

ANPA WEST

Journal of the Western Chapter of the
Alternative Natural Philosophy Association



Volume Five, Number Two

Alternative Natural Philosophy Association

Statement of Purpose

1. The primary purpose of the Association is to consider coherent models based on a minimal number of assumptions to bring together areas of thought and experience within a natural philosophy that is alternative to the prevailing scientific attitude. The combinatorial hierarchy, as such a model, will form an initial focus of our discussion.
2. This purpose will be pursued by research, conferences, publications, and any other appropriate means including the foundation of subsidiary organizations and the support of individuals and groups with the same objective.
3. The association will remain open to new ideas and modes of action - however suggested - which might serve the primary purpose.
4. The Association will seek ways to use its knowledge and facilities for the benefit of humanity and will try to prevent such knowledge and facilities being used to the detriment of humanity.

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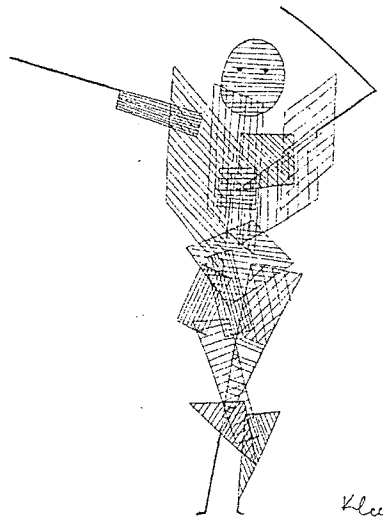
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Illustrations

ANPA WEST has a new
twist on things in this issue.
Our victim, Fernand Leger.



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Book Review

Eddington's Search for a Fundamental Theory: A Key to the Universe
C. W. Kilmister, Cambridge, 1994

Reviewed By Pierre Noyes

A letter to the Editor of ANPA WEST

from A. K. Kwasniewski,

Objectivity and Huge but Finite Numbers

G.F. Chew

Following a delightful lunch conversation about ANPA business with Pierre Noyes and Mike Horner beautiful day this spring at the Stanford Faculty Club, Pierre asked me to put on paper some thoughts I expressed about the need for a huge “special number”, hitherto unrecognized by establishment physics, to illuminate the miracle of objectivity. Expression of these thoughts was provoked by a question from Mike as to how I felt generally about the ANPA enterprise. I began by voicing uneasiness about combinatorial-hierarchy calculations so far undertaken to explain particle properties. Then I stated my opinion that, because the conceptual underpinning not only of science but of most human thought - - the (geometrical) notion of space-time populated with localized objects - - can only be approximately meaningful, the extraordinary efficacy of “objectivity” in describing the universe deserves attention. Whence deriveth an accuracy so overwhelming as to be almost never discussed? My guess is that an enormous although finite “special number” is involved. This number characterizes the “size” of an early dense “pregeometrical” universe - precursor of our present dilute geometrical objective universe. Largeness of “pregeometrical size” facilitates accuracy for subsequent geometry. Because it was ANPA’s combinatorial hierarchy that called my attention to the exceptional mersenne prime, $2^{127} - 1$ (a number that may be large enough for the task at hand), I have felt that ANPA thinking merits attention. In this regard I feel especially indebted to Herb Doughty.

Physicists are accustomed to ideas that, although only approximate, enjoy a usefulness derived from large (or small) dimensionless parameters. Sufficiently extreme parameter values can produce, on human scale, the illusion of absolute truth”. For example, when the number of involved particles is $\geq 10^{23}$, the notion of temperature appears unflawed. When quantum action in units of the Planck constant is huge, classical dynamics constitutes “truth”. For velocities tiny compared to the velocity of light, the *Newtonian kinematics* taught in high school is all we need. *Energy conservation* is not an exact idea, nor is the complementary notion that tomorrow will be equivalent to today - - the notion underlying science’s dictum that a “correct” experiment can be reproduced. Although absolute reproducibility of experiment is an illusion, for most purposes physicists treat Poincaré covariance as *the* rock on which to stand. Wobbling of the Poincaré rock can usually be ignored but only because, in human-based units, present Hubble time is huge while Planck time is tiny.

All physical ideas are flawed although some are less flawed than others. Ordinary modes of human thought depend on the seemingly-flawless geometrical idea of space-time populated with separate spatially-localized objects. Yet quantum mechanics, especially when gravity is recognized, implies a holism - a “wholeness of universe” - -

incompatible with objectivity. How does objective thinking, although based on fallacy, manage to be so productive? Dimensionless parameters are involved in this mystery, facilitating the possibility of “thinkers” in our present universe who are at once huge on particle scale and tiny on Hubble scale. An enormous ratio between Hubble and particle scales is essential. In our present universe this ratio is $\cong 10^{40}$ and growing as the universe continues to expand. Day by day, objectivity becomes increasingly more accurate as the universe becomes more dilute. For an early universe, so dense that individual particles lacked meaningful separation one from the other, objective space-time description was unfeasible. At what Hubble time did “threshold” of objectivity occur? Was the “indivisible” pregeometric universe in some sense already “large” below this threshold? Can early dense universe (below objectivity threshold) be given a nonobjective holistic description that does not require space-time?

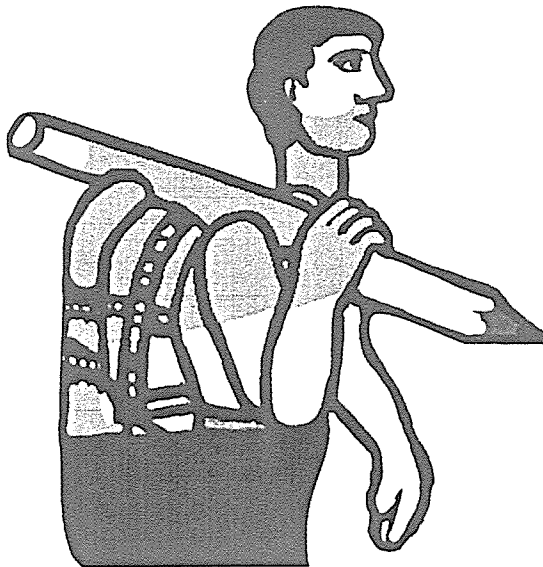
Over the past decade I have been developing a model that allows such questions to be posed. “Standard” models, even those touted as “theories of everything”, do not admit inquiry of this character. Such models continue to employ an underlying space-time manifold. My model, described in a forthcoming *Foundations of Physics* paper, is based on a quantum-mechanical Hilbert space - - a Fock space. There is neither *a priori* space-time nor *a priori* meaning for “object”. Such ideas, together with other “classical” notions, nevertheless have opportunity to emerge as large-action approximations in a coherent-state basis. It has long been known, especially since the 1960 work of Glauber on electromagnetism, that sufficiently-large coherent-state parameters may (approximately) develop “classically-physical” - - i.e., “objectives - - significance. In my model’s Fock space resides a natural pregeometric meaning for “expansion” of certain coherent-state parameters. The model shows via explicit computation how objectivity can be an (approximate) outcome from expansion of a quantum mechanical universe where space-time lacks *a priori* status.

Although the basis vectors of any Fock space may be labeled by integers, such space is infinite-dimensional and my model requires an *ad-hoc* parameter that, in effect, prescribes a maximum integer. In the model’s pregeometrical (dense) quantum phase, this ad-hoc parameter sets the ratio between “age of objectivity threshold” and the earlier “age of big bang” - - this latter smallest meaningful time turning out to be on Planck scale, i.e. $\sim 10^{-43}$ sec. Between big bang and threshold of objectivity, time enjoys model meaning although 3-space does not. “Before big bang” not even time has meaning. Values observed for particle masses, together with the measured value of the gravitational constant, suggest the ad-hoc ratio to be of the order of 10^{34} . * How might such a huge ad-hoc number - - setting the “size” of the pre-geometrical (dense) universe - be understood in a less arbitrary model?

In a model built from discrete (and finite) mathematics, prime numbers plausibly will be important; the exceptional mersenne prime, $2^{127}-1$, provides an example falling into the

needed logarithmic range. In models (such as mine) built from continuous mathematics, it is difficult to envisage “explanation” for a number of order 10^{34} . Although I am delighted by my model’s capacity to illuminate interesting mysteries once the huge ad-hoc parameter has been injected, I look forward to a more satisfactory model based on discrete mathematics, where no arbitrary parameters are required. A counterpart of my model in ANPA spirit is a “consummation devoutly to be wished.”

* Hubble length at threshold of objectivity is then close to human scale. Significance of this striking coincidence remains to be understood.



PEEKING AT THE CONSCIOUS BRAIN : NEW CLUES, NEW CHALLENGES

Emmanuel RANSFORD

Neuroscience and psychological research strongly indicate that no consciousness center exist, but we still don't know very well at all how or why some brain events become conscious and others do not.

Daniel Dennett

FOREWORD

In the last issue of the ANPA West Journal (Vol. 5, No 1), I presented an outline of the so-called 'im-im' model of the conscious brain, which rests on the assumption that awareness is somehow embedded in matter *without* being reducible to a mere side-effect of it.

More accurately, I contend that 'matter' is actually 'psycho-matter'. My stance on the age-old *mind-body problem* is therefore neither monistic nor dualistic, but is rather a kind of oxymoronic "dualistic monism" (psycho-matter is a unique - or *monistic* - and bi-dimensional - or *dualistic* - stuff).

As its very name suggests, psychomatter is made up of two components, namely : its material or physical part on the one hand, and its 'psychic' or 'psi' part on the other. The latter is overwhelmingly *latent*, or dormant. Hence, most of the time, it doesn't show. This is why we tend to think that it is nonexistent...

The 'im-im' model can be summed up in one sentence : **The brain is the organ of consciousness because it is prone to yield supralled paral**, continuously and on a wide scale.

Here an explanation is in order : **Paral** is the state psychomatter is in, whenever its 'psi' part breaks away from its latency, to become active (and thus, to *interact* with the physical part).

Supralness blends or welds together different (and normally unrelated) psi parts - pertaining to different elementary particles and microsystems - into macro-psychic entities.

Thanks to it, nature eventually arrived at our 'macro-psychic' human minds, with

slightly more than a helping nudge from natural selection !

Supralness (i. e. the existence of 'supral links' between psi parts) binds and unites various psi components. It assembles them into harmonious wholes, thereby producing - when paralled - significant amounts of awareness.

(The paralled 'psi' part of an isolated - that is, unupralled - particle breeds an exceedingly faint sparkle of consciousness - so puny indeed as to be well-nigh nonexistent.)

Our holisitc conscious mental selves are striking examples of supralled paral. Broadly speaking, **awareness is supralled paral**. This phrase is the linchpin of the 'im-im' approach.

Quantum physics seemingly provides a firm grounding for the 'im-im' thesis, since paral and supralness arguably relate to actual events and features of the subatomic world.¹

In this paper I set out to explore how the im-im model may fit with the actual workings of the brain. (Of course what follows is no more than a glance at the whole issue.)

This will lead me to close in on the so-called NMDA receptors of the brain, which may well hold some of the keys to its utmost mystery...

Section I. PIECING TOGETHER THE PUZZLE

As most scientists would no doubt have it today, the brain must be understood as a mere information-processing machine, operating on much the same principles as a computer. This expresses the current computer metaphor, when taken at face value - that is, regarded as a scientific truth. Such is the 'scholarly correct' stance of the day.

Really, scholarly correctness is something to be frowned at and wrestled with, if science is to progress! Scientists need and ought to find healthy ways to disagree. They must favor new approaches over old ones revamped: more often than not, tinkering with old ideas just won't do. They must be open to ideas from the periphery as well as the mainstream.

Incidentally, mavericks make the best innovators.

It certainly takes pluck to welcome daring new ideas, that may eventually threaten our most cherished and well-ensconded tenets. But, as Tom Etter warns us, "If there is one

thing that the history of science should teach us, it is that our habitual beliefs don't always withstand close scrutiny. Just because it goes without saying doesn't mean that it's true!"

So, let us feel free to fancy and try out something new...

How can the somewhat irksome conundrum of the conscious brain be tackled, starting from my 'im-im' standpoint? Can we, by relying on it, gather why and how the brain manages to be the organ of awareness - unlike, say, the liver, the nose, trees, stones and cookies?

As seen from the 'im-im' vantage point, awareness is underpinned by supralled paral (or equivalently, by paralld supral). But this supralled paral doesn't come out of thin air. To beget it, it takes all the intricacies of the living brain, with its numbing complexity and its countless simultaneous processes (or parallel neural 'computations').

More to the point, I am led to surmise that the brain is endowed with an array of specific paral-yielding, or generating, structures; which I call the **paralgens**. Thanks to them, we are sentient beings.

Now the question is: *Where in the brain are these paralgens? What do they look like?* Do we have any clue as to their exact location? Will it be possible to pinpoint at least some of them? Big questions, that I leave partly to the next Section. Meanwhile, I take up the issue of how some cognitive functions of the brain can be understood, in keeping with my approach (and in broad and sketchy terms only).

To this end, I shall dwell on human vision, for there is a wealth of well-documented data regarding it.² Of course, there is no question of giving a full account of it. My aim is merely to convey a rough idea of the possible relevance of the 'im-im' line of thought and modes of analysis concerning the inner workings the brain.

Therefore I choose - with a view to dent the enigma of perception - to focus on the human sight, because of our detailed knowledge of the visual system in the primate (and human included!) brain. Here I set the much deeper and far more unwieldy general issue of consciousness aside.

What happens, when we *see* an object 'out there' in front of us? Neuro-mavens know a great deal about this. They can follow the visual information all the way from the retina to the optic nerve, and on to the 20-odd - that many - different areas in the cerebral cortex where this input is eventually processed. They know the various pathways where the initial sensory data are sent, split and computed according to their content.

For example, area V4 is known to process the color information, area V5 is sensitive to motion, whereas the shape of the object is deciphered in area V6. Overall, a slew of separate but parallel computations takes place in different regions or areas of the cerebral cortex, as a result of the sensory inputs originated in the eyes.

So far so good. Yet, on further investigation, the neurobiological underpinnings of human (and presumably mammalian) sight do not quite add up. We are in for at least two surprises. For convenience's sake, I tag them right away: one is the *binding problem*, the other can be labeled the *upshot problem*. What do they consist of?

First, the **binding problem**. This problem arises because there is no area in the brain where everything would, as it were, neatly and nicely fall into line. Put otherwise, there is no single spot in the brain where all the disseminated and fragmented visual information would eventually gather, to form our highly organized view of the world.

We lack (as of now) any convincing neural mechanism whereby the processing done by neurons scattered throughout the visual cortex would combine and reunite, in accordance with our seamless mental image of the world. As Crick emphasizes it, *we can see how the brain takes the picture apart, but we do not yet understand how it puts it together*. Strange and mind-boggling indeed!

How can that be? Francis Crick and others believe that the binding could be achieved by the correlated firings of the neurons concerned. In fact, experiments on cats have (serendipitously) shown that neurons in different cortical areas occasionally oscillate in synchrony, at a ("gamma") frequency of roughly 40 cycles per second.³

For me, there is little doubt that supralness is the likely solution to the binding problem (by providing a forthright and handy, if invisible, psychic binding).

Second, the **upshot problem**. It points to the widely acknowledged fact that it is only the *upshot*, or *result*, of the neural computations that ever becomes aware. For example, our minds gain access to the sole end-products of the fragmented visual processes which go on in the various visual areas. We remain totally unaware of the detailed processing, and perceive only its global final upshot - that which corresponds to the consistent and vivid stream of pictures we actually see.

If anything, this partial blindness (*blindness to the intermediate steps of the computation*) is plainly for our own good!

This *upshot problem* is baffling. It seems to fly in the face of the view that consciousness is but what the brain does - that there is no more and no less than neural

computing to it. How is it, then, that *only* a trifle proportion⁴ - and, to all intents and purposes, the useful one at that - of this computing is ever aware? The brain has an eerie knack at sifting the fully-processed data. It uncannily picks them exclusively, to bear on the mind.

In an attempt to shed some light on these riddles, let me introduce the **cognitive iceberg**. Like any iceberg, it comes with a tip and an underwater part, along with a flotation line to divide them up. This notion is valid for any conscious sense, but here I shall carry on with visual perception. My hope is that it may help us to better grasp why we see and perceive a seamless world.

The *underwater part* is essentially **unconscious**, or *pre-conscious* if you will. Its main purpose is to code the visual information. It achieves this feat through the fine-tuned processing it carries out in sundry areas (such as V4 for color, V6 for shapes, etc.). The new and unfamiliar 'im-im' feature is that its key output is now an ongoing outpouring of definite supral structures: basically, it produces or 'cooks out' countless supral patterns.

In other words, the underwater part continuously churns out *supral patterns* (or *circuits*) of differing shapes.⁵ The idea here is that there is a one-to-one correspondence between the exact *objective* shape of a supral pattern and its *subjective* content - which remains latent *unless* paralled.

This is how, within the 'im-im' outlook, *qualia* are understood to come into being (*qualia* designate these subjective contents). They are brought about by supral patterns of given shapes, and are not felt until... they pour through the flotation line of consciousness.

Why should it be so? Quite simply, it is because these patterns, once formed, typically flow from their incipient specialized visual area into targeted polysensory and multi-modal associative areas of the cerebral cortex, where they eventually project on to paralgens (more about this in the next Section).

Thus, we are now ushered in the tip of the iceberg, which extends above the flotation line. What happens there? To figure this out, let us consider a concrete case - and go back for a little while to the 'underwater' part.

For instance, if the object being looked at is red, then a portion of the 'underwater' part of the visual cortex - namely, area V4 - automatically cooks, out of the incoming 'redness' neural signals, supral patterns of the right shape. It also forwards them straight into the upper part of the iceberg - the tip precisely, which we now want to approach and fathom.

This shape specifically codes the information 'redness' in the supral register. Incidentally, these patterns are the 'engrams' - viz. the memory traces - that Karl Ashley was seeking in the 1950s. (No wonder he failed to pin them down: they are non-material and non-local!)

As such, these bits of information are virtual; as such, the 'red-tagged' patterns bring forth no aware perception whatsoever. To be felt or perceived in the mind, they have to be 'paralled'. It means that they must be turned or 'flushed' into paral (remember: *awareness is paralled supral*). And this is just what occurs inside the tip of the iceberg.

The floatation line of the cognitive iceberg, now: It symbolizes an array of paralgens, whose task is precisely to *enparal* - or 'flash' - any incoming physical microsystem (be it a particle, an ion, a molecule...) as it passes through it.

We can think of a paralgen as a sort of biological device - e. g. *an allosteric protein molecule?* - that would be akin to a channel endowed with a snare; into which, say, ions and molecules are sent by the relevant assemblies of neurons so as to get them caught and trapped in - whence they undergo a paral phase before being released and 'unparalled' again...

All this would happen in a jiffy, as any subatomic event. As long as the 'red-tagged' supral structure is unparalled, its information content remains latent. Conversely, this content becomes conscious whenever the pattern is paralled: then, the subjective load of the engram is activated and unleashed, whereupon it enters the mind and gives off a *quale*⁶ corresponding to its tagging.

As soon as a given pattern moves out of a paralgen, it goes back to its unparalled state. The engram becomes dormant again (i.e. it is subjectively - or mentally - inert or inactivated). Nevertheless, as long as the pattern survives, so does the engram. Granted, it lurks hidden to the mind. But, provided the brain is empowered to *enparal* it again,⁷ to 'read' its subjective content anew, the information is not really lost.

This possibility of mentally calling back, or retrieving,⁸ the engram, is a critical aspect of memory. If the selective process of consolidation⁸ renders the supral engram 'addressable', or accessible to our conscious recalls, this mnesic trace becomes part of our long-term declarative memory.

The preceding analysis brings me to conclude that *our psychic memory is supral in essence*. (This idea would be worth reviewing much more thoroughly.) At this point however, a few words of caution are in order, because memory is a very complicated

affair - to say the least!

For one, there are many types of memory. For two, there are many dimensions to it. For instance, there is the coding stage (creating the engram), the consolidation stage (converting short-term engrams into long-term ones), and the retrieval stage (recollecting the engram). It is well beyond the scope of this paper to mention, let alone discuss, all the facts, theories and issues at stake (such as the Hebb-Hopfield theory, long-term potentiation, and so on and so forth...).

Now I conclude this Section. Some biological senses never yield qualia: their stimuli do not reach consciousness - admittedly, because nature does not need them (e. g. the stretch receptors in the skeletal muscles send stimuli which are brain-processed but remain unaware). Setting them aside and going back to the conscious senses - such as thirst, sight or hearing - the 'im-im' model provides an explanatory interpretation of what goes on. This is what I tried (very skimpily) to show.

I found it convenient to make my point by means of the iceberg metaphor. To sum it up, the cognitive iceberg consists of:

A. An *underwater part*, which cooks supral patterns. This 'patterning' creates *unconscious* engrams which embody (at the supral level) bits of the incoming sensory information. The patterns, once formed, are sent straight on to target microsites within the tip of the iceberg (these sites are the **paralgens**, or the 'paralgenic microsites').

B. A *tip*, that receives the engrams produced by the underwater part and *enparal* them (by means of the paralgens to which they project). The upshot of this second stage of the brain processing is that the psychic or subjective content of the engram - which so far was latent hence unfelt - comes off and enters the mind. In short, the tip is the arena where *conscious* events take place.

It should be clear now how the two-step process epitomized by the cognitive iceberg (*viz. the 'supral patterning' and then, the 'paral yielding'*) gives a seemingly account of the genesis of qualia. At least this is how I try to make sense of perceptual awareness, within the 'im-im' framework.

It is fitting and encouraging that with the above, we may kill three birds (or rather: crack three mysteries) with one stone. These 'birds' are: the essence of our mental memory, the binding problem and lastly, the upshot problem.

These puzzles may well be about to be sorted out (or so do I hope). I propose to unravel them as follows:

1. *The origin of mental (or declarative) memory:* Our conscious recalls are recorded in the supral register (in the guise of patterns tagged by their shapes).
2. *The binding problem:* The 'missing link' of mental binding comes naturally as supralness.
3. *The upshot problem:* Most of the brain processing or 'computing' is carried out in the *unconscious* underwater part of the iceberg. Only the end results (that is, the upshots) of this preliminary processing are - in the case of conscious senses - sent to the tip. There the engrams become *conscious*, by way of their simultaneous *enparalling*. This last event is prompted by a host of paralgens. When it occurs, the engrams are aroused or 'flashed' into suprally well-shaped chunks of paral, whereby they give off clear-cut conscious signals (i. e. specific qualia).

I believe *point 3* to be a likely explanation as to why visual awareness knows of the outcomes of neural computations in the cortex only. Quite generally, it makes a plausible account of the finding that, as Johnson-Laird put it, "What we are conscious of is the *result* of computations rather than the computations themselves."

The acknowledged simultaneous and correlated firing (or synchronous oscillations) observed in the mammalian cortex are likely to be instrumental in achieving that.

As for *point 2* - concerning the role of supralness in binding - it seems poised to elucidate why "there appears to be no single cortical area whose activity corresponds to the global content of our visual awareness". (Crick, 1994) Again, the correlated firing phenomena are likely, so to speak, to wield their sway here too.

Last but not least, *point 1* calls our attention to another outstanding role of supralness: that of coding and 'tagging' - or differentiating - declarative information. If I dub **suprel** a basic unit, or bit, of declarative information, there is every reason to suspect that a vast (and virtually unlimited) number of *suprels* can be stored in the brain. *Supralness would offer much more room and flexibility than plain neural storage.*

Indeed, the staggering and immeasurable capacity of our visual memory bears this out. Moreover, as Crick points out, "There are not enough neurons in the brain to code the almost infinite number of *conceivable* objects. The same is true of language. Each language has a large but limited number of words, but the number of possible well-formed sentences is almost infinite." Still, our brain routinely manages to cope with objects and sentences almost flawlessly!

Supralness comes in handy, to free our mental selves from these material limits. Thanks to supralled paral, our minds are truly amazing - they can go way beyond the

restrictive shackles of sheer biochemistry.

Now we move to the next Section. It raises some of the issues I have to deal with, if the 'im-im' tentative insight is to be turned into actual science.

Section II. PINNING DOWN THE PARALGENS

The foregoing Section leaves us with a number of open questions. In the main, we are faced with at least three broad challenges (at this stage, I shall skip two of them).

The first one bears on the paralgens: they ought sooner or later to be identified and singled out. This is crucial (*assuming, as I do throughout this paper, that the 'im-im' approach is valid*). The second touches on the vital issue of probing and testing.

The third and last big challenge regards would-be attempts at modeling the brain activities and behaviors (or rather, the brain/mind two-way causal relationship) - an uphill task and a thorny problem that is hugely compounded by paralld supral. This is a tall order. It will most certainly require new mathematical tools.

If any credibility is to be lent to the 'im-im' thesis, it is of the utmost importance that I find where in the brain the paralgens are - not necessarily all of them, but at least *some* of them. This is the issue I take up in this Section.

How should I proceed? Luckily, I can benefit from a good many biological clues and hints to this effect. Thank goodness, there is nowadays a sizable body of sound neurological knowledge to fall back on. There are definite leads, which owe much to recent advances in brain imaging and molecular biology particularly.

An obvious starting point is to look into the living brain - what it is made of, how it works - in the hope of garnering data about the likely locus of some neural correlates of, say, perceptual awareness. Chances are, some paralgens will be found on these sites, which will then have to be scanned thoroughly and studied at very close quarters.

In this approach, I borrow chiefly from Crick's book (1994) and from some of the other books given in Reference. My tack is fairly straightforward. It consists in determining which features, if any, are closely linked to at least some forms of consciousness. The trick is then to relate them, whenever possible, to specific neural pathways - which presumably contain paralgens - and processes.

As William James once observed, attention depends on consciousness. By the same

token, consciousness involves very short term memory (this type of memory, which surrounds or 'frames' our ever-fleeting perceptual moments, is also called the *working memory*). And then, as we saw, what we are conscious of are the results or upshots of neural computations held in the cortex.

So I already have three pointers (*attention, working memory and the processing upshots*) to get on with and elaborate from! Before I can unfurl what it all entails, I need to review a few basic things about the brain. Here is therefore a very quick reminder on the brain.

At first sight, the brain is an unimpressive gelatinous three-pound blob. Yet this 'blob' is what makes us think, act and feel as we do. On second sight, it is a hierarchical structure of wrenching complexity, whose basic unit is the nerve cell, or neuron.

Nerve cells have two distinctive features that set them apart from all the other cells in the body. First, they can conduct bioelectric signals (the 'action potentials') over long distances and without loss. Second, they possess special intercellular connections or junctions - the *synapses* - whereby they exchange chemical signals (the *transmitter* molecules). These connections determine the type of information a neuron can receive and the range of responses - e.g. excitatory or inhibitory - it can yield in return.

It comes as little or no surprise that the neuron, which is the functional unit of the brain, is geared to transmit and process information. (For the record, the junctional transmission typically lasts in the order of a few milliseconds.)

Paramount in the human brain is the cerebral cortex, or neocortex. There is compelling evidence that this barely-three-millimeter-thick outer sheet covering the brain is where our higher mental (or 'cognitive') functions - thinking, planning, creating and whatnot - arise. Since no thinking takes place in our minds of which we are unaware, it is a safe bet that at least some areas in the (neo)cortex are awareness-begetting.

Indeed, the weight of evidence consistently points to the cerebral cortex as the neural substrate of consciousness. Thompson (1993) underlines that "The cerebral cortex is what makes human beings what they are. Within the vast human cortex lies a critical part of the secret of human consciousness. . . . The left cerebral cortex was found to have awareness that could be expressed with language, whereas the right cerebral cortex had its own form of nonverbal awareness."

So I can narrow down the focus to the sole neocortex, in my bid to spot *some* paragons. What do we know about it, that may prove helpful?

To start with, it looks a complete mess, with about 100,000 neurons per square millimeter of surface. Overall, it contains thousands of millions of neurons. Quite

untoward and dispiriting for a start!

Moreover, one can divide it in a number of regions or areas; it also comprises four lobes in each hemisphere (left and right). The occipital and temporal lobes receive visual and auditory inputs respectively, while the parietal lobe receives information from the skin and the body. Each of these sensory fields has a "map", or spatial layout, of its receptor surface.

Most interestingly, the frontal lobe is the origin of many motor pathways, and is "involved in circuits which construct an internal representation of the visual information about the place of an object, and then read out that information to control a motor response at an appropriate later time." (Shepherd, 1994)

This 'reading-out-and-delayed-motor-control' bears the hallmarks of *conscious* decision-making.

This unambiguously brands this brain region as a prime location for the higher mental functions. In fact, modern research indicates that the operations of working memory are carried out in the prefrontal part of the cortical frontal lobe. Furthermore, the prefrontal cortex actively partakes of attentional and motor commands, aided by the existing strong connections between prefrontal and parietal associative areas.

The *associative areas* are those areas in each lobe that are not directly related to a specific sensory or motor function. The higher associative areas (in the prefrontal cortex) become increasingly polysensory and multimodal - which undoubtedly implies that they deal with the upshots of the sensory information processing.

With the foregoing, we can be fairly confident that the prefrontal (and parietal) associative areas loom large in the brain production of awareness: these are places where paragens should eagerly be sought after.

Can I go any farther - and how?

To carry on, I must explore (very briefly here) the cellular and molecular levels. The cellular level, first: it is that of the individual neuron. As we learn from the textbooks, most brain neurons fit into two classes: principal neurons and interneurons. It turns out that cortical information is first processed by the interneurons, which project to the principal neurons - which then "decide" what kind of message they will send out to other regions.

In short, it means that the processing upshots (and the possible responses thereof, by way of neural - *and mental?* - "decisions" or initiatives) are the business of principal

neurons, not of interneurons. This is yet another telling and clearcut lead in my search for paralgens.

The principal neurons of the neocortex are the pyramidal cells, which are excitatory (I expect most paralgens to be on fast excitatory rather than on inhibitory pathways). It appears (Shepherd, 1994) that they are involved in the highest levels of processing in sensory and motor systems, in memory mechanisms and in higher cognitive (i. e. mental) functions - such as intentional and willed attention.

A noticeable feature of the cortical sheet is that it is layered. As emphasized by Crick (1994), there is some shred of evidence that the activities in the upper cortical layers are largely unconscious, while at least some of those in the lowers (i. e. layers 5 and 6) correspond to consciousness:

The neurons in the different layers do somewhat different things. It is conventional to describe six layers The only part of the cortex whose neurons project completely out of the cortical system ... lie in layer 5, although some neurons project to other cortical areas. In a sense, therefore, layer 5 is where the processed information in the cortex exits to other parts of the brain and to the spinal cord. All these connections that leave the cortical sheet, even if they enter it again, are excitatory. ... The pyramidal cells are excitatory There is one type of cortical neuron that attracts one's attention. They are the only neurons that project right out of the cortical system. ... It could be argued that what one should send to other parts of the brain are the results of the neural computations. I have argued that it is plausible that visual awareness corresponds to a subset of these results. This makes one wonder about these particular pyramidal cells. Do they have any other unusual properties ? ... In fact, some of these neurons can fire in a special way. A number of neuroscientists have found that such neuron tend to be "bursty". ... All this rather sketchy evidence makes one wonder whether these particular layer 5 pyramidal cells are closely involved in awareness ...; [these cells] do express the "results" of the cortical computations. ... One characteristic of an awareness neuron is that its firing is often likely to be the result of a decision by the neural networks involved. Making an equitable compromise can be a linear process but making a sharp decision is a highly nonlinear one. ... Not all cortical neurons in the lower cortical layers can express consciousness. The most likely types are some of the large "bursty" pyramidal cells in layer 5, such as those that project right out of the cortical system.

This analysis is most instructive: with it, I can confine my quest of *some* paralgens to the large bursty (and "glutamatergic") pyramidal cells of layer 5 of the neocortex (what is more, within the associative areas only).

Finally, I go down to the molecular level. What clearly stands out at this level is the chemical synapse (the main site of functional interneuronal communication). It is pivotal, as stressed by Thompson (1993):

The event behind all the doings of the nervous system, from planning an evening to orchestrating a sneeze, is *synaptic transmission* : the communication of neurons with other cells at synapses. The human brain, with perhaps 100 billion neurons, has at least 10 trillion

synapses, and a typical neuron in the mammalian brain alone may have several thousands.

The author adds:

If any one key concept underlies our current understanding of how the nervous system works, it is that neurons (and the cells releasing hormones) communicate by releasing chemical transmitter substances that attach to specific receptors on neurons and other cells. By virtue of its shape and other properties, a given transmitter molecule fits into its receptor like a key fits into a lock. A transmitter molecule is said to bind to its receptor. ... Since the forces that bind transmitter molecules on receptor molecules are very weak, a given transmitter molecule will attach only briefly to the receptor and then let go. ... In a mixture of receptors and transmitter molecules ... the process of binding and unbinding is continuous.

Receptors (and what goes with them: effectors and channels) make a very compelling target for speculation about paragenic microsites. A convincing hint is provided by potent psychoactive drugs: their powerful effects on the brain and behavior is due to their action on chemical receptor molecules (the details of which are very delicate to disentangle).

It is widely acknowledged that the neurotransmitter receptors hold the key to the functioning of neurons and the brain. One may wonder: Has the continuous process of binding and unbinding a direct bearing on the ceaseless overall formation of supralled paral? It could well be...

Of particular interest is the so-called NMDA receptor found on the dendritic synapses of pyramidal cells. It is excitatory, and has several critical properties suggesting that it may be involved in a wide range of neurophysiological and pathological processes - such as learning and memory, developmental plasticity and epilepsy. (C. B. R., 1991)

In addition, the NMDA channel is highly nonlinear, is a prime candidate to explain the synchronous oscillatory behavior in the cortex, and is a calcium channel (most of what flows through it are Ca^{++} ions).

Other inviting features have been spelt out in the literature, but I believe that I have already gleaned enough data to make my point. The conclusion I draw is that at least **some NMDA channels in the dendritic spine synapses of the large bursty pyramidal cells of the cortical fifth layer do function as paragens.**

At this stage (and pending supportive experimental evidence) this claim is no more than an educated guess. In summary, here are some of the reasons for my choice. A few tantalizing hints are:

- Paragens should be sought for somewhere along the neurobiological pathways of mood-altering substances in the cortex. (Psychoactive drugs are known to act on

receptors channels; but actually, also on the 'second messenger system'.)

- Paralgens should be linked to some apparently random and acausal (and/or highly nonlinear) brain events, as a token of 'free will' or decision-making. (This again points to the NMDA channel.)
- Paralgens, in order to yield (collectively) well shaped, or well-suprally-patterned, paral, should be involved in synchronized oscillations of sorts, connecting neurons in different cortical areas - whereby they can achieve duly correlated firing and simultaneous *enparalling*. (Such oscillations have been observed in the 35- to 75-Hertz range; calcium channels - like NMDA channels precisely - seem to be key players in this scenario.)
- Paralgens should be linked to fast excitatory synaptic transmission, for at least a fair proportion of them. (Glutamate is the primary fast transmitter in the brain - and the NMDA channel is glutamatergic.)

A full proof of my contention would require:

- a) To evolve a neat and tidy set of experimental criteria to discriminate between paralgens and other receptors (and/or effectors) in nonparalgenic microsites;
- b) To design and carry out conclusive experiments (relying on molecular biology, quantum chemistry and such techniques as 'patch clamping' - which allows to study the behavior of a single molecule of an ion channel);
- c) To work out artificial paralgens mimicking the biological ones, and develop *artificial awareness* from them...

All of the above implies to set up and implement a full-blown research program, based on inter-disciplinary teamwork. I look forward to it!

Now, in order to be more specific and concrete about the nuts and bolts of the 'im-im' model, let me just add a few provisional details on the *actual* paralgenic microsites. My aim is but to give a remotely indicative idea of what biological paralgens may possibly amount to.

If I am right to put forward the NMDA channel as a prime candidate for a paralgen, then I am led to surmise that the Ca_{ν}^{++} ions which keep gushing and spurting through it are likely to be *enparalled* in the event.

The all-important supral dimension must not be overlooked. As we remember, in the case of the conscious senses the supral patterning is first molded in the 'underwater' part of the cognitive iceberg - which corresponds to specific (i. e. non-associative) cortical

areas.

The stellate cells - a type of interneurons - seem actively involved in this pre-conscious patterning (Shepherd, 1994):

In granular sensory cortex, such as visual cortex, the afferent [or incoming] input ends mainly in a specific population of stellate cells that defines a new layer This population of cells can be seen to function as a kind of intracortical relay, receiving the thalamic input and transferring it to the pyramidal neurons, providing thereby a more complex preprocessing of information prior to its input to the pyramidal neurons.

Both the final stage of the binding and the large scale simultaneous paralling would, in the 'im-im' picture and as already mentioned, critically depend on the synchronized 'gamma' oscillations. (They would not directly concern the unconscious pre-processing stage involving the interneurons.)

As it is presently known, this striking phenomenon simultaneously affects and connects an enormous number of synapses in the dendritic spines of the cortical pyramidal cells. And this is exactly what is needed to yield wide-scale supralled paral! (Recall that the latter is what underlies, in the 'im-im' perspective, any conscious state.)

It is fitting, in my view, that the organization of the pyramidal cells has been found to favor a great deal of computational complexity in their dendrites (*esp.* the distal ones), and that that the dendritic spines are semi-independent metabolic subunits (Shepherd).

Chances are that many paralgens are tucked inside these distal dendrites; whose 'computational complexity' would then account for much of our higher mental capabilities. The very fact that dendritic spines play a prominent role in the after-birth brain development (and are affected in certain kinds of diseases that produce mental retardation) further substantiates this.

This ends what I hope is a promising insight into the inner workings of the conscious brain.

CONCLUDING REMARKS

According to the 'im-im' standpoint, mind is *both* a collection of brain processes *and* a substance. In the same vein, mental events are truly triggered by the firing of large sets of neurons, but their full causal expansion must resort to a very peculiar nonmaterial stuff - *supralled paral*, as it turns out. The above provides a tentative elucidation as to how mind fits in with the rest of reality - how mental and bodily processes differ and relate, how mental functioning is intimately bound up with biological makeup. The 'im-im' approach (of which I gave only a nodding account) seems to have the potential to do justice to the uniqueness of mental phenomena - as radically different from physical ones

- whilst explaining how and why they intersect causally with *some* non-mental processes.¹⁰

Mental states (such as sensations, desires, thoughts, moods and feelings) are understood as *nonmaterial correlates* of special kinds of physical events. Neural processes which put brain paralgen into effect are an instance of such physical events.

This being so, we can readily figure out how it is that our psychic lives (the mental events going on inside our skulls) interweave so seamlessly with our bodily processes. This is everyday experience - and needs certainly not be an ever-unvanquished and hopelessly fathomless riddle...

The 'im-im' scheme looks poised to put paid to the seemingly hard-core conflict between the (admittedly, rather glaring!) nonphysical nature of mental states on the one hand, and their close and strong dependence on physical events on the other hand.

Finally, a few words about the future of the 'im-im' undertaking. Its main thrust was an attempt to give a scientific account of awareness - without discounting it by reducing it, one way or another, to matter. (In my view, any reductionism - whatever its hue and however sophisticated it be - is doomed to explain consciousness away, by dismissing it at the outset.)

I hope that I have made an auspicious, if modest, inroad into the tantalizing puzzle of consciousness: With the proposed 'im-im' model, I wish a few steps have been made in the right direction, and that it will in turn give rise to more of them.

However this is, at best, only a beginning. Science is hypothesis testing, and any tentative model or theory will eventually be discarded, if divorced from any experimentally accessible data or phenomena. As for any speculation, so for the 'im-im' endeavor. Fortunately, the notion of paralgen holds out the promise that it will be amenable to experimental probing.

It must nevertheless be borne in mind that it will certainly be difficult - and *devilishly* difficult at that! - to shed conclusive explicative light on the most elusive of subject: that of consciousness and, more generally, that of the living mind. But we play for high stakes: arguably, the fully-attested discovery of a paralgen would be a major breakthrough.¹¹ It could eventually pave the way to the technology of artificial consciousness.

Will new technological advances soon make the search for factual backing much closer at hand? One thing is for sure: scientific research is no longer a matter of isolated individuals - whatever their personal merit. It is increasingly the concern of large technostuctures: "big labs, big teams, big bucks", as the saying goes (until the money

requirement becomes so huge that the venture is ditched altogether!).

For this reason I look forward to get in touch with investigators open (or reckless?) enough to accept to have a hard but fair look at the im-im assumptions - and perhaps, to join efforts and share skills to think up, contrive and implement a full-fledged research program along the 'im-im' lines.

I am convinced that the unconventional prospect of psychomatter is far-reaching enough to deserve to be taken in earnest - at least for a try.

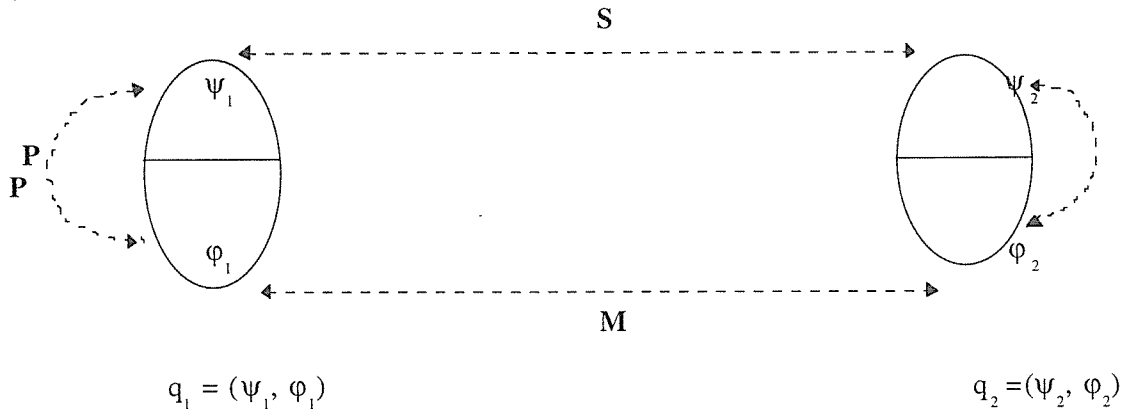
APPENDIX

A GLIMPSE OF PSYCHOMATTER

What is psychomatter? How does it behave? To approach these questions, I go back to the drawings laid out in my earlier paper (see ANPA West Journal, Vol. 5 No 1). Thus, let q_1 and q_2 be two elementary particles (or rather *wavicles* - since they exhibit both *wave* and *particle* aspects).

According to the 'im-im' hypothesis, these particles are made up of a bi-dimensional stuff, namely, psychomatter (instead of plain matter). Hence I can write them down as : $q_1 = (\psi_1, \phi_1)$ and $q_2 = (\psi_2, \phi_2)$. (Here ψ_i [$i = 1$ or 2] labels the 'psi', or psychic, part of the wavicle q_i whereas ϕ_i stands for its material, or physical, part.)

Given their twofold nature, q_1 and q_2 are prone to three different types of interactions, as made plain by the following drawing:



We successively have:

M : **material** interaction (between ϕ_1 and ϕ_2) y

P : **paral** interaction or phase, or else, **paralling** (between ψ_i and ϕ_i , $i = 1$ or 2)

S : **supral** interaction, or link (between ψ_1 and ψ_2)

The good news is that this twin aspect of paral and supral events has a definite counterpart in quantum physics, namely:

- The paral phase is nothing but the 'wave packet collapse' of quantum mechanics. (*As I argued in my ANPA 16 paper given in Reference, its onset is brought about under specific 'paralling' - and really, 'triggering' - conditions that generalize quantum measurement acts; they have to do with the energy makeup of the micro-system*). It is at the heart of mind-matter interaction, at its barest and most elemental level.
- Supralness (that is, the phenomenon of supral bonding) is nothing but quantum 'non-separability'. It welds or binds erstwhile unrelated wavicles into psychic wholes. (Our minds are examples of such suprally harmonized 'macro-psychic' entities.)

With all the foregoing, we may start to wake up to the prospect that consciousness is but the subjective side, or content, of wide-scale supralled paral. Some celebrated facts can unequivocally be traced to this double dimension (objective and subjective) of paral and supralness. For instance (Thompson, 1993): "The mind cannot exist in a single neuron; it is the product of the interaction among the myriad of neurons in the vertebrate brain."

Or else: "It is the wiring diagrams, the ways neurons in the brain and body are interconnected, that determine particular behaviors. To understand the brain, both the neurotransmitter receptors and the wiring diagrams must be taken into account. A phenomenon as complex as consciousness presumably has as its basis the immensely complex circuitry of the cerebral cortex."

Neurotransmission addresses - in some instances - the paral yielding aspect, whereas the wiring diagrams contribute (e. g. in conscious perception) to shape, or pattern, supralness. (Actually, these wiring diagrams do more than just that.)

As we may reckon, the (as yet hypothetical) relevance of supralled paral on the issue of human mind goes some way beyond the reduction of psychic realities to a set of algorithms.

Oddly enough, this reduction is the conventional wisdom of the day, even though this 'creed' is far from substantiated (besides, it goes head-on against seasoned folk psychology). Worse still, it failed hitherto to elicit any breathtaking, let alone significant,

technological progress - notwithstanding sweeping and repeated pledges to the contrary.

The supporters of artificial intelligence stick to their creed. They have no misgivings about saying that the mind (*or is it the brain only?*) is really a kind of machine like any, which simply carries out computations of sorts - and that's it. Their ultimate goal is to break our higher mental functions and abilities into "certain sets of cognitive skills" that can eventually be computerized. They currently strive to come up with an algorithmic definition of creativity!

True to our present knowledge, within the last two decades or so neuroscientists have made great strides forward in understanding the relation between cognitive processes and the anatomical organization of the brain. No doubt, they arrived at some hefty success in analyzing higher mental functions in terms of the coordinated activity of neurons in various brain structures.

With new technologies at hand, such as functional magnetic resonance (fMRI) and positron emission tomography (PET), researchers can even catch the brain in the very act of cogitating, feeling or remembering. But what they peek at is actually no more than the objective neural correlates of the mind-in-progress. They gain no first-hand access whatsoever to its private intimacy - *to the subjective contents of the supralled paral produced in the brain, that is?*

For all the hype and glitter surrounding high-tech brain imaging, there is definitely *less* to it, explanation-wise, than meets the eye. All our heady scientific and technical advances, impressive though they are, do not make up for a genuine explanation of the conscious brain. Nor do they come anywhere near to it.

What strikes me in the whole thing is the widespread confusion which seems to prevail, between a mere *description* (however accurate) on the one hand and a full-blown *explanation* on the other. The two are a world apart - there is far more than just a nuance between these notions. The former does not necessarily steer to the latter - it only supplies battle-tested, hence dependable, leads. Which is already an awful lot - granted!

One last word: owing to supralness, mental entities can no longer be deemed separate, as fragmented in watertight individual wights and beings. On the contrary, there is a most welcome - and wholesome - basic (w)holistic unseparatedness or interconnectedness which unites all the living beings, and extends to the entire universe. This exhilarating perspective (which was uncannily unearthed, long ago, by some traditions) is mind- and heart-opening. I touched upon it in my JACM article (Ref. 1994b).

FOOTNOTES

1. This issue is examined at some length in my article: *From Quantum Physics to the Conscious Brain*, in the *Proceedings* of ANPA 16 (Sept. 1994). (In a nutshell: **paral** relates to the quantal 'wavefunction collapse' whereas **supralness** connects to non-separability.)
2. I follow the track of Francis Crick, who considered vision in an endeavor to tackle the same question of conscious sensory perception in his best-selling book: *The Astonishing Hypothesis* (1994).
3. I shall come back to these synchronous oscillations later on.
4. For the split-brain specialist Michael Gazzaniga, a whacking 99 % of what goes on in the cortex is stark unconscious (see his interview in the OMNI magazine, October 1993).
5. A **supral pattern** (or a supral micro-circuit) binds together an arbitrary number of elementary particles and/or ions and molecules. Its 'shape' varies with the kind of particles involved and the type of supral links, or wiring, within this supral community. All this receives a sharp meaning in quantum physics (where supralness, as I suggested, identifies with non-separability, a.k.a. 'nonlocality'). More on this in the paper indicated in footnote (1).
6. As already explained, a **quale** (and **qualia** in the plural) designates any particular subjective content of consciousness, e.g. the (felt) redness of red. Needless to say, a continuous stream of paralleled red-tagged patterns secures a longer timespan for the quale and qualia - as long as the red object lingers within sight. The discipline-to-be which studies the correspondance between (paralleled) supral patterns and *qualia* is **suprology**.
7. Apparently with a significant and well-documented contribution from the hippocampus.
8. The phenomenon of **consolidation** picks selected bits of our short-term declarative memory to 'consolidate' them into the long-term mnesic register: the consolidated bits can be recollected months and even years afterwards. (The **declarative** memory is the register of our conscious recalls, those of which we can talk - or 'declare' - about. There are other kinds of memory, like the *procedural* one, which concerns our learned motor skills: how to ride a bike, how to play piano, etc.) A mnesic engram is **addressable** if it can be retrieved (otherwise it is lost, as buried into oblivion in some dim recess of the mind: its address is unknown, so to speak...).
9. How exactly the right conditions (so-called *paralling conditions* or rather, *triggering conditions*) for this to happen could be arrived at is yet to be investigated - this is a question of quantum (bio)chemistry.
10. A reminder: The causal tie in question boils down, at the most elemental level, to the **paral interaction** (also christened the **paral phase**, or the **paralling**). It jolts a subatomic particle out of its smooth and steady wavelike motion (of 'least action'). The occurrence of suprally harmonized parallings is what allows elaborate conscious and bodily processes to entwine and 'converse' seamlessly, through the biological sensory-motor function.
11. Are the NMDA receptors of the large pyramidal cells of layer 5 of the neocortex good candidates, as I presume here? Can we pick other and better target microsites - 'better' in that experimental evidence would be easier to arrive at?

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Looking At, Through, and With

Tom Etter

I would like to offer here some thoughts about mind and brain that were stimulated by reading Ransford's article "Peeking at the Conscious Brain" (this issue). First, let me say that I generally agree with his broad framework, and very much like the simple and orderly way in which he has laid it out. And, as those who have read my previous writings on the subject know, I strongly agree with him on the need to challenge the prevailing wisdom that the brain is "nothing but" a computer. Also, I think he has coined some useful technical terms, notably 'paral', 'supral', 'the binding problem' and 'the upshot problem'. These terms express essential concepts that must in one way or another be dealt with by any serious philosophy of mind. What I am presenting here is meant to complement Ransford's essay, going more in the direction of epistemology, and probing the "quantum connection" in a somewhat different way.

Like Ransford I would probably classify myself as a pan-psychist, to use an old-fashioned term. That is, I believe that analyzing the world into objects is ultimately not a viable project unless it is of a piece with analyzing the world into experiencing subjects. Also, I'm quite ready to extend *fellow feeling* to all things, even electrons, though I haven't the slightest notion of what's on an electron's mind.

What is a mind? The word "mind" has been used in some weird ways by philosophers and psychologists, but it has an ordinary meaning in everyday life that we all understand quite well. If I ask you "What's on your mind?" you know perfectly well what I am asking. Notice that I am not asking to look *at* your mind but to look *through* it; "What's on your mind?" is shorthand for "What's on the screen in front of your mind's eye?" I suggest that, at least on the first pass, the criterion for something having a mind is that it makes sense to ask what's on the screen in front of its mind's eye. To know a mind is to look *with* and *through*, *at*.

It's important to realize that *looking at*, *looking through*, and *looking with* are very different ways of relating to another being. The first makes the other being into an *object*, the second into an *instrument* and the third into a *fellow being*. To say that electrons have minds (or iminent minds or bits of mindstuff or whatnot), if it is to be more than just playing with words, must conjure up some sense in which we can at least imagine looking *with* and *through* electrons and not just *at* them. Furthermore, and this is the really hard part, if we are to parallel the composition of material objects by the composition of their bits of mindstuff, we must have some intelligible notion of what it

means to *compose* various occasions of *looking with* and *through* into a single occasion, or to put it another way, what it means for several fellow beings to coalesce into a single fellow being. Ransford calls this the *binding problem*.

You ask Mary, John and Alice "What's on your mind?" You get three thoughts, three screens before you mind's eye. Perhaps you are able to merge them into some kind of unity. But that unity, that single thought, is *your* thought. You haven't merged Mary, John and Alice into a single person, nor have you merged their minds into a single mind, you have only merged your experiences of looking through their several minds into a single experience of your own. Ransford has some interesting speculations about *how* several pieces of mindstuff might combine into a single consciousness, in the sense of what might be the brain process that combines them. My intuition that he is on the right track here. But I still have a question: what exactly is the task that this brain mechanism is supposed to accomplish? What on Earth does it *mean* for several minds to merge into one? What does it *mean* to take a mind apart?

The words "part" and "whole" are so ordinary and familiar that we rarely imagine that there is any problem with what they mean. But that is because we normally use them in the context of everyday physical objects, which we are quite used to taking apart and putting together. When we try to focus on the parts of a thought or the parts of a mind, we automatically switch to the *looking at* mode and imagine these as parts of objects. William James points out how this can lead to egregious confusions. In trying to find the parts of our state of mind, what we usually find instead is our thoughts about the parts of the *object* of our thought, as if the thought of water were the thought of hydrogen plus the thought of oxygen! James, perhaps the best introspective psychologist of all time, seriously raised the question of whether analyzing the mind is possible at all. In another of his wonderful images, he says that trying to capture the fleeting stream of consciousness by introspection is like trying to turn on the light quickly enough to see the darkness. To put it in our present terms, perhaps you can't ever *look at* the mind -perhaps you can only look *through* it *at* what's on it. This problem has its physical counterpart: How is it that we look *through* our brain, *through* our sensory neurons, *through* our eyes, and see the apple on the table? Why don't we see our neural processes instead? Ransford calls this the *upshot problem*.

Pan-psychism is thus faced with two very serious difficulties. First, and this is the traditional objection, it seems impossible that we could ever know or imagine what is on the minds of beings as different from ourselves as stones and electrons, so panpsychism appears to be an empty assumption, devoid of empirical content. Second, since we can make no sense of the idea of constructing minds out of smaller minds, the idea of a

mindstuff distributed throughout nature is intrinsically meaningless.

These are hard problems, and I don't claim to have the answers, but I would like to offer some tentative suggestions.

Concerning the first problem, the panpsychist certainly doesn't aspire to know what is on every mind or every kind of mind - it's hard enough to know what's on the minds of our best friends! Rather, he is looking for general principles, and I propose that these are precisely the principles governing the "with-through-at" relation as a factor in the physical structure of nature.

Concerning the second, the point in itself is well taken, but it doesn't really bear on the issue. Why should we ever imagine that it's possible to analyze mindstuff apart from the rest of nature? Indeed, this would commit us to a kind of dualistic parallelism quite at odds with the effort to understand how mind is immersed in nature. The alternative is to treat mind as always *embodied*. When we analyze nature, when we take it apart, we necessarily treat bodies as objects made out of objects - this complements, but in no way contradicts, being able to see with and through bodies, i.e., treating them as fellow beings.

Our first impulse when we try to make sense of the world is to *classify*, and thus we classify substance or "stuff" into earth, air, fire, water, or into matter and mind. Now these are perfectly good categories if we don't take them too seriously or expect too much of them, but it's important to not let them interfere with the next phase of making order, which is seeing how things are *related*. In our approach to the mind-body problem, it's high time to start on phase two. The image of mindstuff as a companion to matter has a certain charm, and can be useful in getting us started; I really like Ransford's images of releasing bits of mindstuff by "sparking" or "waking up" bits of matter. However, I think perhaps we can analyze these same events in greater depth by treating *mind-body* as a relationship. When we do so, panpsychism then says simply that this relationship is universal, i.e. that mind and body are always found together, like big and small or up and down.

There is a strong leaning in this direction in the credo of empiricism, which holds that facts about the natural world can only be known by observation, thereby bringing the observing subject into every nook and cranny of the world, at least potentially. The trouble with classical or *Cartesian* empiricism is that the observing subject is not actually *part* of the world he is observing, but remains a disembodied abstraction, the famous (or infamous) transcendental ego.

The transcendental ego got quite a shock when Einstein, by paying careful attention to the behavior of actual measuring instruments like clocks and rulers, overthrew our basic conception of space and time. The lesson here is that measuring instruments can play an essential role in *constituting* the facts they reveal. What's peculiar about measuring instruments as opposed to other kinds of objects is that you look *through* them as well as *at* them - quite literally in the case of telescopes. You wouldn't say that a telescope has a mind of its own, but nevertheless when you look through it it becomes in a very real sense a *part* of you as the observing subject.

Bertalanfy, I believe it was, had a telling example to illustrate how this can happen to any object that becomes an instrument of knowledge. People who explore unlighted caves find their way by poking a stick in all directions. At first their attention is largely on the stick; they poke, feel something, and infer something about the cave. But with practice the stick disappears and it is the cave wall itself that is present to the mind's eye, almost as if one were actually seeing it - one *sees through* the stick. Ransford writes at length about the wonderful mechanisms of the lower brain that "measure" our sensory neural input and send their highly discriminating "observations" to the upper cortex where consciousness is presumed to reside. Another case of *seeing through*, this time within the brain itself.

Which of course brings up the obvious question: *who sees?* The obvious answer is *we do*. Now that we have dared to put our clocks and rulers and even our brains into the world, the only thing left is to take the big plunge and go in after them!

What's it like down here in the world? Well, for one things we've become objects, bodies. In fact, everybody is a body! We still use the word "we" very selectively, but our democratic proclivities are inexorably lowering the entrance barriers to our club. Oh, what the hell, let 'em all in, why not! Such is the downward slide into panpsychism.

Let's review our journey. Beginning as pure spectators of the world, we found that our vision was badly flawed unless we looked *through* certain objects called measuring instruments. It then became evident that any object can play the role of a measuring instrument - you can always look *through* something at something else. We, ourselves, however, remained on high, each in magical communion with a certain spot in a certain brain (Descartes said it was the pineal gland, but now we think it's the cortex.) Learning what was on your mind, at that stage of our journey, meant that my celestial consciousness looked *with* your celestial consciousness *through* your brain and eyes *at* some worldly object. But then we descended into the world ourselves. What a shock!

What am I doing down here, hanging out with you, a mere object? Horrors, am I an object too? Groucho was right when he said "I'd never join a club that would have me as a member." But now it's too late - I've already joined it. This is going to take a lot of getting used to.

Indeed it is. The three-way relation *with-through-at* has become universal. That's a lot to digest. Here, I hope, is a small start:

Let us operationally define the *phenomal field* $ph(w,t,a)$ as what would be vicariously experienced by the experimenter if he were in contact with the three objects w , t and a in the three modes of *with*, *through* and *at*. Notice that this has the same general form as operational definitions of things like distance and temperature: distance $d(x,y)$ is the number the experimenter would read off his ruler if he were to stretch it from x to y , temperature $T(x)$ is the measured height of a certain enclosed column of mercury if the experimenter were to place it at x , etc. The difference is that in the case of $ph(w,t,a)$ the probe, the measuring instrument, is the experimenter himself (However, even in the case of things like distance, the experimenter is an essential adjunct of the probe, since he must interpret certain light patterns reflected off the ruler as numbers, etc. For the empiricist, the buck always stops with us).

Our definition is based on the sort of thing the neurologist actually does in his laboratory: He listens to the words of a subject while poking his brain or stimulating his senses, letting them evoke the experiences that he himself would have were he saying the same things. Crude, vague, unreliable, and not very general, to be sure. But for now, it's state of the art. Remember, the operational method is an ongoing cyclic process: We alternate real experiments with *thought experiments*, the latter leading to theories that in turn lead to better definitions, better procedures, better probes, and back to better theories, in what we hope is an expanding virtuous circle. Making ourselves into better probes of $ph(w,t,a)$ has much in common with a liberal education, which will soon hopefully be improved by the study of a new science of mind and body!

How can our definition, which is presently based on human speech, ever go beyond the human mind? But then, how can our definition of distance extend to galaxies and atoms? And how can we confidently speak of the temperature inside a star? The answer is in the magic of thought experiments, of which Einstein was a particular master. When we only *think* about "measuring" $ph(w,t,a)$, we are free to imagine a "neurologist" who can understand the speech of mountains and galaxies and even electrons. If, for instance, we are concerned about certain general conditions under which $ph(w,t,a) = ph(w',t',a')$, we may not have to say anything at all about the experimenter or what he is able to

experience, and we can probably leave the specifics of w , t , a etc. quite open. It is on such “wholesale” thought experiments that theories are built..

Since *with*, *through* and *at* are now associated with w , t and a , which are objects at least for us as scientists, it’s time to call them by their more traditional names: *subject*, *medium*, and *object*. The neurologist looks *at* the subject’s brain and compares what he sees with what he imagines it would be like, based on the subject’s words, to look *with* the subject *through* the medium of the subject’s brain *at* what is on the subject’s mind, the last being what the phenomenologist calls an *intensional object*. Actually, we must be a bit careful here; we are not following Husserl in severing the intensional object from all contingencies, but are treating it as a manifestation, an appearance, of something beyond itself; as an object in the world seen in a certain way.

Note that of these three objects, only the medium, the brain, is a material object in the usual sense, meaning something that has mass, energy etc. and a place in public space and time. Thus, in trying to understand the relationship of mind and matter, it makes sense to think of $ph(w,t,a)$ not as a relationship among three pieces of stuff but rather as a kind of *polarization* of a piece of matter t . As panpsychists, we must be willing to look for this polarization anywhere in the physical world. To put it another way, we should be willing, at least as a thought experiment, to probe any bit of matter as we would a *brain*.

What might this mean for matter in its simpler forms? Take, for instance, a gas in equilibrium. A piece of that gas differs in many ways from the human brain, but one obvious way is that it manifests nothing of the *asymmetry* of brain function that corresponds in a human to the arrow from subject to object. A person looking at an apple is enormously different from an apple looking at a person, but any hydrogen molecule looking at any other hydrogen molecule must see pretty much the same thing. The very presence of a probe $ph(w,t,a)$ in the gas introduces a subject-object *polarity bit* into every part of the gas, just as a coordinate system introduces a parity bit into every part of space, but reversing this subject-object bit could have no effect on what we observe of the physical structure of the gas. Another way to put this is that there is no way of using large-number physical effects to communicate with whatever mind is in the gas. That mind is totally *uncoupled* to the classical macrostructure of the world; it is fast asleep.

If matter is independent of the *s/o* bit, why bother with that bit at all? At the risk of seeming to change the subject, let me speak briefly about complex amplitudes. Mackey [1] showed that we can dispense with complex scalars as a primary concept in quantum mechanics by introducing a certain symmetry operator into real quantum mechanics and

requiring that this operator commute with all others. Here's another way to state this: We start with real quantum mechanics and introduce a certain two-state particle which I'll call the *Janus particle*. We assume that there is exactly one copy of the Janus particle, that this copy is present in every quantum system, and that we can only measure those states for which the state of the Janus particle does not affect the measurement probabilities. If we confine ourselves to just these states, the resulting theory is isomorphic to complex quantum mechanics. The principle of the irrelevance of the Janus state is familiar to physicists in another guise as the irrelevance of phase to probability.

What have we just seen? Here, in the midst of standard quantum mechanics, is a "status bit", the state of the Janus particle, which makes no difference for observation, but whose bare presence makes a huge difference to physical theory! What if this status bit were the subject-object polarity bit? (It could conceivably have this interpretation even within physics, as the choice between the Heisenberg and Schrodinger representations.) What if Janus is the omnipresent cosmic neurologist?

If this were true, then quantum physics would be precisely the science of "non-living" matter, i.e. of matter in which the mental component is still completely latent, to speak in Ransford's terms. What he calls the "sparking", the "waking up", the "paralling" of matter would then be represented by a breaking of Janus symmetry. With such a breaking, the phase factor now becomes measurable, which means we need a more general kind of quantum mechanics to describe it; I'll come back to this shortly. If this all seems far-fetched, let me add here, for what it's worth, that Pauli had the strong intuition that understanding complex scalars is the key to uniting physics with psychology [3].

Ransford interprets his *paralling* in physical terms as the collapse of the quantum wave function that accompanies quantum measurement. In this, he and others have taken their cue from von Neumann, who regarded consciousness as what collapses the wave function; Ransford's "paralagens" turn von Neumann around, reversing cause and effect, as it were. Since being awake means that your mind is coupled to the everyday physical world, this makes a lot of sense. However, at first sight it seems to conflict with the above account of paralling as breaking Janus symmetry.

To sort this situation out, we must first of all realize that the collapse of the wave function is not a well-defined theoretical concept but a rather clumsy makeshift designed to bridge the seemingly incompatible frameworks of quantum and classical analysis. To give a better account of the what's going on, we need a *covering theory* that encompasses both quantum and classical. Fortunately, one is now at hand [2]; it involves generalizing the allowed forms of the density matrix so that some are quantum, some

classical, and there is a wide variety of others in between - I'll say a bit more about this later.

In this wider covering theory, the collapse of the wave function is a coarse common denominator of many kinds of process that transform quantum into classical via intermediate forms. For physics as we know it, the details of such processes and of the intermediate forms are irrelevant, but for a theory of mind in which the collapse of the wavefront corresponds to “waking up”, they are of the essence! Thus we can hypothesize that, among the many kinds of collapse, the “waking up” kind are those that involve a significant breaking of Janus symmetry. By significant, I mean cohering with other breaks into a larger pattern. But this brings us to what Ransford calls the *binding problem*.

How do the microscopic bits of subjectivity that are released in the human brain by the breaking of quantum Janus symmetry at the molecular level cohere into a single state of mind? (Ransford calls this supral bonding) This update of James' problem is Ransford's binding problem. His solution, which in one form or another has been adopted by most people in the “quantum consciousness” business, is, in his own words, that “Supralness ... is nothing but quantum ‘nonseparability’. It welds or binds erstwhile unrelated wavicles into psychic wholes.” This ‘nonseparable’ (or inseparable) state of mind is presumably pure, which means that when we diagonalize it, it becomes a monad, an undivided whole, its matrix consisting of a solitary 1 among a sea of 0's. On the other hand, when we try to “measure” it by introspection, it collapses into what could be complicated pieces corresponding to the engrammatic structure of the brain. These can go off associatively in all directions - the thought of water really could become the thought of oxygen plus the thought of hydrogen - a neat solution to James' connundrum!

I think this is certainly on the right track, but as Ransford remarks, we need new mathematics to really get a grip on it. The covering theory I mentioned above seems very much to the point here, since it is based on an analysis of separability and connectedness; we can think of it as a general theory of dynamic parts and wholes. Here, in a nutshell, are its key ideas:

- 1.) Define A and B to be *separate* if what is the case with A is independent of what is the case with B.
- 2.) Define A to be *separable* from B at C if specifying what is the case with C separates A from B, i.e., if what is left of the variability of A after “fixing” C is independent of what is left of the variability of B. The most familiar example of separability is that the

past A is separable from the future B by the present C, or so we imagine.

3.) To *disconnect* A from B at C means to present a pair of separate objects A&C and C'&B such that if we supply the *connecting condition* that $C=C'$, we obtain a description of the joint object A&C&B.

Theorem: We can disconnect A from B at C if and only if A is separable from B at C.

Actually, our main interest in C is in its variability, so the above definitions can be restated replacing C by a variable x . 3) then generalizes as follows, we *separate* the variable x in A into x and x' by presenting an A' containing x and x' such that by supplying the condition that $x=x'$, we turn A' into A.

The central concept of the present theory is that of the *disconnection matrix*, which is the (normalized) case-count matrix of x and x' (we allow case counting to go negative as well as positive). This matrix is what generalizes the density matrix of quantum mechanics. It turns out that at every x , there is a generalized Born probability rule, and at every x and y whose joint variation separates T from everything else, there is a generalized Schrodinger's equation, where the case-count matrix of T is the generalized transformation operator. Thus the mathematical form of the core quantum laws belongs entirely to the *arithmetic of connections*.

Quantum mechanics proper results from assuming that all *states*, i.e. all disconnection matrices, are symmetrical in rows and columns. On the other hand, classical Markovian analysis, which encompasses everything that can be modelled in a computer, results from assuming that all columns in the state matrix have the same sum. These two, quantum and Markovian, stand out as natural special cases among an infinite variety of other modes of analysis defined by other kinds of states.

Given that A and B are separable at x , there are in general many different ways to separate them. That is, the separation matrix at x (i.e. the state of x) is only partly determined by the structure of A&B as a whole. This means that we are free to use any kind of analysis we want, quantum, classical, whatnot, in taking things apart, without running into contradictions with the data. However, we must be willing and able to pay the price! Having disconnected A from B, the question arises whether we can take apart A further, e.g. is there a y that separates A into C and D? It turns out that this depends on what kind of analysis you used in disconnecting A from B. For instance if you used causal (Markovian) analysis to take apart preparation and measurement in EPR, the two measuring stations are hopelessly entangled, but if you used quantum they come apart very neatly. Thus *separability* and *nonseparability* depend on your mode of analysis, just as separability of coordinate dependence depends on your coordinate system.

This throws a bit of cold water on the idea that supralness is simply quantum nonseparability. In studying psychic unities or wholes, we would like to find mathematical methods that go beyond the accidents of our “coordinate systems”; we need concepts analogous to the invariant metric of curved geometry. I think that the search for invariant unities should focus not so much on states of mind as on the subject-object polarity, so that *single* thoughts and *single* things would emerge together from the amorphous flux. This is only conceivable in a much wider framework than that provided by quantum mechanics plus computer theory, and I hope that the above general theory of connections may be helpful in the search for that framework..

I'm aware that I've now opened up a topic that will take a long book to finish, so perhaps this is as a good place as any to stop.

References:

1. George W. Mackey *Induced Representations of Groups and Quantum Mechanics* pp. 107-109, Benjamin 1968
2. Etter *Arithmetic, Information and Quantum Mechanics*. To appear in *International Journal of General Systems*, special issue on “General systems and the Emergence of Physical Structure from Informational Theory”.
3. Herbert van Erkelens “Wolfgang Pauli’s Dialogue with the Spirit of Matter.” *Psychological Perspectives*, Issue 24, Spring-Summer 1991



BOOK REVIEW

Eddington's Search for a Fundamental Theory: A Key to the Universe

C.W.Kilmister, Cambridge, 1994

This book, by one of the founders of ANPA, explores a mystery in the history of science. Sir Arthur Eddington was a brilliant astrophysicist and one of the leaders of British science in the 1920's. He was one of the most important figures who brought Einstein's work on general relativity to the attention of the British scientific community. He was responsible for organizing the solar eclipse expedition whose observations gave dramatic evidence for the prediction of the bending of light as it passes close to the sun. His book, *Mathematical Theory of Relativity*, published in 1923, was recognized at the time as the definitive textbook in English on the subject. It was a model of lucid presentation. In 1936 he published *Relativistic Theory of Protons and Electrons* (RTPE), which most readers found obscure and unhelpful; some felt it was completely on the wrong track. His last book --- *Fundamental Theory* (FT) --- essentially complete before his death, but published posthumously in 1946 --- went even further toward destroying his reputation with most physicists. How could such a bright star fall so far?

Author Clive Kilmister attacks this mystery by asking and answering three questions about these two controversial books:

1. What made Eddington write RTPE (and then FT) ?
2. Why is RTPE (and also FT) obscure?
3. What important and valuable aspects does each work have?

Since a reviewer is not supposed to reveal the plot of a mystery story, I will not summarize the answers here. I urge you to learn for yourselves by reading this delightfully written volume which clarifies an important piece of scientific history in non-technical language.

This work is, of course, required reading for anyone interested in ANPA. Ted Bastin and Clive Kilmister met originally because of their common interest in Eddington's theory, and in the early 50's started the collaboration which has continued to this day. ANPA was originally founded in 1979 in order to attract more attention to their efforts to forge a new foundation for physics. As Clive remarks, ``For all its faults, RTPE remains, because of its wealth of revolutionary ideas, one of the most important scientific books of the first half of the twentieth century. It puts at the head of its statement of purpose the outstanding problem of physics --- the establishment of a sensible relationship between general relativity and quantum mechanics. An enormous amount of work on somewhat more orthodox lines than Eddington's toward quantum gravity in *some* sense of the words

has still left this problem unsolved. This suggests that perhaps the wrong question is being asked."

As those who have attended recent meetings of ANPA in Cambridge, England know, there is as yet no consensus *within* ANPA as to *what* is the right question, let alone *how* to ask it! How to formulate the problem of quantum gravity is a matter of lively debate among us, and not just in the community at large. This debate will certainly continue at the next meeting [ANPA 17, Sept. 7-10, 1995]. As background for understanding the fireworks, which should provide considerable entertainment in September, I suggest that you read the masterful outline of the situation as Clive sees it, quoted below in the APPENDIX.

APPENDIX

Excerpts from C.W.Kilmister *Eddington's search for a fundamental theory: A key to the universe*, Cambridge, 1994, quoted with kind permission from the author.

pp. 216-217

If the scale constants are prior, it is necessary to show how the appearance of other numbers can be understood. Eddington did not get so far as that problem, but he unconsciously anticipated the way ahead. For the triumphal conclusion of RTPE quoted in the last chapter, though it overstates its case, does so in this way:

"There is nothing in the whole system of laws of physics that cannot be deduced unambiguously from *epistemological considerations*."

[CWK's italics]. Now if one considers Eddington's claim carefully, it becomes clear that, if there is anything in it, questions of epistemology cannot be simply pasted afterwards onto a theory like physics which exists independently of them. If Eddington is right in seeing his theory as epistemological, and it is hard to see it in any other way, then this fact needs to be part of the theory from the beginning. The resulting theory cannot be a physical theory in the usual sense, but a theory of how physical knowledge is gained. The process of gaining physical knowledge must be part of the subject matter of the theory. Such a theory has been formulated in recent years by Bastin, Noyes and others.* It is beyond the scope of the present book to examine it in detail merely because it arises in response to Eddington's difficulties. Suffice it to say that the theory has no obvious connection with Clifford algebras but it gives, like Eddington's, 137 as a first approximation to a scale constant. Its strength lies in its being able to use this numerical value to identify the scale constant with the fine-structure constant and to carry this

identification forward to the finding of the next approximation. This further step gives 137.035... as a second approximation. The theory also gives good reason for the dimensions of space to be three and it generates in a natural way the scale constant $2^{127} = 10^{38}$. To describe these achievements of the new theory must not be seen as denigrating in any way the achievements of RTPE. Rather, it is from the basic idea of the scale constants as prior, with its inevitable consequences, that the new theory is generated, so that it can be seen as a logical development from RTPE.

pp. 219-222

* Much of this work is not yet published so a summary is given here. The basic idea is to study the process of increase of information about the world. The model of this chosen is that involved in the division between that part of the world that is known and what remains unknown. Entities may change from being in the unknown part (when nothing can be said about them) into the known part. They then show up as new mathematical elements and the frequency of appearance of such an element is the one source of information about the world. The process is autonomous, so that the requirement of quantum mechanics of 'incorporating the observer' is satisfied without the need to make an untenable distinction between observation and other operations and without the temptation to ascribe properties to human observers.

Each new element has to be labeled say as (a,n) where a is the label of the element and n is an integer stating how many times the element has occurred. The following discussion is concerned with a . It is argued that the method of carrying out labeling is immaterial, so that the process will have the same character as if it were systematically carried out with some fixed label alphabet, L . The particular alphabet $L=[1,2,3...]$ is adopted for analysis, as it can be without loss of generality. Here the symbols of L are not cardinal numbers but they are used in an ordinal fashion with the obvious ordering. The labels are strings of symbols of L or 'words in L '. The labeling requires a test of whether an element is new or not. In whatever way the process actually operates, the effect is the same as if it operated thus: S is the set of already labeled elements. The process relates S and the not-yet-labeled element; the result is to 'signal' whether the new element is a member of S . The signal is a word in L if the entity is in S . Otherwise it will have a value outside $W(L)$ (the set of words in L) and this value can be taken as one fixed value and written as 0. In all this it is the process that is taking place that is emphasized, rather than the objects taking part in it. Nothing is known about the background (by definition) and so at each stage all possibilities must be treated indifferently; and a consequence of this is that if the process continues long enough any possibility will in due course occur, which is thought of in the theory as a kind of primitive ergodic principle.

An analysis of the special case in which S has only one element, b say, so that the question of whether a is in S is that of whether a is equivalent to b , shows that the requirement of an equivalence relation mean that: (i) Attention can be confined to a subset R of $W(L)$, called the set of rows, of the form:

$$r = r_1 r_2 r_3 \dots r_k, \quad r_1 < r_2 < r_3 < \dots r_k$$

where the r_i are symbols of L . (ii) There is a map

$$\text{row: } W(L) \rightarrow R$$

constructed by removing any pair of occurrences of a symbol of L and reordering the remainder. (iii) The signal generated for $a, f(a,b)$, can be written in terms of an associative and commutative operation $+, f(a,b)=a+b$, where the operation $a+b$ is defined in terms of concatenation of rows by:

$$a+b = \text{row}(a \bullet b).$$

Because of the way in which the operation is used, it is called discrimination.

The general case in which S has more elements cannot be treated simply by testing the new element against each in turn of the existing elements of S since such a process would also need to ask, for each element, 'Has this element been tested before or not?' and so on in an infinite regress. The set S has to be treated as a whole. An analysis on the same lines as in the one-element case shows that: (i) an unambiguous labeling by this process arises only if the sets S are *discriminately closed* (that is, such that $a+b$ is in S for any two *different* a, b in S); (ii) there is no loss of generality in taking the signalling process to be defined by a linear characteristic function (because of (i)) S (using the same symbol for set and functional process). The value of $S(a)$ is in R if a is not in S but is 0 otherwise. When such functions S, T are defined, an operation $S+T$ is induced by the rule:

$$(S+T)(x) = S(x) + T(x)$$

for all x in play up to the point reached. (Here $+$ denotes discrimination on the right-hand side.) This operation between S and T also turns out to be discrimination operation but at a 'higher level'. It is therefore possible for the process to ascend to a higher level at which single elements stand for sets of elements at the lower level. It need not do so since the process is self-organizing but the ergodic principle shows that eventually it will do so.

There is a limit to the extent of this self-organization and this limit is given by the construction of Parker-Rhodes: consider any set S of R elements. These generate a discriminately closed set of $2^r - 1 = r^*$ members. Arbitrary discriminations between them will yield one of them or zero; i.e. one of the 2^r cases. To specify a member means giving r bits of information, or for shortness, each element carries r bits. The number of discriminately closed subsets generated by subsets of S is also r^* and so, in level changes, any of the corresponding r^* characteristic functions is specified by listing its effect on each member of S - r bits for each of R elements. Thus each function carries r^2 bits. A system of levels can therefore start like this so long as $r^2 \geq r^*$, which limits r to 2,3,4. To subsume a second level under the previous construction, regard the r^* elements as a subset of r^2 ones each carrying r^2 bits. Then a second level change is possible if $r^3 \geq (r^*)^*$ and this limits r to 2 (in which case a further level change is also possible). The bounding construction therefore begins with two elements. At the first stage they define $2^*=3$ discriminately closed subsets with three corresponding characteristic functions each carrying four bits. These give rise to a further $3^*=7$ discriminately closed subsets, making 10 in all, and each corresponding function carries 16 bits and gives rise to 127 more discriminately closed subsets, bringing the total to 137. Now these 127 characteristic functions each carry 256 bits but give rise to $127^* = 10^{38}$ more discriminately closed subsets, which terminates the construction because $r^2 = 65,536 < r^* = 10^{38}$.

The theory argues that the three-fold basic characteristic of this hierarchy of levels corresponds to a three-fold structure of experience (since the process is that of increasing knowledge about the world) and so the bounding construction of Parker-Rhodes demonstrates the three-dimensionality of space. The successive numbers 3, 10, 137, 10^{38} are identified as scale constants in the sense used in the text and the numerical values of them then indicate that the third and fourth correspond to electromagnetism (the fine-structure constant) and gravitation respectively. This suggests an identification of the two others with strong interactions but this seems at present less clear.

Once 137 has been identified as a first approximation to $1/\alpha$, the logical position changes. The particular scale constant is now known and better approximations to it can proceed as follows. Suppose the process is artificially constrained to be operating at the first three levels only and that these three levels have been filled. There are 137 elements and so, in subsequent operations of the process, subject to the constraint, there is a probability $1/137$ of any particular element arising again. This interprets the first approximation as a probability in the process. Now if all constraints about level are removed, so that when an element arises it is not determined whether it is at one level rather than another, then at the first level the four possibilities, of its being one of the three elements or being at a higher level, must all be given equal probability $1/4$. Similarly at the next level, $1/8$ and at the third $1/128$. The probability of being at none of these levels and therefore at the top level is $1/(4 \times 8 \times 128)$. The probability of being any

particular element at the first three levels is reduced accordingly and 137 is increased to 137.033. This second approximation is in error by only 0.002%.

The strength of this argument appears, however, when it is realized that it is not quite correct and that correcting it further improves the agreement. The point is that there are 74088 possible set of characteristic functions for the 7 discriminately closed subsets at level 2 and of these only 61772 give rise to 127 such subsets at the next level. The remainder give rise to fewer. The factor 1/128 therefore needs to be increased and a lengthy calculation shows that, to a good approximation, it should be replaced by 1/122.229 giving rise to a corrected value of 137.03503, in error by less than 0.001%.

Only imperfect versions of this work have so far been published

(Bastin 1966 [it Studia Philosophica Gandensia bf 4, 77],
Bastin et al. 1979 [it Int. Journ. Theor. Phys. bf 18, 445],
Noyes & McGoveran 1989 [it Physics Essays bf 4, 115],
McGoveran & Noyes 1991 [it Physics Essays bf 2, 76],
Kilmister 1992 [it Philosophica bf 50, 55]).

Work is proceeding very actively and the workers have formed an international group, the Alternative Natural Philosophy Association. Further details can be found in the annual Proceedings of the group's meetings (obtainable from Dr. F. Abdullah, City University, Northampton Square, London EC1V 0HB). The group is not monolithic. Some members, particularly in North America, have employed promising short cuts to derive a large number of physical constants. For example, to concentrate on one familiar to Eddington, they derive

$$m_p/m_e = 137\pi/K, \text{ where } K = 3/14 \cdot 4/5 (1 + 2/7 + 4/49),$$

which agrees to better than 0.0001%. Such individual agreements could perhaps be dismissed as numerology, but the large number of good agreements is a good defense against this. By contrast, the UK arm of the group is most concerned to clarify principle before embarking on numerical calculations and has also made considerable progress.

A letter to the Editor of ANPA WEST

from A. K. Kwasniewski,

Dear Editor;

Why should “it from bit” be some - **thing**?

Abstract Enclosed you will find my “it manifesto” ... a declaration of convictions and views on *Q. M.*, that are perhaps not only of verbal significance. This letter was written on the occasion of celebrations of the distinguished Professor Jean Pierre Vigié's activities.

“It from bit”: J.A. Wheeler

With this letter I argue for my conviction that “elementary particles” are not Micro Unidentified Flying Objects (M.U.F.O. s[1]) subject to the wave-particle dilemma.

Instead, I see them as *causal ties* among events, causal patterns (R.Haag [2]).

Instead, I see them as the names of rules discovered and/or imposed within/on that foam of self-recognition, of self-reception ... that we call *events*.

Instead these are rather manifestations of global properties, manifestations of convex set geometries (B. Mielnik [3]), which provide us with a vast family of quantum worlds in addition to the one pictured by orthodoxy.

....And even so ... even ... if we stick to the orthodox framework, then these so-called “elementary particles” are the names of operationally interpreted representations of symmetry groups (H. Weyl, E.Wigner,...) within a larger setting, symmetries of the projective geometry of infinite dimensional quantum phase space, for example.

In this connection - recalling now the orthomodular poset [4] or ortholattice (not necessarily modular) [5] approaches that started with the paper of Birkhoff and von Neuman [6]...- what is the working identification of quantum (Markov?) processes with the mathematical objects that we are to choose

- Quantum processes are sequences of words?...

Are they, then, propositions of some corresponding lattice of “quantum logic”?

- While thinking in terms of words and propositions, an analogy with number - theoretic structures might arise; especially in the minds of those who feel about our epistemological creations the way, for instance, Balmer and Heisenberg did. If so, then ... then the names of quantum processes are at the same time names for rules governing number-theoretic structures.

This conviction, which I expressed in [1], has been strengthened after reading Y.M. Orlov's paper [7]. The number theoretic character of quantum states of matter is there [7] uncovered almost to its ultimate. But is there an end?.

Similarity in [3], we are again confronted with a vast family of possibilities that originate from H. Weyl's example [8], [9] of finite dimensional quantum mechanics. Here - one degree of freedom is represented by a toroidal grid $z_p \times z_p$ i.e., by a classical phase space. Generators of generalized Clifford algebra graded by the $z_p \times z_p$ group serve then as realizations of Weyl's relations interpreted as transitive system of imprimitivities.

In such a setting, the Hanney & Berry method of quantization leads naturally to Fibonacci - like sequences labeling the trajectories of quantum states [9,10]. Hence a plan arises [9,10] a plan to treat finite dimensional quantum theories as examples of digital image processing theories.

This is to be confronted with an idea that Fourier transformed crystal or quasi-crystal patterns (...tilings...) viewed via corresponding distributions, support mind-matter identifications - ... i.e., that these are a way of communication between symmetries of matter and symmetries of cognitive images. In this connection I am tempted to attribute an intrinsic significance to orthogonal polynomials - (vide, Hermite ones that are eigenstates of Fourier transform) - for the efficient basic data structures organization[11].

Well, now for some closing remarks concerning the so called... "elementary particles" - "Particles" ? .

These seem to be - "si esset" (I.Newton)-names of specific informational-type patterns recognized and named via Fourier (Laplaceetc) analysis i.e. inspection. To put it another way -"Elementary particle" - Micro-UFO? -We would answer - ... Micro UFO is a phantom (useful for mass communication? ... then it is a *phantom-mass*!)

Finally, and again in this connection - what about the "empty wave" concept ? - what about Dirac's aether, collective excitations etc. (J.P. Vigiier [12])? In the context of my "it manifesto", I would rather like to call these *imaginative waves* ..: "waves of virtual recognition" *This or that*, and nevertheless, we feel that the way out of these and those apparently non-verbal dilemmas, ... the way out, ..., the way forward is ... in *doing*, is in *constructions*. Hence

In view of this let me end this essay with quotations from a letter to me from Mendel Sachs (1991) (1) "all of the activity in the past 20 years does not address the really crucial questions of physics" (2) "Einstein and Schrodinger believed that quantum mechanics is an approximation for a generally covariant, nonlinear field theory for closed system, not a theory of separable, interacting local things."

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Thought for the Day

“has three words” has three words

“has the property that if you write it down in quotes and then again without quotes, the resulting expression is not a true statement.”
has the property that if you write it down in quotes and then again without quotes, the resulting expression is not a true statement.

