today, with the over-confidence of accumulated scientific knowledge comes a danger: in arrogance and short-sightedness we have fallen into the trap of confusing our *derived* knowledge of Reality with Reality *itself*. Many physicists and laypeople intuitively feel this over-confidence in our knowledge is unjustified. The situation is analogous to that described by the Cloud of Unknowing quote above. In order to go forward even our best physicists have to humbly acknowledge the possibility that they may be wrong about taking some major claims literally. Their theories do explain experimental results, but they can be mutually incompatible (for example General relativity and Quantum Mechanics). This is a sure sign that such a Cloud of Unknowing separates IT from what we *think we know about IT*. Without belittling the vast achievements of modern science, it may be useful to recognize that physicists may sometimes act like the blind men and the elephant. We experience only a very limited part of Reality but then due to our preconceptions and limitations, we are prone to make serious cognitive and theoretical mistakes. (Fig. 1)



Five blind men. One touched a snake, the second a shirt, the third a tree trunk, the fourth a wall, and the fifth a rope. Together, they concluded that they had found ... an ELEPHANT!

FIGURE 1. The way information is derived from Reality by physicists and how this Information is used to create theories about Reality does not necessarily lead to the truth. In the author's variation on the ancient parable of the five blind men and the elephant, misconceptions can easily arise even from correct data.

In Section 2 there is a historical discussion of the role of vision in obtaining Information about Reality and in forming our theories about it. In Section 3 is a discussion of how Reality (i.e. Nature) 'writes' information, and how the observer 'reads' the information distorted by the effects of noise and scale on the channels transmitting the information from input to output. How a Cloud of Unknowing obscures perfect imaging, even theoretical analysis is illustrated by examples from our macroscopic experience down to the conjectured sub-sub nucleon world of quarks, their proposed so-called preon component particles, and beyond. In section 4 devices such as the abacus are discussed, in which the hardware and the software are the same. It is speculated that at its most basic physical level the fundamental Reality of the Universe may be like that, made up of a lattice of nodes acting as hardware and software simultaneously. Such nodes with their spherical rotational degrees of freedom, may be cases of $IT = QUBIT$.

2. ABSOLUTE REALITY AND RELATIVE OBSERVERS

Abstract thought, particularly mathematics, gives us humans power over our own inventions and theories. Reality however does not oblige us by becoming what we think of IT. We need to climb down from our intellectual high horses and try to understand IT on its own terms. Primitive people struggling to survive in Nature knew their own limitations and dealt with Reality on its own terms – something today's physicists luxuriating in their multiple layers of abstract speculation seem to have forgotten how to do.

Tens of thousands of years ago a cave dweller spreads her hand and devoutly places it on the wall of the cave. She sips a mouthful of liquid mud and blows. The spray stencils the outline of the hand imprints it on the wall. Hand to wall there was a tactile sense of touch on a scale of 1:1. If the hand was IT then the print was its image, and the Information in the image could be read thousands of years later. There was a certain absolute truth and stability in the way our knowledge was immediate and real: IT = IT. Nowadays we have almost lost our confidence in the reality of Reality. We accept the observer-centered world of Relativity Theory and the Copenhagen Interpretation without batting an eyelid. We seriously consider ideas such as the Anthropic Principle^{viii} that the Universe was created just so, to enable us human beings to come into being. We ask if IT is from BIT – i.e. whether the Universe grew out of BITs such as those we regularly manipulate in our computers and devices to email jokes and play Tetris. It is time we stopped being too clever for our own good and make a concerted effort to rid physics of its current bedeviling philosophy: The lack of confidence in the absolute existence of physical Reality in which we live and breathe. To do that we have to examine how this state of affairs came to be. It is a problem of vision - both in its optical and its conceptual meanings, which turn out to be quite related.

The relation between Reality and the Information we glean from it by observation and experience has a fascinating analogy in representational art. The close relationship between the art of a given era and the state of physics theories has been satisfactorily demonstrated in two fascinating books. *Art and Physics*^{ix} demonstrates the close relationship between the physical theories of different eras and the prevailing artistic styles. In the case of *Picasso, Einstein*^x it is shown how Picasso's cubism used a four-dimensional formalism proposed by Poincaré in a popular book, *Science and Hypothesis*^{xi} a book that also directly influenced Einstein in formulating Special Relativity. This is not as far-fetched as may seem at first. In both fields the presence of an observer and the role light plays are fundamental.

In Medieval painting things were still depicted in a tactile and absolute way, a tradition going back to cave art. A distant tree is painted leaf by leaf, and as large as one nearby. Artists saw Reality as God's world, something complete in itself. A person's role was strictly as a humble participant in his or her tiny corner of the cosmos. Things existed absolute in their own specific 3 Dimensional space and time. With the advent of the Scientific Method mankind gradually adopted a new vision of the world and of itself. This was initiated in the 10th c. by thinkers like Ibn Al-Haytham^{xii}, whose discovery of optical rays and ways of thinking about them (through his works translated from Arabic to Latin) would influence the new way of seeing in the Renaissance. Man as observer took center stage, at the apex of the cone of lines of vision linking everything to be seen with his eye – the point-of-view. In paintings made according to the newly discovered laws of perspective, things in the picture plane were deformed, changed size according to their distance, or were occluded one behind the other according to their position in space, all in relation to the observer. A painting made on a 2-Dimensional panel gave the illusion of being 'real', 'lifelike' and 'natural'. By the time of the Industrial Revolution

realistic painting, architectural plans and designs for machines, all gave the artist, architect or inventor a tremendous sense of knowledge, possession and control, but at the same time seriously distracting from the 3-Dimensional Reality 'out there'. In the mid-19th. c. it was customary to paint trees in dark muddy colors, and it was quite a revelation when dissident painters painted them using green paint.

Similarly in physics new ideas supplanted older ones. But the startling theories and discoveries did not mesh well with each other. For example Maxwell's old ether theory to explain the transmission of electromagnetism and the Michelson Morely experiment that 'proved' the ether did not exist. The particle-wave duality in light quanta caused conceptual problems for the founders of modern physics. A pragmatic piecemeal approach was adopted: it was easier to frame various uncoordinated theories from the observer and experimenter's point of view, rather than mold a theory of an absolute universe that explained everything. The ultimate result in physics of putting the observer at the center of things was Einstein's Special Relativity (SR) which can be thought of as a way that a stationary observer measures phenomena in reference frames moving in relation to her. Everything else even time and space had to be twisted, compressed or pulled to suit that relative point of view. We are paying the price of that decision. SR is like trying to rewrite Euclid's Book of *Elements* by projecting every figure and theorem according to the laws of perspective. Instead of a triangle being itself, its own quidity, it has to be projected on a picture plane according to any given point-of-view. (Figure 2).

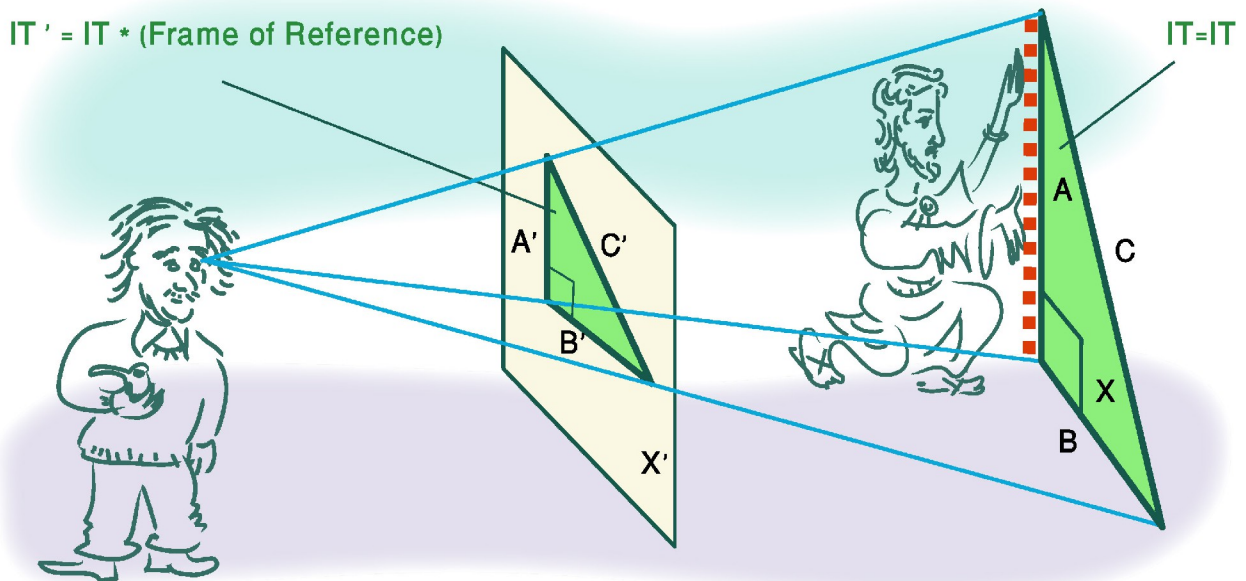


FIGURE 2 The observer invariably sees a transformed view of the Real. Pythagorus uses a scale to measure the right triangle with sides A ,B, C in the plane X, and finds that $A^2 + B^2 = C^2$. Einstein from his own point of view sees a small image of the triangle distorted by perspective on a screen X', (similar to the view projected on his retina). If X' and X are not parallel, then $A' ^2 + B' ^2 \neq C' ^2$ and the Pythagorean theorem now needs to be transformed according to the new point of view. Pythagorus deals with an absolute and 'real' world, while Einstein's is relative, based on his point-of-view as observer.

The Born Rule, Bohr's Copenhagen interpretation, and Feynman's "shut up and calculate" attitude to fundamental questions comprised a final surrender to any quest to know what the IT of the Universe actually was. This attitude was carried to ridiculous extremes by Everett's multiple universes and the unnecessary distractions of Bell's theorem, spawning a faux Reality that passes for the real thing. String theorists cheerfully speak of a score of Dimensions

and a landscape of possible theories. Fortunately there is no want of researchers who have challenged some of these absurdities. Eric Reiter has experimentally demolished the physical interpretation of the Born Rule^{xiii} joining generations of physicists starting with Max Planck who have challenged Einstein's proposal for a photon emitted and absorbed as a point particle. Hendrik Lorentz and many others today, including this writer^{xiv}, variously challenged other assumptions such as the nonexistence of the ether, the constancy of the speed of light, or that space and time *as dimensions* distort during relative motion and in gravitational fields. Only when such challenges are satisfactorily answered in a consistent theory of everything can the fundamental essay Question about Reality be answered.

3. IMAGING, IMAGINING & INFORMATION CHANNELS

What happens when Reality (i.e. Nature) 'writes' Information, which we as observers 'read'? Errors are involved – a Cloud of Unknowing obscures both the process of experimental observation of Reality and in thinking and creating theories about it. This Cloud should not be confused with the Heisenberg's Uncertainty Principle, which is *not* a general philosophy of doubt and fuzziness in everything as it is often wrongly construed, but is a very specific theory about quantitative relationships involving phenomena such as frequency, energy and Planck's constant h on the tiny quantum scale.

Information about Reality, including BITs, is an artificial concept obtained by sentient observers who sample Reality (IT) using various very limited aspects of it through the senses or scientific instruments. This imperfect input is processed through various neurological, logical and mathematical means to form a concept, idea or image of the original. Fundamental Reality is diluted, distorted or lost. The process is exemplified by an optical imaging situation where the object (Reality) emits or reflects light (Information) to create an Image. In the case of an ideal lens the image is almost identical to the object, but most other situations involve imperfect instruments and fallible human perception and understanding. The image is often imperfect, and its interpretation heavily biased by the cultural, philosophical or even religious beliefs and preconceptions of the time.

Taking a hint from Shannon's Information theory^{xv} it is useful to think of the Information about the subject as passing from Nature to the observer through an information channel. There is always the possibility of noise distorting the information as it is transferred from its original manifestation to a sensor, retina, (including the paraphernalia of data processing in a brain) or computer. The limitations and distortions in the image can come from many sources – for example by a badly figured camera lens. Or it could be a befuddled brain on the one hand, or one too intent on seeing something expected, blinding it to other facets of an image. Error could come through filtering the data through some mathematical procedure that smoothes out incongruous data that may hint at new discoveries. All these cause the Cloud of Unknowing that obscures Reality. Interestingly as far back as the 10th. c. Ibn Al-Haytham was aware of how such errors occur in vision, and meticulously listed and analyzed them in his masterwork on optics^{xvi}.

The other important source of error is in how we human physicists - I use this phrase to stress the role of thought during a given era and culture - process this observed data. We use our untrammelled imagination and a wide range of mathematical tools to create theories of Reality and are so spellbound with our ideas – our own creations – that we assume Nature has to fit their mold. Figure 3 illustrates some aspects of this discussion.

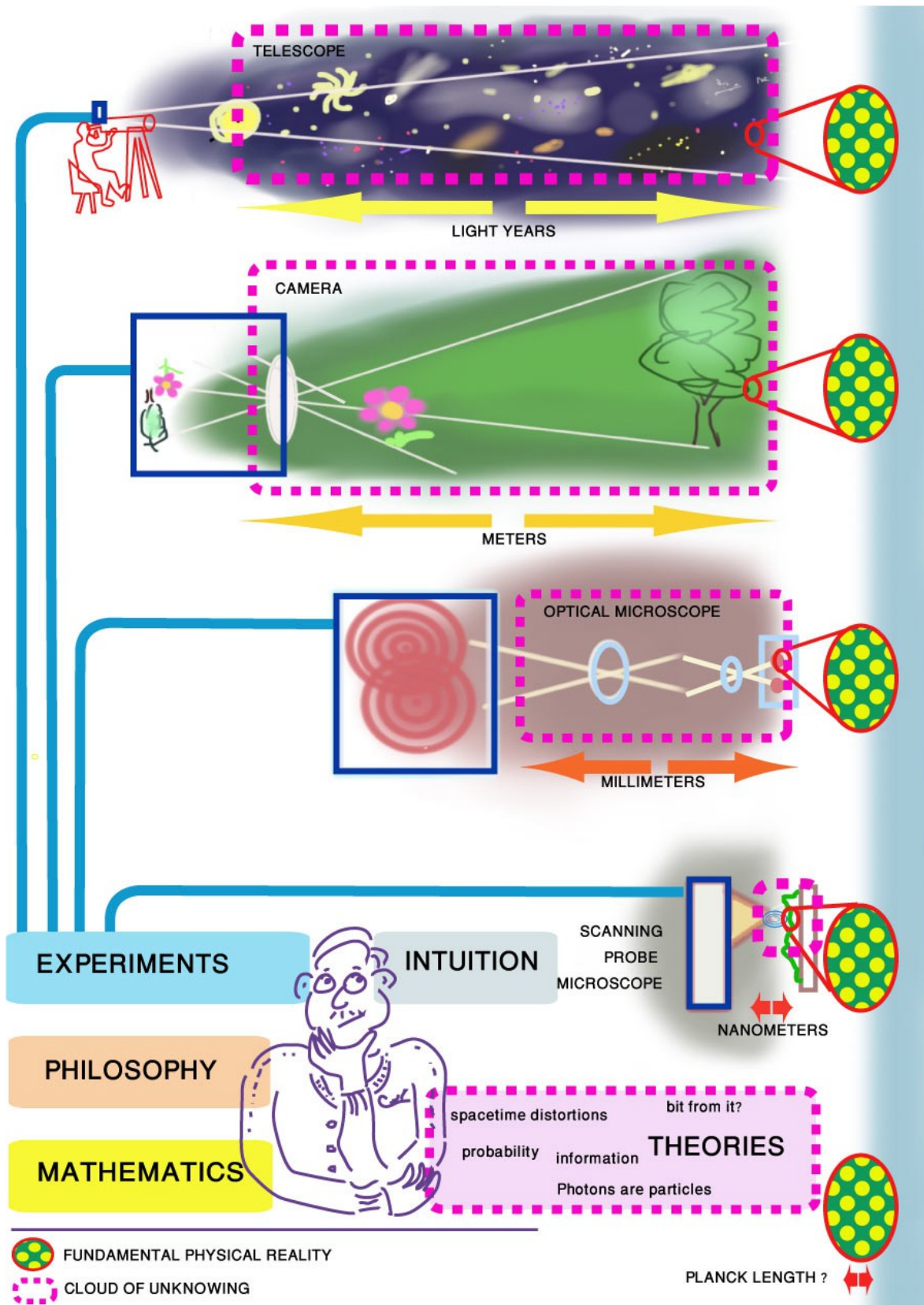


FIGURE 3. Experimental and theoretical knowledge and information about Nature should not be confused with Nature itself. To obtain data observers use instruments such as the imaging instruments shown here. However only the final image (blue boxes) is known for certain. There is a "Cloud of Unknowing" (purple dashed lines) that obscures the actual physical makeup of Nature (yellow polka dots). The limited experimental data is used to develop assumptions and build tentative working theories that are our best guesses and may be disproved, embedded in their own Cloud of Unknowing.

4. AN IT = QUBIT UNIVERSE?

What Dirac said about the photon ^{xvii} can be paraphrased as “Nature deals only with itself”. IT is from IT and that's it. As the information channel gets shorter and shorter, eventually a 'shortest' length is attained, whether it be the Planck length or something somewhat different (as I believe), an irreducible IT=IT state prevails. In other words Information and the 'emitting' object are one and the same. On the macroscopic scale this is illustrated by the abacus (such as the Japanese *soroban*) where the physical positions of the beads is also the state of the computation. In such analog computing machines the hardware and the software are the same. Similarly in the slide rule, the hardware solves the arithmetical problem, and simultaneously displays the answer. Nature may be like that too (Figure 4).

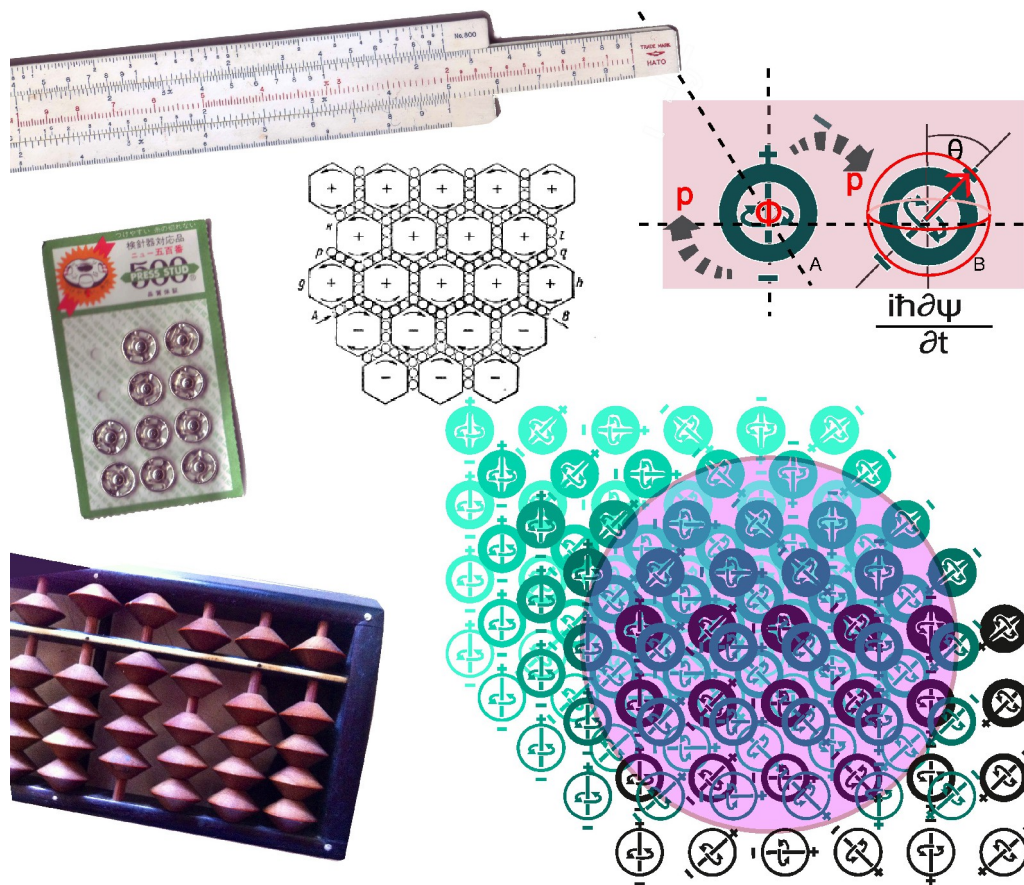


FIGURE 4 Some examples of It=Bit-or-Qubit, i.e. information embedded in various physical objects. In this Japanese abacus (*soroban*) the bead positions represent the numbers 504655. The sheet of sewing studs shows a physical representation of a grid in which studs either exist or do not – binary states. In the slide rule the logarithmic scales are manifested as a physical distance marked on the face of the rulers so that adding one length to another gives their product. The physical distances are read as numbers. J. C. Maxwell's hexagonal ether 'gears' were a mechanical conceptual model of the the transmission of electromagnetic fields. Above right two of the lattice nodes in Tamari's Beautiful Universe Theory^{xviii} that can be oriented in any spherical direction effectively making them into qubits - dielectric spinning spheres that can be construed as Bloch Spheres enacting Schrödinger equation operations by transferring momentum in units of Planck's constant h . The Theory proposes that everything in the Universe is made up of a lattice of such nodes arrayed as in the cluster bottom right. The node states on the surface of a volume (purple) are the resultant of all the nodes within, as in the Holographic Principle.

While Maxwell's mechanical model of an ether made up of rotating dielectric gears does no computation and was strictly posited to transmit electromagnetic radiation, it resembles my proposal for a universal lattice where the 'spherical gears' are dielectric nodes that exchange angular momentum, to enable the creation of matter, radiation, the vacuum etc. These nodes can be thought of as miniature Bloch spheres, each containing unique information about the phase angles and the potential energy of each 3-Dimensional 'pixel' of the Universe. Node-to-node interactions are by direct magnetic induction responsible for transmitting kinetic energy. It is my view that at its most fundamental level, when the channel length is at the supposed Planck-scale the IT of the universe – the hardware - is indistinguishable from the information content, and the means that this information is transformed - the software.

Nature and information can then be regarded as one and the same thing. The state of the nodes on the surface of a volume of such nodes is the result of interference-like effects of all the nodes within, affirming the Holographic Principle. Another way of putting it is that the Universe is a sort of quantum computer. In this paradigm the Question can be readily answered:

In the Universe it is neither IT from BIT nor BIT from IT, but rather $IT=QUBIT$.

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