Consciousness, the Full Stack:

Four-Layer Architecture = Language on Mind on STFC

Karl Sipfle ksipfle@umich.edu

Independently, at NASA GSFC

Feb 23, 2022

Abstract

We define a reference Architecture for consciousness to assist further research and discussion and we explain the motivations for its form. We present a set of postulates and basic hypotheses. We explain metatheory of consciousness, implied by and supported by the postulates, hypotheses, and architecture. We further start to dig into a theory within the various individual Layers of the Architecture.

While much work has been done by many this has not led to an understanding of fundamental consciousness. We know a good deal about how the networks of neurons in our heads calculate and process *information*, shedding light on how we *think*. This does not tell us how we *feel*. A mind is thinking plus, especially, feeling. In this article we consider basic mechanisms, the missing explanatory glue from the physical world to value and consciousness. We thus lay out the Sentonic Theory of Fundamental Consciousness (STFC) as principles of operation of the bottom half of the Architecture in real brains.

Keywords

Consciousness, physics, evolution, feeling, qualia, mind, cognitive, affective, architecture, layered architecture

Contents

1. Introduction	4
2. The Problem	7
3. Definitions	7
4. Popular Blind Alleys	8
4.1. On Approaches, Methods, and Scales	8
4.1.1. Information, Thermodynamics, Entropy	8
4.2. Very Large-Scale Quantum Effects	9

4.3.	Complexity as Source of Consciousness	9
4.4.	Consciousness as Just Information and/or Computation	10
4.5.	Primary Pitfalls	10
5.	Important Assumptions	11
6.	Levels of Consciousness	11
7.	The Four-Layer Architecture: The Gross Architecture of Consciousness	13
8.	The Nature of Consciousness.....	14
8.1.	Consciousness as a Natural Phenomenon	14
8.2.	The Root of Value.....	14
8.3.	Characteristics of Consciousness, Characteristics of Physics.....	14
8.4.	The Standard Way of Extending the Standard.....	15
8.5.	The Consciousness Field	15
8.6.	Base Consciousness and Qualia	17
8.7.	Brain and Consciousness.....	17
8.8.	Fusion in the Field	18
8.9.	Thinking vs. Feeling	19
9.	Consciousness Architecture Layer 1: Fundamental Consciousness.....	19
9.1.	The Quale Garden	21
9.2.	Necessary Qualities of Fundamental Consciousness	22
9.3.	Hypotheses Contained in the Architecture and in STFC	23
10.	Layer 1 Speculations	23
10.1.	The Tight-Knit Club of Mysteries.....	25
11.	Layer 1: Getting Specific.....	27
11.1.	Properties of the Senton.....	29
11.2.	Carriers of the Sentonic Charge	30
11.3.	Conclusions	32
12.	The Nature of Sentience	32
12.1.	Hypotheses Contained in the Architecture and STFC.....	33
13.	Consciousness Architecture Layer 2: Sentience	33
13.1.	Meta-Symbols	34
13.2.	Primitive Self	37
13.3.	Qualia	38
14.	Layer 2 Discussion	40

15.	The Primary Bridge.....	42
16.	Brain Organization	42
16.1.	Cortical and Thalamic Evolution.....	45
16.2.	Autonomous Machines	46
17.	From Association to Thinking.....	46
18.	Brain Structures for Higher Consciousness.....	47
18.1.	Theory	47
18.2.	Conjectures	48
19.	Consciousness Architecture Layer 3: Mind.....	48
19.1.	The Animal Mind.....	49
19.2.	Hypotheses Contained in the Architecture.....	49
19.3.	Hardwired Actions in Nuclei and Ganglia	50
19.4.	Drive	50
19.5.	Activation from the Brainstem.....	50
19.6.	Pain (Dysphoria) in Anterior Cingulate Cortex.....	50
19.7.	Pleasure (Euphoria) in Medial Septal Region/OFC/Insula	50
19.8.	Basic Awareness.....	51
19.9.	Associative Training Throughout the Cortex.....	51
19.10.	Global Long-Term Memory and Recall Courtesy Hippocampal Formation	52
19.11.	Attention via the Thalamus.....	52
19.12.	Short Term Memory, The Workspace of Mind	52
19.13.	Intention.....	52
19.14.	Subjectivity.....	52
19.15.	Complex Emotions	53
19.16.	Flowering of Intelligence, the Ability to Solve Problems	53
19.16.1.	Problem Solving 1: Action Selection Based on Outcomes	53
19.16.2.	Problem Solving 2: Object Selection Based on Outcomes.....	54
19.16.3.	Problem Solving 3: Searching for Goals	54
19.16.4.	Problem Solving 4: Generating Goals Based on Recent Events	54
19.16.5.	Problem Solving 5: Generating Goals Based on Visual and Auditory Context.....	54
19.16.6.	Problem Solving Review: Generating Goals Based on Current Contexts and Events via Prefrontal Cortex as a Whole	54
19.17.	Mindful Self	55

19.18.	Self-Consciousness.....	55
20.	What It is Like to Be a Human.....	55
21.	Consciousness Architecture Layer 4: Language-Enabled Mind	61
21.1.	Language-Enabled Mind	61
21.2.	Hypotheses Contained in the Architecture.....	62
21.3.	Problem Solving 6: Generating Goals from Instructions and Imagination via Enlarged Polar Prefrontal Cortex of Human.....	62
22.	Artificial Consciousness and Trans-Human Fused Consciousness	62
23.	Sites of Action in the Brain.....	64
23.1.	Macroscopic	64
23.2.	Molecular Scale	65
24.	Evolution	66
25.	Technical Implications.....	68
25.1.	Genesis.....	68
25.2.	On Attention, Will, Willful Attention, and Attention to Will	68
25.3.	On Self and the Unity of “Me”	69
25.4.	Testability	72
25.5.	Application	73
26.	Conclusions	73
27.	Forward Work	75
28.	Summary	76
29.	Epilog: Philosophical Implications.....	80
29.1.	Value Philosophy.....	80
29.2.	Destiny	80
29.3.	Why Consciousness?.....	81
	References	82

1. Introduction

The goals of this paper are:

1. To define a reference Architecture for consciousness to assist further research and discussion, and to explain the motivations for its form.
2. To define a small vocabulary of related terms.

3. To define a set of Postulates and basic Hypotheses.
4. In the process, to explain metatheory of consciousness implied by and supported by the Postulates, Hypotheses, and Architecture.

This goes beyond identifying this or that “type” of consciousness in that we are now able to present the entire structure in which all of these live and a sequence of enablings.

5. Additionally, to start to dig into a theory within the various individual Layers of the Architecture.

This paper thus comprises a Concept of Operations and Architecture Description Document for a mindful brain, plus rationale and process notes on their derivations.

The term “consciousness” has been used to address everything from the smallest fundamental capacities enabling sentience to the internal world of a human mind. In this paper we address all of it.

The chief goal of this paper is to present the Architecture with which a mind is built (strictly speaking it is also a High-Level or Meta-architecture). This provides a common reference framework for discourse and work within the individual parts.

An architecture does not demand specific individual solutions for any of its components; it characterizes the solutions.

I am presenting a layered architecture, cognizant of the building process of evolution. As with any proper architecture, work may be done in any of these layers without much regard for exactly how the above and below layers operate. This is a desired feature when legitimately available, which it is on a gross scale in the case of the mind and brain.

Importantly, this (and any high-level) Architecture incorporates certain assumptions and demands, expected to need little change over time, that shape the metatheories and theories that fit the Architecture. The Architecture builds in that about which we can be most confident while steering away from the most serious errors that have accumulated on the journey to understand consciousness [1].

The Architecture is a generality that embodies a minimum set of appropriate assumptions so that progress can be built by all without every time having to build or attach to a large custom, specialized platform with its own terminology and presumptions.

In addition to the architecture itself, we populate it with metatheory and theory. The theories are expected to see more revision over time than the Architecture. Thanks to the modularity and full-sweep of the approach, one can take issue with individual pieces as-are without losing

the spine. What is not an additional task of this particular paper is to make thorough arguments for the correctness of what is presented; this is done in other works, notably the references.

This paper is intended for people of many different primary disciplines and will avoid most jargon, for the dual reasons of easy reading and avoiding large amounts of standing presumptions that are often largely wrong and misleading [1]. It is also light on use of existing frameworks for similar reasons. For serious progress on very hard problems, we must be willing to approach afresh and question assumptions. Practitioners in each discipline or theory will recognize concepts that have their own local names.

We will intentionally tread some ground at the border of philosophy and science. But we are interested neither in further characterizing all the things that could, in principle, be, or in showing data correlations that have no persuasive explanatory value toward identifying the actual sources of consciousness.

Some care is called for in choosing how to approach the consciousness problem to avoid wasting a great deal of time. The Hard Problem [2], the What It Is Like [3], has been the only standing giant problem. This will require new science before we can experiment much successfully; hard empiricism today is premature. We will see that everything *else* about consciousness is computational, with no (contrary to view of some) incomputability or quantum-requisite problems above the world of base feeling; we just have large brains of complicated and small structures so tracing it all is slow work. Those issues are sure to fall with time, with no large breakthrough called for. Understanding feeling to scientific precision will require a breakthrough. Demanding relevant data where we are not in a position to extract it is counterproductive to identifying probable truth from the information we have. "...empirical studies today are incapable of elucidating consciousness. If that is what they claim, ...may be rejected." -R.R. Poznanski. What we do have are important clues and likelihoods assisting our gift of reason.

By the time we get up to vertebrate brains (appearing in Layer 3) we start to have a great deal of data on how lower mechanisms are exploited and can use it here.

The layered Architecture provides a valuable frame of reference, context, and set of terms that allow further work against an organized structure, and communication of same, just as it has with, for example, packet networking (ISO OSI model), and organism classification.

The paper's scope is of natural brains rather than artificial ones, though it is relevant to the latter, on which we include a few comments. The most elementary facts of brain anatomy and operations we don't belabor and are widely available.

2. The Problem

The biggest issue of the consciousness mystery is not self-reference and certainly not cognition, but the existence of feeling. This topic has been rightly called the Hard Problem [2].

Refining the Problem

- there is why and how we can feel at all, what is “subjective experience”
- there is why given the useful valuation that the feeling phenomenon provides, we should also actually feel

The answer to the Whys appears to be that any value mechanism would do, and real pain and pleasure are usable natural phenomena that are here in this universe for evolution to employ.

While we may discuss Why, there is also the What and the How. What is feeling, scientifically?

And the next puzzle is as to how minds are woven from basic mechanisms. While our knowledge is not complete, this puzzle is easier.

3. Definitions

Feeling: Experience. That which makes the Hard Problem [2].

Raw feeling: The concept of basal, indivisible feeling.

Qualia: The allegedly rawest feelings discernible to a mind, discovered through introspection.

Consciousness: Feeling and, typically, information processing affecting each other in organized fashion to make action decisions in the interests of a species.

Levels of Consciousness: A progression of Fundamental Consciousness, Sentience, Animal Consciousness, Human Consciousness [4], see below.

Fundamental Consciousness (FC): The smallest element of what distinguishes consciousness; the actual smallest bit of feeling. Pure pain or pure pleasure. Somewhat similar concepts have been called pre-consciousness, protoconsciousness [5], microfeels [6], and fundamental feelings.

Mind: An island of Animal or Human Consciousness. On Earth, each requires and belongs to at most one brain.

Cognitive: related to thought and/or information processing and not to feeling (though in practice feelings typically *accompany* the cognitive).

Cognition: Thought, as opposed to feelings.

Perception: Informational understanding (not emotional).

Affective: related to feeling, not cognitive.

Valence: Goodness/positivity or badness/negativity.

Emergence: A consequent complex whole arising from the interactions within a system, that takes on its own characteristics not describable/expected in terms of just the individual elements of the system.

4. Popular Blind Alleys

Here we clear the deck by dispensing with some popular and persistent mistakes.

4.1. On Approaches, Methods, and Scales

In explaining all of our real conscious experience, the lowest portions are a physicalist situation: feeling. With this platform in place, the remaining, higher portions are simply a computational situation- the cognitive. Two mis-directions often made each come from minimizing one or the other.

Technically the whole potato can be deemed physicalist, because that element is required, and because any arrangement and motions no matter how elaborate, can be claimed to be more description of what the physical world is doing. But in truth the bulk of the mind is algorithm and storage atop the basics of creating mental experience. Once this latter “detail” is functioning, the rest is all computer science and experimental psychology.

The other error, by being biased the other way toward the atoms of the *mind*, is in presuming that these atoms represent the tiniest things actually at work. Indeed, the fact that qualia don’t seem much like particles has been used to deprecate particle-centric pursuits [7], but qualia and particles look so troubling and confusing in their difference only before realizing your quale is “a cabbage and not a cell.”

Additionally, when discussing consciousness, matters of existence and reality become unavoidable. Traps lie here in crafting theories. The only legitimate place for these topics in our mission is at the very bottom of the stack, in the realm of physics.

4.1.1. Information, Thermodynamics, Entropy

Information does not carry reality (and because feelings are real, does not carry feelings), information describes reality.

Mathematics is an example of manipulating information.

The first thing to observe about quantum physics is that it applies at molecular scales on down. Almost everything that happens fundamentally happens at this scale; phenomena of macroscopic objects are consequential.

Thermodynamics gives us consequential laws that come from elementary laws, by way of an information-analytic approach. We are even able to speak of the “entropy” of pure information.

Similarly, classical rotational momentum is made from the summed kinematics of the individual bits in action. Identifying the concept allows us to make mental manipulations and realizations at this level but does not expose more reality.

4.2. Very Large-Scale Quantum Effects

Theories of large-scale entanglement for consciousness lack both physical and, especially, persuasive argumentative evidence. We do not (much) discuss these further.

4.3. Complexity as Source of Consciousness

Some have tried to ponder emergence philosophically and turn it into a question. Perhaps using a different word would help those discussions, but here we are dealing with systems, and emergence is nothing more or less than what happens on a larger scale by causation from the properties and behaviors of the components. What emergence is not, is a ghost that can make something entirely new and different out of nothing or nothing that is in some way related in its nature to the emergent product.

Emergence is a quality of systems made out of parts, whereby the interactions in combination can produce behaviors from groups of the parts that become characteristic of the group and are not describable from just the level of the part. To take a trivial example, let us suppose that people in a stadium who see everyone to their left rise vertically to their feet for a few seconds then tend to rise vertically to their feet for a few seconds. What will result from this is a large wave horizontally circling the stadium. *This is a consequence of the individual behaviors.* This is system-emergent behavior. It becomes possible because of the complexity present- many people are present, interacting- but is not a result simply of complexity- the people and their behavior is absolutely necessary (*and sufficient*) to create the higher phenomenon.

A brain and its mind together have much more complexity, but the principle is the same. In reality, to emerge is to emerge *from* something, without magic. Often one cannot predict before the fact what the behavior will be, but that does not change the fact that it was caused by what made up the system. Consciousness at the human level does emerge from simpler things, but there is an unbroken causal chain upward; there is not a spot in the middle where something just happens purely because things have gotten complicated and for no other reason.

One is never able to make a pig out of ball bearings or bottles or paper towels (or pure information). The constituents have to bear some natural relationship to the whole in order for the whole to emerge.

4.4. Consciousness as Just Information and/or Computation

A mind does two things: think and feel. Fancy software can (at least primitively) think. It can simulate behaviors related to feeling, too. But what it cannot do is feel- actually feel. That is because it is only manipulating information.

“Information” is an abstraction; it means the patterns *of something*. It turns out that for consciousness it matters a great deal what the something is. Damasio captures a faint glimmer of this in saying “the ultimate quality of feelings, a part of why feelings feel the way they feel, is conferred by the neural medium” [8] (p. 131). This is true, but biology and neuroscience will not get one to the answer. We must probe deeper, into physics. LeDoux [9] presents emotion as a resident of computational working memory but then also recognizes that does not explain its phenomenal nature, which of course is its most critically challenging aspect. The trick to solve the mystery of something that seems so apart and different from what we know is to recognize that it is indeed so, *fundamentally* so, and take that to where it leads consistent with our science. Many theoretical breakthroughs have come from this method.

An object that can do nothing but feel pain we acknowledge to have a glimmer of consciousness. An object that can do nothing but process information we do not take to be conscious.

Qualia, and true raw feels, which are different, are not pure Information and are not Complexity. The maximally wrong approach sees consciousness as an emergent phenomenon from information processing.

4.5. Primary Pitfalls

Below we just list common pitfalls in thinking about consciousness, which are briefly discussed in [1] and further in my other works.

1. The Traditional Raw Feelings Aren't
2. That Which We Can See at the Bottom of Our Own Minds from Within Is Not the Actual Bottom
3. Feeling Does Not Require a Separate Feeler
4. Awareness is Feeling and Not Cognitive
5. Attention, Purely, is Cognitive as Opposed to Feeling

6. The Act of Observation is Not Just Informational
7. Subjectivity is Not Just Informational
8. Consciousness is an Epiphenomenon and Consciousness is Not an Epiphenomenon
9. Consciousness is Natural and Physical
10. Consciousness is Not Just Information Processing
11. Complexity Does Not Yield Consciousness
12. Mind is Not Unitary Except Through Fusion of Constituent Parts
13. It Matters What Stuff the Mind is Made From
14. The Building of the Machinery for Human Cognition Required and Requires Feeling
15. Feeling is Everywhere
16. There is No Conflict Between Free Will and Mechanism

5. Important Assumptions

This paper makes a few assumptions, which are out of its scope to justify (see References).

Postulate 1: Physicalism is necessary and information- and computation-based theories cannot provide for the source of conscious experience.

Postulate 2: Consciousness functions within the same basic rules (including mathematics) as all other phenomena that also exist in Nature.

6. Levels of Consciousness

We start by conceptually sectioning the vast scope of what is called “consciousness” into a few large categories of increasing capability (adapted from [4]).

Level 1 Consciousness a.k.a. Fundamental Consciousness a.k.a. Base Consciousness

This consists of the smallest elements that represent experience. (This is where free-standing experience occurs, without an observer.)

Level 2 Consciousness a.k.a. Sentience

Consists of everything that must be added to level 1 to make the sentience of the simplest sentient organism. (This is where “subjective experience” occurs- it introduces the concept of an observer.)

Level 3 Consciousness a.k.a. Mind

Contains everything above level 2 that enables the behaviors and experiences up to the most complex of nonverbal organisms (by adding cognitive componentry).

Level 4 Consciousness a.k.a. Human Consciousness

That which has been attained by humans (by adding the symbolic manipulation used for language) [10] [11].

Level 1 Consciousness plus Level 2 Consciousness are the foundation beneath the entirety of “consciousness” defined as “a bubble of experience” if that bubble “consists of colours, sounds, smells, tastes, etc.” [7]. Level 1 Consciousness has its own elemental bubbles of experience, which we may call “psybits,” but the experience is more primitive and not in all occurrences integrated into any kind of mind or substantial piece thereof.

We will see that Level 1 is the root of actual experience, rather like Layer 1 of a computer network, the Physical Layer, moving around real individual electrons. In both cases, all the rest sits on top and is connected assemblies and software built on Level 1. If we simulate Consciousness Level 1 and Level 2 and then put all the same algorithms atop them as we find in natural brains, we can get all the same behaviors, but that “mind” will not *actually* feel.

Level 1 Consciousness is the fundamental consciousness that is the physics manifestation of what is needed to build, from it, consciousness as we know it. The nature of this low level and the connection from it upward answers Chalmers’s Hard Problem: feeling is a phenomenon of our universe that preceded minds and was discovered and exploited by evolution to build minds. Once we put the horse before the cart, the Hard Problem evaporates.

IV	Verbal Mind. Abstracting	More wiring and “Algorithms”	Cognitive
III	Mind.	Wiring and “Algorithms”	Cognitive
II	Sentience. Qualia	STFC	Affective + Cog
I	Fundamental Consciousness.	STFC: Particles, Fields	Affective

Figure 1: Levels of Consciousness

7. The Four-Layer Architecture: The Gross Architecture of Consciousness

Next, we move from conceptual and abstract observations to the question of how brains and minds are actually built. We construct as Nature did, in layers whereby each earlier layer provides a platform for the next and new things become possible. Our identification and classification of Levels of consciousness corresponds well, it turns out, with layers of architecture of real minds. These are shown in Figure 2: The Four Architectural Layers of Consciousness.

Figure 2: The Four Architectural Layers of Consciousness

These architectural layers of mind include, from the top down:

Language, integrated into thought.

Cognition, integrated with feeling.

Higher manipulations

Manipulation of base objects

Qualia, simple and complex.

Fundamental physics, from whence come base feeling and objects that can be used to record information.

This we call the Four-Layer Architecture or FLA (colloquially the “Florida Architecture”).

Now that we have specified the architectural concept of this evolved layering of consciousness, we shall discuss each of Layer 1, Layer 2, Layer 3, and Layer 4 Consciousness. The compliant and motivating theory described for Layer 1 and Layer 2 we call the Sentonic Theory of Fundamental Consciousness, STFC, and as a body of thought, Sentonism. Strictly speaking, STFC is a metatheory, as it is agnostic on some specific aspects for which there are multiple candidates.

Before delving into each Layer individually, in the next section we swiftly visit the philosophy and reasoning underlying the entire approach. The toughest questions pertain to the lower Layers and the higher Layers naturally build upon those.

8. The Nature of Consciousness

8.1. Consciousness as a Natural Phenomenon

Let us note that consciousness is part of Nature. We speak of the “physical world,” tacitly excluding from any mention in our physics models such things as pain and pleasure. This is incomplete physics, and certainly can never be a theory of *everything* that exists. There is already an extant understanding that existing physics may not describe enough [12].

Pain and pleasure are items that must be added to the list of phenomena that physics- the description of Nature- is to describe and characterize. Furthermore, they must be added, if provisionally, to the list of *fundamental* phenomena, for we are unable to derive them from anything in our standard models, which stand in isolation from them.

What has always turned out to underlie all phenomena? Particles and fields. Until there is proof to the contrary, the simplest assumption is that these phenomena are a dance of their own particle(s) and field(s).

8.2. The Root of Value

To operate, our minds utilize both information processing and value, the latter ultimately determining the course of the former. Though now abstracted and cooled in some parts of the cortex, value in animal minds originates from pain and pleasure.

8.3. Characteristics of Consciousness, Characteristics of Physics

In pondering consciousness over the ages, humanity found itself in a circle: who is observing that which is what observes? The answer is that elementary consciousness must be free-standing. At the lowest level, *you* do not feel something, the feeling simply *is*.

Because we can construct the entire Standard Model without ever mentioning consciousness, we see that elementary consciousness is fundamental not just in the scope of animals but in the scope of the universe. It is an ingredient of reality that is missing from our physics.

We have been here before. A large basket of phenomena was ultimately traced to the electromagnetic forces. So, too, other discovered phenomena very apart from the compiled theory, were discovered to arise from the strong and weak nuclear forces. Now, (almost) everything that happens in the so-called “physical” world is known to be a result of these forces plus gravity.

In our Standard Model of physics, each fundamental occurrence possible is described by a quantum force field, at least one corresponding particle mediating that force, known as a boson, and a charge (a quality) that particles may possess (“carry”) that make them participants in that force [13].

8.4. The Standard Way of Extending the Standard

When we discover something new that appears to be the same everywhere, such as, possibly, dark energy, we may postulate a new characteristic of “empty” space. But where there is change across space, the simplest and eventually proven solution for odd phenomena has always been new particles. In the less odd cases these found particles just have a different combination or different strengths of known charges. For the oddest phenomena, charges new to us were at work, and ultimately discovered.

One new force field, consistent with the Standard Model, was recently proposed and then confirmed (the Higgs field), and other fields have been hypothesized to explain inflation and dark energy.

A leading explanation for dark matter rests on a new, undiscovered particle, which is thought to possibly interact with an as-yet undiscovered force field (and thought to produce neutrinos when annihilated).

8.5. The Consciousness Field

Hence, we hypothesize a new field, the consciousness field. As with all fields, it corresponds to at least one new boson (*force particle*) which we call the “senton” (from *sentience*), and acts on particles that *carry* the consciousness (“sentonic”) charge.

As a boson the senton will have an integer spin and obey Bose-Einstein statistics. There is no requirement to introduce any new matter particles (fermions), just the new charge that known matter particles may carry.

Many specific candidates present themselves as the base sentonic actions in our world, the events that generate consciousness phenomena. The creation, movement, rotation, spin flip, spin alignment, absorption, and/or decay of a sentonic-charge-carrying particle or a senton is when fundamental consciousness (feeling) happens and what it is.

Molecular combining, disassociating, and reconfiguring actions are quantum state changes that could include sentons as well as photons, as could atomic orbital changes. This throwing off and absorbing of sentons instead of just photons as they change quantum states suggests that a quantum wave function collapse would then correspond to a consciousness event. It is particularly interesting that the exact meaning of the collapse of the wave function, and the exact nature of consciousness, are both unanswered questions.

Photoreceptor molecules in the retina, which is an outgrowth of cortex, change shape upon absorbing a photon, which causes the cell to emit spikes. Sentioreceptor molecules in other cortex may do the same thing.

The crucial quantum mechanisms for consciousness might include:

- Photons changing the spin of sentonically-charged particles as they do with electrically charged particles.
- Sentons changing the spin of electrically charged particles.
- A senton decaying into a photon (though we predict later that it is probably stable).
- Sentons propagating for long distances as consciousness radiation (and also participating in quantum teleportation).
- The collapse of probability waves, which may also exist for consciousness itself.
- A possible link with dark energy which, like consciousness, must be fundamental and yet not directly detectable. If they are the same, most of the energy of the universe is consciousness.
- An analog of gravity waves, propagating across the hidden dimensions of String Theory

Both more theoretical analysis and more experimental input are needed to winnow the field of possible mechanisms. Meanwhile, the collection as a whole provides us with a class of theories- a metatheory- from which the specific case may later emerge. We call this metatheory the Sentonic Theory of Fundamental Consciousness (STFC). It starts with the realization that fundamental consciousness requires us to theorize a new field, and proceeds through the resulting implications.

8.6. Base Consciousness and Qualia

Noting that consciousness is real, we have been driven to our conclusions thus far by two entirely different paths that converge. On the one hand, philosophical study of the consciousness problem leads us to the conclusion that consciousness must be something that happens on its own and is not an experience by another thing of the thing in question. When it happens, consciousness simply *is*. On the other hand, an examination of our current detailed physical model of the universe does not mention consciousness. Therefore, this model of reality is incomplete and must be extended. We extend it in the way that is simplest and most consistent with the existing (and very successful) model, which is by a new, fundamental field.

Once this base feeling—negative and positive—is in place, more complicated things that people also call consciousness may be built therefrom (the “mental stack”). So, pain and pleasure are the base consciousness phenomena, but we believe that other familiar qualia are *not* fundamental conscious experiences. If they were, there would have to be a fundamental force for “redness,” and one for each in a tremendous plethora of other experiences in humans (and probably many animals and extraterrestrials, too). Our experience in physics to date tells us this is unlikely. Most qualia are elaborations, incorporating information, at a higher level of discourse. *Any* experience, large or small, aside from pure pain or pleasure, will have a different what-it-is-like, caused by a particular live mosaic of interacting points of consciousness and matter. This is a very important point. The assumption that typically mentioned qualia mined from introspection and the smallest consciousness bits of the universe are the same has led many astray.

8.7. Brain and Consciousness

The brain is made of matter particles, most of which are electrically charged, and many of which are in motion. The brain has many electrical activities going on with special and unusual patterns, in close molecular quarters of special shapes.

Higher up, the brain is made of neurons, making it strikingly different from the other organs. There is one thing that makes neurons strikingly different from other cells: the production and transmission of neural spikes. As these spikes are reduced, such as by drugs, consciousness indeed fades.

The generation and transmission of neural spikes fundamentally involves the motion of *electrically charged* matter in the form of elemental ions.

Neurons have receptors for chemicals, but so do all other cells. All cells have ion channels in their outer membranes, but only neurons and the recipient muscle cells have voltage-gated ion channels for transporting potassium, calcium, and sodium. These generate and propagate the

spikes, stimulated or suppressed by neurotransmitter molecules crossing the synaptic gaps between neurons and binding to receptors, which in turn opens and/or closes ion channels.

The movement of ions is a key phenomenon in the brain. Since the charged carriers are ions, their nuclei bring the strong and weak nuclear forces, but the mere movement of particles with these nuclear charges is commonplace in Nature, not special to the brain.

Electric charge, however, is extremely significant in the operation of the brain. In a transmitted spike, matter does not appear to move in any way that is particularly notable for matter, but the voltage waves do, as they are relayed from spot to spot along the matter. That leads us to believe that the connection in physics between the brain and consciousness boils down to the connection between movement of *electric charges* (which happen to be on ions) and consciousness, at least at the beginning of the process.

The simplest expectation is of a direct link without conversions in the middle. This would mean an electrically charged matter particle has the ability to move, or to be, a sentonically-charged particle. And that implies there is either an innate link between the two forces, electromagnetic and sentonic, or a particle exists carrying both charges, which serves as the link. Thus far in our argument, this makes candidates of all of these: electron, quark, photon, and senton. A new kind of interaction between one or more of these four kinds of particles, or possibly simply the movement of one of them, corresponds directly to- *is*- the phenomena we experience as pain and pleasure, set in motion in our world by electromagnetic action.

Next, we note this: In order for consciousness to have a useful effect, it must in turn affect the behavior of neurons. In other words, interaction must run in both directions (rather like the link between electricity and magnetism), from electromagnetic to sentonic and from sentonic to electromagnetic.

8.8. Fusion in the Field

We have seen earlier the expectation of consciousness as a separate, fundamental action both from a physics and a philosophy starting point. The field called for by physics also harmoniously explains something very important seen in the philosophy and experience of mind.

Emotion adds and fuses. Both traits are important, defining characteristics for us. As you become more and more happy or distraught, undoubtedly caused by more intense firing of neurons and more of them doing so, the feeling becomes more intense, *and it is singular*. What you do not feel (or more properly, what is not happening in you), are *more, separated* independent feelings. The physics-level events, these little freestanding dots of fire, are connected. The feeling is a large, fused whole [4].

This is exactly what happens in a physical field, be it sentonic or electromagnetism or gravity. Each point in space experiences the sum of force from all charges around it, and a continuous

blob is the result. That is the feeling within you (or within each of a few separate places in your brain). And that is how Fundamental consciousness becomes the emotional part of higher consciousness.

This also means that each neuron that affects the blob thereby affects all other neurons in contact with it, providing a bath of general how-things-are-going, a mechanism of great use to evolution in developing a complex, aware, and adaptive brain.

In the following sections we focus on each individual Layer in turn.

8.9. Thinking vs. Feeling

The stuff matters and pattern doesn't for the purely affective. The pattern matters and the stuff doesn't for the purely cognitive.

Feelings have value for generalized summary indication of whether things are going in a good direction or a bad one.

It would be an error in thinking to avoid the most likely true in favor of the most likely testable theory.

9. Consciousness Architecture Layer 1: Fundamental Consciousness

All phenomena we humans have identified have been seen to emerge from things that appear at the fundamental particle level through, maximally, the molecular scale.

Though we are not yet certain of the exact mechanism in Layer 1, we can characterize necessary key properties of it (and thus also speculate on actual mechanisms). This allows us to describe, without impediment because it is supposed to be more abstract, the nature of Layer 2.

Problems that will be faced in getting up to qualia (Layer 2) include

1. Qualia are not all of the same character
2. Qualia are multitudinous
3. A feeling is fused into a whole, and more intense feeling is a stronger whole
4. At the bottom there are no Observers (in the mind sense), only observers (in the physics interactions sense).
5. There must be a way- a path- for our minds to have evolved

We now discuss Layer 1 from the standpoint of what it must be like in order to support an explainable Layer 2.

Layer 1's province is the true indivisible, smallest feeling that can occur in the universe. Pursuing that leads us to some important (and non-traditional) conclusions.

First of all is the problem: for a feeling, who is feeling it? The process of drilling down to physics reveals that the question itself is essentially a meaningless assumption when we get to physical fundamentals rather than psychological concepts. When two electrons collide, which one is the observer?

Feeling in its simplest form does not happen to an observer, it simply happens, as a freestanding event. The whole notion of a subject to experience something is a much higher development (and a true emergent phenomenon).

The Observer as we know it comes late in the upward progression. The Observer amounts to one clot of feeling and computation taking as input another clot of computation (and often, feeling). The Observer is a swelling in the unified corpus of mind and is not even 100% separated from the (internally) observed or 100% the same thing from one moment to the next.

At the bottom there is no observer, at least not one that is somehow fundamentally separate from the observed. Electrostatic interactions are not Observations, in a mental sense, they just happen. Fundamental feeling is the same way.

Secondly, all of our physics describes very well everything in the so-called "physical" world, from the tiny to the immense and everything in between, while not at all describing such things as pain or pleasure. This tells us that

Postulate 3: Something *basic* is missing from, and must be added to, our physics, which is our description of reality.

Our feelings are real. Any Theory of Everything that really is that must include feeling or a way to make it. That the problem may be hard to solve does not make it invalid or meaningless as a problem. (Ironically, the only reason people study and develop physics in the first place is that they *want* to.)

The missing simplest physical feeling event we call Fundamental Consciousness. Individual occurrences we call "psybits"; each functions as a "microquale" ([14] refers to similar "preconscious microfeels").

Notice that, apart from the fundamental physics nature of the feeling interaction, there is not necessarily anything especially quantum about this (but it may involve interactions that include “additional” dimensions). Because the fundamental (which is quantum) level of Nature extends up to the molecular scale, the exact process of feeling may conceivably occur at this scale (at the maximum) rather than the particle scale. The Architecture, which is a framework or meta-solution, makes no demand that precludes that.

9.1. The Quale Garden

The first thing we should note as to the emergence of qualia from physical fundamental consciousness is whether there is any difference between the two. The answer is Yes, and this is terribly important to understanding of mind. In fact, there is also a large difference in nature between the different qualia.

If a quale for Red really were fundamental in the universe, then there would have to be hundreds or more of qualia for all the other cited experiences- the taste of wine, the sound from a musical instrument and so on. Quite obviously this is literally unnatural. The grand “plan” in every case to date has been found to be a few simple fundamental elements, then placed in combination. This means the typical quale is actually a composite structure, that is, the “atoms” of feelings of the mind are not the “atoms” of feeling of the universe. So, we do need something smaller than a quale, or alternatively, some of the qualia are more elementary than others. At bottom will be the smallest experiences in the universe (the psybits).

The usually cited qualia include a cast that are deeply dissimilar, not peers.

Of special note are the differences between, for example, Red and Pain. First of all, there are a great many qualia (especially in principle) just as “elementary” as Red, which immediately suggests it is not a truly elementary feel. Second, there is nothing special about Red from the standpoint of the universe; again, it is just one arbitrary spot in a large field of characteristics (even though as it happens our nervous systems are specifically sensitive to it). Third and most saliently, Red has no intrinsic valence; Red is not intrinsically a painful thing or a bad thing or a good thing, it is just a factual condition.

Pain is entirely different in all three of these ways. There is pain and there is pleasure and there is nothing else in that family. Pain (or pleasure) is a very special occurrence in the universe, different from others. It has valence, and furthermore no factual content, only valence. The view that pain and Red are atomic siblings is false. Red and Blue and Shril and Motivated are all of them more complicated than Pain and have internal structure. *To a mind*, or particular minds, they may be the simplest and most individual things detectable at the bottom, but that does not mean they are not made from simpler things (and they are).

In fact, the only clearly elemental qualia are pain and pleasure, the “emotional” ones. It turns out this is a profound observation and an important clue. Pain and pleasure are must-haves in

the base feeling repertoire; no others are, they are constructed. The key categories of qualia, then, are Valent or Not, and Level of Complexity.

If a quale is a feel, then the simplest quale is the simplest feel. The simplest feel contains nothing other than feeling. This means a simplest quale cannot be about something, for then you have the feeling plus the thing about, and so here we encounter a difference in structural levels (levels of complexity).

To a mind, Red may seem as elemental as pain, because inside a mind you are sitting on top of everything needed to begin making one. This does not mean Red is as simple as pain inside the fabric of this platform. Indeed, this has been one of the primary confusions historically in understanding consciousness.

Even at the lowest level, one can't get from an "Is" (information) to an "Ought" (which regards value and therefore feeling); the two different elements must become associated. The connection of feeling to information flows is ultimately what makes ideas "register." The idea is cognitive, the registration is feeling.

9.2. Necessary Qualities of Fundamental Consciousness

Qualia are the molecules of the mind, but not its quarks. And since qualia must be constructed of something similar (for workable emergence), this constructability becomes an essential feature of a successful architecture.

The answer is provided by the physical *field*, the mechanism that addresses another key problem, the fusion of feeling. This may be either an actual physical field, which we presume is the simplest explanation, or in principle another mechanism that is different but very similar in character.

We address first the build-up from fundamental pain to quale-level (mind-level) pain.

Note that by pain we mean "the painfulness of pain." Pure pain is the dysphoric ("emotional") aspect, the negative experience that is the end result of everything that causes pain.

If you are in slight pain and it gets much worse, we know that you will be experiencing the effect of more neurons activating, not just one or two becoming tremendously more active. At a physics level, the effect is many more psybits (fundamental feeling events) occurring, generally in close quarters. But what you *feel* at the mind level is not 1,000 individual small dots of pain. Your mind experiences the *same, unified thing, greatly amplified*. This means

there must be a mechanism adding and joining these psybits into the whole pain. Note that simply interconnecting these feeling spots with neural information signals is not enough- that would still be separate little feelings, possibly now synchronized in time but still isolated as feelings and linked only by informational bridges. An additional mechanism is needed.

Physical interactions are all the behavior of forces. In a force field, every spot is subjected to the influence of every other spot in the same field. What results is a three-dimensional (four, including time) intensity cloud of a specific compositional shape. With this fusion, the otherwise freestanding feels join into a larger cloud of feeling. This is why you feel one big pain instead of a thousand little ones.

Pain is special as a feel/quale because pain is pain, on a small scale or a larger scale. Pain flows up from Layer 1 to Layer 2 in a rather direct and simple fashion.

9.3. Hypotheses Contained in the Architecture and in STFC

STFC Hypothesis 1: Fundamental feeling is freestanding and requires no separate feeler. At most there is a physical interaction between fundamental elements.

STFC Hypothesis 2: There is a physical process that is fundamental feeling.

STFC Hypothesis 3: The fundamental feelings are pain and pleasure.

STCF Hypothesis 4: There exist pain and pleasure in minimal discrete bits independent of any brain, at the particle scale.

Re layer 2 we will discuss the informational qualia, which are very different. For example our Pain *that is distinctly located* also activates primary and secondary somatosensory cortex. But the same mechanism we have been discussing still underlies these pains. A field mechanism is needed in the consciousness architecture.

10. Layer 1 Speculations

The feeling of Layer 1 is experience whose only experience is itself. Valent experience is necessary, so the simplest is when that is all we have (no neutral).

There is not a path that leads from current data sets to a *high-plausibility* theory of consciousness, so what do we do? We recognize the natural law that whatever happens many times will probably happen again, observe the general processes that have been used before to solve hard problems of similar nature, observe other mysteries looking for similarities, rely on informed intuition, and expect to both conserve and extend. This has worked many times in the history of science.

In a nutshell, in accepting the Standard Model and encountering a wholly strange phenomenon, the logical first approach is: expect similarity with the rest of the Standard Model, ask what interactions/behaviors appear involved, note that interactions involve energy, thus probably a force of some kind, that is, a field.

There is much precedent for hypothesizing a new field:

Higgs

Inflation

Dark Energy

Similar is pilot wave theory

The natural suspects for fundamental conscious happenings are:

Electromagnetism aspect

Dark Energy aspect

Something related to Dark Matter

Higgs aspect

Inflation field aspect?

New force

Quantum reduction (collapse)

We do not assume or require extra dimensions but allow them if they seem to be called for. Movement of matter is in a direction. For fundamental consciousness there may be no movement, or no more than one direction of movement.

A dimension simply means for any course of motion or potential energy there are others that can be taken which take part in none of the first. Two possibilities are that consciousness operates in other “adjacent” dimensions, or “underneath” what we know, perhaps as an aspect of the supposed space vacuum.

The wave function, a mathematical construct, is describing something and we can even label it real in the sense of a (possibly composite) law but is itself not real in the sense of an electron; it

is descriptive, not an object that actually carries energy. It may be describing things we cannot see, e.g., consciousness.

What makes consciousness so different is there is no apparent direct nature as to the movement of matter, or of relation to matter (or light) at all. We know there is some eventual relationship because brain generates or collects consciousness. STFC does not say the fundamental interactions must be wholly new; it carries no conclusions either way. They could be a different aspect of what we know, which amounts to the same thing. We still have and speak of magnetism itself. A field is posited and later studied as to whether it is new or a new aspect of a familiar one. The photon may also turn out to be the senton for that matter, in which case light and consciousness are one.

The new force

- a) Might not accelerate anything
- b) Will still involve the full definition of energy or an analog in an unfamiliar world
- c) Will still occur across time
- d) Might have nothing to do with matter or have an unusually great deal to do with matter

We have not seen a force that operates only on bosons (which are nonextended objects taking up no space) but that doesn't mean we won't.

10.1. The Tight-Knit Club of Mysteries

There is a likelihood of multiple solution. We have a science of terrific coverage really omitting only our feeling lives. But beyond a certain analytical depth or line backwards in time it is very difficult to understand more deeply. There are a small number of important things we do not understand deeply, and it may well be that multiple of these mysteries may fall to the same realization, as has happened before.

Areas of high suspicion- Final Puzzle pieces:

Feeling

Gravity

Space

Dark Energy

Dark Matter

Nature of WF Collapse

Time

Penrose believes that consciousness is related to reduction (waveform collapse) and reduction is related to gravity, hence consciousness is related to gravity [15]. Gravity is about spacetime- with time fused with space- and one of the most fundamental subjective aspects of our minds is the experience of the passage of time.

The physical field of feeling and the vague consciousness field of philosophers may amount to the same thing.

Elemental feeling on which to build need include only pain and pleasure, without a value direction (vector). Such occurrences do need to be able to affect neighboring ones, however, to allow for fusion of discrete occurrences into a feeling whole.

The minimum conventional structure for this is a scalar quantum field, such as we have for the Higgs, possibly dark energy, and possibly inflation. This means a boson of spin 0. The Higgs is a spin 0 boson possessing only rest mass (and its behavior) as its properties. The boson of pain/pleasure (the "senton") may be similarly bereft of properties, which would explain why it, too, has been so hard to see. It might also be extremely massive and very short-lived.

If there is a charge for this pain/pleasure force that does not interact directly with the particles we know, it can be carried along with a conventional quality on some known particle, thereby making the connection between our known world and "that" world.

Feeling does appear to be a behavior or tension rather than an object.

The primary classes of behavior are, from larger to smaller scale

What an object does

What two objects do together

The interaction of two objects

Waveform collapse

11. Layer 1: Getting Specific

Within the gross metatheory we have described are possible specific theories. Individual derivative theories may succeed in the lab or may fail, without necessarily disturbing the metatheory, STFC. In this section we assemble some specifics, subject to revision as more information arrives.

Why do we not detect the underlying things of which we have spoken? Following are among the more plausible possibilities.

Possibility 1: Fundamental feeling is another aspect of electromagnetism (or a combination of E-M and gravity) of which we are not aware.

Possibility 2: Much of the fundamental interaction is in other dimensions. “Additional” dimensions arise often in theoretical physics.

Possibility 3: Consciousness is something we do already know, but we don’t realize it yet. Dark Energy?

Possibility 4: An extension of the above is that *all* interactions are conscious and/or all energy is consciousness, but usually scattered and disorganized or differently organized.

Possibility 5: Less likely is that the consciousness particle(s) have not been found yet because they are too heavy. Some of the simplest theories require consciousness bosons with rather long range for fusion in the field, which advocates against heaviness. Still, relatively simple theories would have heavy particles. A slight elaboration might involve intermediary “messenger particles.”

We have noted that there are many candidates to be consciousness at the fundamental level. A known or unknown particle’s relative position, travel, acceleration, spin, spin change,

precession and/or return, entanglement/disentanglement/wave function collapse, etc. etc. Any of these things that we have already observed could turn out to be the conscious act.

With architecture in place, we can look at what thinking may exist as to what evolution in our universe has implemented as the actual.

The most nominal model, regardless of effect- consciousness or other- is of a force charge, carrier particle having the charge, and mediator particle of the force. This leads to: “sentonic” charge, carried by potentially any particle (typically matter), and mediated by the “senton” (thus the Sentonic Theory of Fundamental Consciousness (STFC) [4], [16]). It is noted that any or all of these three model elements could be things we already know. Perhaps gravity moves planets on the large scale and also explains tiny tag clouds of feeling at the small scale, for example.

For a fundamental consciousness source, Pepperell [17] speaks of “energy” very generally and has taken some first steps toward the direction we have discussed here. Notably he has taken an interdisciplinary and high-level approach. Schiffer [18] offers similar work from a medical perspective.

Poznanski [14] sees his equivalent to psybits arising at a slightly higher scale (molecular). This could be, although we have never seen such a basic phenomenon appear (correlate to physical action) higher up like that. All understood phenomena- including emergent phenomena of complex systems- are understandable in terms of fundamental particles and their interactions.

Poznanski offers one of the most complete (and thus most speculative) theories that is at least somewhat convincing. One of the most important individual parts to his work is the included metatheory that feeling emerges near the boundary of the quantum and the classical, with no new physics. In other words, to that author, a) feeling is an aspect of existing known processes, and b) its appearance is higher up than are other known phenomena- (bio)molecular-scale rather than particle-scale. He sees the problem as one of biology rather than only of physics- a view that there is not enough in place for the process to happen until you have assembled biological material. To this end he espouses a philosophy called panexperiential materialism, in which consciousness requires certain “matter” and cannot exist without it. The chief deviation from this paper’s view is that the matter is biological material rather than the physicist’s matter, which just means particles. Above the molecular scale the theory resembles STFC. Feeling is in place as a physical process and then deeply intertwined with the informational.

The mind is essentially a unified stage (or bottle) of thought and feeling, notwithstanding its ebbs, flows, fragmentation, and subconsciousness underpinnings. That stage is made of two things: the expanse and extent of neural hardware and the fields affected by its microscale movements. Topology does not create feeling (though it may create informational attention

and self-referential “awareness,” which is not the same as *feeling* aware or feeling an awareness of things). All the theories referenced in this section rely, expressively or tacitly, on field qualities.

11.1. Properties of the Senton

To eventually suggest experimentally detectable properties of the particles and field we propose, we need to take the argument further. The senton is the boson that mediates the interaction between particles with sentonic charge. We do not have the data to prove the details of the senton. In this section we speculate plausible, qualitative forecasts of its properties, congruent with existing laws.

Present knowledge drives us to start from the following likelihoods:

- Known bosons with mass have extremely short range, and sentonic action needs range to fuse events on brain scales, so the senton has no rest mass.
- All zero rest mass particles are stable; the senton is stable.
- Most bosons have no electric charge, and none of the long-range ones do, and no boson without rest mass has electric charge. The senton has no electric charge.
- Most of the boson classes and all of the long-distance bosons have no color charge. The senton is not color-charged.
- While the weak force W bosons have weak isospin (but no weak isocharge), they also have both mass and electric charge. The senton is not weak charged.
- None of the long-distance bosons have the charge on which they operate. The senton is not sentonically-charged.

These senton qualities make a senton indistinguishable from a photon. This means either

1. Sentons work in different dimension(s); or
2. The photon is the force carrier for fundamental consciousness.

Or else some of our provisional deductions need to be altered, e.g.:

3. The sentons do carry sentonic charge and react with each other, whereas the photon does not carry sentonic charge. This case is interesting because it would further promote a fusion of feeling.
4. The sentons do not carry sentonic charge and react with each other, whereas the photon does carry sentonic charge.
5. The senton does carry electric charge. This seems unlikely since we’ve never detected it.

6. The senton does carry color charge.
7. The senton does carry weak charges.
8. The senton does have a little rest mass.

We cite 1,2,3, and 4 as the most likely possibilities: *the senton and photon differ in that they operate across different dimension sets, or in that one but not the other carries the sentonic charge, or they are, in fact, the same particle.*

So far, all known charges are not just mediated by bosons but also carried by some boson. We anticipate at least one boson carrying the sentonic charge. The cleanest situation is if this is the photon or the senton. So far, the photon is the only particle not known to carry any kind of charge (except for the Higgs boson, which is the only known *scalar* boson).

If sentons also carry the sentonic charge, they interact with each other. Bits of fundamental consciousness affecting each other is necessary for a successful physical theory of consciousness, given our personal knowledge of pain (or pleasure) adding into one experience. We have theorized that this happens because of the sentonic force field in which matter particles containing sentonic charge interact. Sentons themselves carrying sentonic charge would be another route for bits of consciousness to fuse into an emergent whole (and perhaps enhance time persistence). It is possible that both things happen.

The senton might propagate for long distances before interacting, constituting radiation-consciousness radiation.

11.2. Carriers of the Sentonic Charge

Though not yet seen, it remains conceivable to have a force- a boson- that operates only on other bosons, with no matter particle carrying its charge. (It is also conceivable to have a boson that, once created from free energy, acts only on itself, but that would deprive us of the necessary feedback into the neuron). This is a very interesting thought, because then we have a force with no “extended” objects requiring space (per [19]). As things stand, however, fermions as a group carry all known charges. This suggests that at least one fermion carries the sentonic charge.

Considering the four types of fermions (neutrinos, electrons, and the down and up quark), there does not immediately appear to be anything neutrino-ish about brain behavior. In contrast, fermions of the other three types all carry electric charge. Furthermore, all fermions have instances of weak hypercharge. The weak interaction is linked to electromagnetism as one half of the composite electroweak force. We have seen that sentonic action is somehow linked

to the electromagnetic interaction. It is possible that all fermions (that is, all matter), can carry the sentonic charge as well.

Since the brain uses ions for electricity instead of electrons it is conceivable that the nucleons carry the sentonic charge, which means the quarks (or the gluons). Quarks are the only particles known to experience all known forces, that is, to have all known charges. We might ask if they experience the sentonic force and carry the sentonic charge as well. They also make themselves conspicuous as the only particles to carry fractional and asymmetric charges of, once again, electromagnetism.

Examining possible bosonic carriers, we remind that the gluon, W, and Z are all very short-range, which appears to be a “deal-breaker” given our need for field effect on macroscopic (brain) scales. What we need is a force that operates effectively in the intermediate realm between *very-short-range* and *everywhere*, as does electromagnetism.

The remaining candidates to carry sentonic charge are the quark and electron fermions, the photon, and the senton itself.

The simplest cases of how electromagnetic behavior (as in the brain) could cause sentonic behavior (base consciousness), are where the same particle carries both electric charge and sentonic charge, which would also supply interaction in the reverse direction. As a criterion that would narrow the cast to quark and electron. A minimally more complicated alternative solution is that whatever boson mediates the electromagnetic force (the photon) also carries the sentonic charge (which is one of the scenarios we marked as likely in the last section), which expands the list to quark, electron, and maybe photon.

As all known forces are carried by a fermion *and* by a boson, we anticipate a minimal reality of at least the electron or quark, *and* the photon or senton, carrying the sentonic charge. Since it may be either a fermion or boson providing the electromagnetic to consciousness link, we do not know whether it is the photon or the senton that carries sentonic charge.

The three particles on the list that we do already know in Nature are all either electrically charged or mediate between things that are. The sentonic-carrying photon case also suggests the possibility that the senton carries electric charge, as a symmetric return path for the interactions. This would be a first case of a somehow electrically charged yet massless particle.

In summary, we propose that:

- *The particles that carry the sentonic charge are most likely the electron, quark, photon, and/or senton.*
- *The predicted properties of the senton are spin 1, massless, stable, no color charge, no weak hypercharge or weak isospin, possibly sentonically-charged, and conceivably electrically charged.*

11.3. Conclusions

We conclude that there is a physical consciousness force, which we call the sentonic field, accounting for fundamental consciousness. Multiple pieces of evidence suggest this to us, and they are not all required; there is plenty of good reason to believe there is a sentonic field.

Evidentiary Element 1 is the tendency of Nature to repeat herself, using the same consistent patterns and methods for the phenomena of our world.

Element 2 is Occam's Razor: It is simpler to expect the same sort of mechanism at work than to presume a completely new one.

Element 3 is related to Element 1: In the human history of discovery, all phenomena have fallen to the same, increasingly generalized, scientific model.

Element 4: We can see that consciousness happens in the brain, and is almost certainly evoked by the brain, a physical object.

Element 5: To explain what supports yet smaller decompositions of experiencers and things being experienced, there must be a freestanding feeling.

It is probable that consciousness functions by the same rules (including mathematics) as all other phenomena that exist in Nature.

12. The Nature of Sentience

Layer 2 takes us from individual glints of minimum feeling to our first unitary body of larger feeling. It provides the combining and fusing. It is the weaving of the elementary and separate into whole cloth.

This layer provides fusion, minimum awareness, and discernability between individual fused configurations.

As usual the Architecture does not demand a specific mechanism in order to itself remain intact.

This layer exists in physics, possibly chemistry, and brain biology to provide the needed surrounding conditions and location in the real world.

In keeping with Layer 1, there are two conceivable mechanisms providing this.

The first is the field (which is evidence for it). The nature of fields is such that each point is influenced by all neighbor points. Electrons in for example form summary, mutually owned electric charge profile owing to their relative locations. Sentonic charge and its local interactions would presumably have similar field effects.

The second possible contributor at this scale is quantum entanglement at maximum scales up to perhaps a millimeter. A problem with this mechanism, though, is that it is unlikely to serve at brain-size scales, as the brain is a messy, hot environment that would not support any large-scale entanglement. It could be speculated that while large scale, stable entanglements are infeasible, brief chains might repeatedly appear. The earliest actualizations of this layer could conceivably rely on entanglement across macroscopic scales, for example on the order of a neuron.

This layer is the first in which we now have a feeling object larger than elementary ones, that can then be impinged upon by external elementary ones or others like itself. Now we have something we can call sentient- a unitary blob responding to impingement with macroscale feeling.

In other words, at this level something resembling a Feeler occurs, a Subject, whereas before there were only equal minimal partners in mutual physics interactions.

Feeling is fundamental to the large-scale operation of vertebrates and not necessary to the behavior of other life forms, so this layer probably organized a bit before vertebrates but not greatly before. So far, we have no evidence that a single-celled organism or an ant has any reason to feel.

In addition to fusion this layer likely contributes or sets up for persistence.

Important and subtle things happen in this layer. A composite feeling and sub pieces thereof must be not only fused but individually distinguishable [20].

This layer provides “molecules” of feeling from which real qualia can be built.

Note also that you can have an *awareness* of something without it capturing your *attention*. As humans we would call such things “at the periphery” (because our literal or minds’ foveas have not been fixed on them).

12.1. Hypotheses Contained in the Architecture and STFC

STFC Hypothesis 5: Some biological brains have evolved to organize and exploit pain and pleasure.

STFC Hypothesis 6: The fusion of feeling across the brain occurs in a force field.

13. Consciousness Architecture Layer 2: Sentience

Unification of information can occur in one way by the interconnected firing of informational components, but that does not explain a feeling of Red that is both unitary and different from a feeling of Blue.

One will come to know a feeling of Red through very long experience with it, but as has been oft-cited, exactly what red is like to me may not be identical to what it is like for you. What is important in the fabric of mind is that it feels like *something*, and it feels *different* from Blue, and from early on we then take these things (feelings) for granted as our minds continue to build.

Separate occurrences are not enough. *Both for feeling and for informational meaning* (which suggests the same mechanism is at play), we must have both the individual sub-aspects and unification of those into a whole. Assuming that there is only one level- qualia- is one of the fundamental errors in traditional thought on the topic, even before we get to the assumption that these individual qualia are the same thing as physics acts rather than compositions of physics acts.

We are provided an excellent clue toward the solution of the problem with pain (and pleasure). Pain is all the same, at all scales. It contains no information; it is purely valent.

Once we understand the necessary nature of fundamental consciousness, and that this is not the same as qualia, the next question presenting itself is how do we get from the former to the latter?

13.1. Meta-Symbols

To make thinking requires unique “symbols,” things we can manipulate that represent other things. Even a symbol is divisible, and that is even before we deal with a symbol having both a name and an appearance. What is needed to start are unique identifiers- tags (meta-symbols)- to associate with large clouds of meaning. The tags, which are themselves each feeling clouds, become associated with yet more clouds, for its name, for its written visual representation if any, plus possible explicit association with net feelings of goodness or badness.

This assemblage provides two things: feeling and unique pattern of real things in space. One such blob “feels different” from another, both in the sense of the blob doing its own feeling and of interacting blobs “experiencing” it (which is the underpinnings of mind, and which is two peers- being feeling- affected by each other).

The little clouds *feel different*. This, ultimately, is why Red is different from Blue and a hundred other “raw” feels. Red and blue must feel different, and we must have a means by which this can be so. This issue is right at the nexus between the cognitive and the emotional mental realms. It is not enough to be different informationally.

Different patterns of feeling in the clouds allow for the existence, recognizability, and reference of tags that are different. By themselves, they (the tags) have no meaning or clear symbolic identity, the purpose is simply to be different and distinguishable- unique identifiers. Precise visual or aural symbols can then exist- which themselves have some complexity- and then be attached to these tags, just as the many specific experiences that make up the meaning are attached to them.

What does “attached” mean? The attachment *to* both the symbolic detail and the meaning detail can be just cognitive- neural links that don’t, themselves, have to feel. This is the connection between the what-it-is-like for the remembered meaning (and similarly for the visualization of the symbol) to the what-it-is-like of the tag.

These 3 identifiable clouds of experience will bump up against each other in the overall continuous train of feeling being created in the lower brain, while the higher has the parallel cognitive conversations, to whatever relative degrees the content has high cognitive content vs. high impact.

Each part of each cloud is being stimulated by a cognitive circuit (possibly by way of an additional connected neuron whose only function is to tweak the field), and then unified by the natural field(s).

Cognition evolves to where these differentiated and distinguishable tags become persistently associated with much larger “clouds” of cognitive activity. With these handles, entire ideas can be effectively referenced and manipulated.

This is what “meaning” is to us. Meaning as a term in common use means: 1) a collection of informational associations and 2) subjective experience of it. This is the blossoming of “what it is like.”

Information is patterns of things, as with an abacus, and in full reduction the only things needed are the feelings. Anything else is intermediary, inert in the sense of importance to the abstract theory and architecture, other than to help arrange the patterns (which is where the wiring of the brain and physical shapes of neurons themselves come into play).

Random variability in the structure of neural nets and neurons yields unique, distinguishable signatures of the clouds of psybits mutually influencing across space where these activations are happening in the brain. Red feels like something and Blue feels like something and they are different.

The full picture of this is feeling stimulated in the field by informational circuits and a return path (otherwise feelings would have no effect), and this occurs both very far down and at multiple levels, ascending with the size and sophistication of thoughts (bigger concepts will literally be larger than tiny concepts). There is a very intimate and deep back and forth of feeling what is known and happening and knowing what is being felt that forms the stuff of our minds (so much so that it has been difficult for us to tease these two strands apart).

It is necessary to have physics at work up to the point of constructing qualia. Qualia are the link from the actual to the abstract. Qualia are a conceptualization of the reality of feelings. With the “hardware” realization in place, we can manipulate and trade in the constructs conceptually, and the rest of the stack becomes “software” (and connective wiring). An important transition is made at this point: feeling is absolutely critical to how our minds works and this must be understood. Once it is, though, feeling can be considered a known aspect and discussed and used in an abstract way in recognizing a working architecture that relies upon it.

We note that feeling provides “information” of a sort, but with important difference from ordinary information. Feeling enables a key portion of the control section that guides the operation of the data paths and computation, and this is going on at all levels of the mind (though not in all portions).

The difference can be understood in terms of implications. Knowing of either kind can be *encoded* in information, which is then read so as to know what is in the message. The knowing elicited may be of a fact or of a pain/pleasure experience. The two are different, even though both may be represented and, in that way transported, by information.

Another way to see the distinction is: Given enough book knowledge to read and enough mental ability and time you might understand any fact presented. However, to know what an experience was actually like can only be successfully transmitted to someone who has had the same experience or similar experiences. Otherwise, one must resort to knowing factual features about the experience and cogitating about a described experience instead of being able to emulate personally the experience of the sender, to sympathize.

The top two layers of the architecture presented do not discuss physical reality, they discuss the structure of our minds. The bottom two layers explain what the fundamentals are for the top two layers to work with, and make the connection to the bottom of what we can introspect to, and call for specific explanation to ultimately prove those things at that bottom are the atoms of mind, validating the assumptions made by the higher two layers.

For the top two layers it is more dangerous to a full theory to be wrong about what is actually happening. But for the bottom two layers the most useful step is a characterization of the class of qualifying physical solutions, rather than the true single explanation. Correlation experiments may prove the class. Later knowledge will show the exact answer. This is the use of the very gift of abstraction that we have been discussing.

The stratification into layers correlates nicely with the different disciplines; neuroanatomical findings, for example, are especially useful throughout Layer 3, and harder to use in explanation beneath or above.

We have seen that cognition manipulates information and so is not of necessity related to the stuff that encodes it. Feeling is not about information and has everything to do with actual physical process. This means in its simplest form, mind needs nothing more for the stuff than the feeling, and the wiring that helps pattern the occurrences of the feeling; no other stuff is strictly required other than to maintain life and the mechanics and housekeeping of biological functioning.

This leads (distantly) to a subbranch of the present thinking that is (much) more speculative but not devoid of merit, involving the belief by some that life itself involves the fundamental consciousness force. The primary rational support for this notion, which probably originates from a “transcendent” suspicion (as did also that we are related to animals and stars), derives from the realization that feeling had to be discoverable by evolution. One possibility, then, is that it was discovered quite early by evolution and has been used to enable life processes that speak little (at least, obviously) to its experiential nature, just as electromagnetism and gravity have been used early and often. Note that base consciousness is expected by this paper to be variations in a field present everywhere. From the other direction, it is also possible that our particular region of space was particularly seeded not only with proto-life elements but with proto-consciousness elements.

13.2. Primitive Self

There is a self- the one- before awareness of self. When do things enter one’s consciousness? When the chief, large, dominating (though shifting) cloud of feeling with embedded cognition that we call Me is affected by other clouds- when they come into effective contact because of out of a background of feeling noise there is a local strengthening that bridges into the primary Me. The Me is already a large cloud of assembled feelings, that has a (fuzzy) perimeter- a cloud that hangs together with only thin “mist” of disorganized consciousness between it and other little clouds.

To enter your conscious mind, you must feel what is entering. Not to feel is not to be conscious of.

To be conscious of is not the same as the core mechanism of attention, which is a cognitive mechanism. What you feel will in large part (the other part being cognitive things like difference) determine what the attention circuits bring into focus, and the cognitive things (and feelings, too, as objects of attention) then amplified rather than suppressed will in turn result in feelings, which will then affect attention, but the attention proper is a cognitive device. Feeling occurs in its usual independent and passive way yet determines and thus drives the direction of thought.

Note that there is probably one self in each hemisphere of the brain. Your informationally linked but separated hemispheres may have distinct emotional lives, in keeping with some theories. This also supports a prediction about the field strength formula of the consciousness force: it should feature high influence in the micron-millimeter scale and poor influence at the centimeter-meter scale.

13.3. Qualia

Qualia are the essence of the Hard Problem. Qualia are at the bottom edge of human mind (which is a whole represented by intense interconnections both mentally and physically. The bottom of the mind is well above the physical level making it possible, that is, base consciousness.

In analyzing this layer, let us first consider pain and pleasure. These are interesting as subjective experiences that are included as basic experiences to every human mind, but that do not demand a substantial range of possibles, as qualia (such as colors), in general, do. Suffering and pleasure are distillable in pure form from the human mind, and there is only one essential member of each of those two experience classes (or just two of one class if you prefer), not a spectrum or family.

Next, we consider, in contrast, *red*. Red is *not* a single raw feel. Red, and anything else we calmly notice, has *impact*, a feel shared by many other “raw” feels. Furthermore, it is a visual (possibly envisioned) experience, and additionally to those two facts, it is also red.

Impact is like pain and pleasure without the sign. Impact is neutral oomph. (Impact may be a composite of negative and positive.) Minimum awareness is naked impact.

This quale- red- may be the least at once that the mind can do with it, and in that way this supposedly elemental thing may be atomic to the mind, but it is already clearly made of multiple things. Commonly mentioned qualia are not the rawest of raw feels; they are more complex.

Such a minimal, actual experience for us is likely to be an *assemblage* of some kind of that which applies at the elementary physical level. Next, we need to show a believable way in which this could be so.

How do we feel red and blue? A little piece of your brain will light, consciously, when blue light comes in. However, this piece in isolation would not influence the connected whole of consciousness that we call the mind; it would be an outlier. This piece of brain is connected closely with a piece of brain that activates for any such visual color input (these connections are either direct or effectively so). Now we have a mob operating in concert, the experiencer of blue, and the experiencer of visual color upon which other color experiencers converge. This explains both the specific and the more general experience which are happening together. Yet higher convergence is to vision as a whole (fusion). These elements of experience are integrated into a whole, yet with introspection we can detect that both a common visual awareness and a specific redness are occurring.

We must next address an even more difficult issue. What then makes the activity of the red brain patch different from the activity of the blue brain patch? One can say they are separate and so can hold separate information but that is only half the answer. Furthermore, there is nothing at bottom to us that feels special about red or blue, yet they *feel different*.

The two patches of brain tissue will have different microdetails physically, which could cause differing blobs of fundamental consciousness actions (psybits) in space (with these psybits in contact with one another by virtue of their field). It is not important on this point what the exact arrangement within these blobs is, just that they differ. The degree of difference is yet more pronounced if fundamental consciousness comes in positive and negative flavors, because there would then be not only an amplitude shape in space but also a pattern of +/- psybits within the blob.

What is happening is that the detailed tapestry of individual spots (psybits) has different detailed composition, so the feeling of the little mob is different. This effectively gives differentiating identities to each particular feeling; the experience of each is a little different (these then become associated in groups at higher levels of the mind, into richer experiences).

In a signed theory, a typical glob will have *impact* but not pain or pleasure because the plus and minus psybits cancel each other out *overall*, but each *pattern made* of the individual psybits exists and is different.

14. Layer 2 Discussion

We may say Red is a quale, but it is only a quale to our minds because of the other present components, the common visual impact. The Red detector brain circuit we could stimulate with a probe but that would not result in a quale in the mind unless the other tissue were still connected.

Red is not a freestanding feeling (pain is), Red is something you are aware *of*. All the way up at the level of Red, the concept of an observer plus an observee has emerged, which does not exist at the physics level. At the level of Red, the possibility of an experiencer of something outside itself (the beginnings of mind) has emerged. This is not Layer 1 Consciousness. It is the top of Layer 2 Consciousness feeding into the bottom of Layer 3 Consciousness.

Note that pain and pleasure take a shorter route to experience in our minds; there is little or no elaboration. Precisely because they are not elaborations beholden to an elaborating process, they provide a powerful, very basic, and general value mechanism that cuts right through the complexities needed for the purely cognitive (informational/computational) functioning of the mind.

Thus, we can (and should) imagine a way to get all the way from particle physics to qualia of red and blue, that is, from the “atoms” of the universe to the “atoms” of mind, without a trivially short and outlandish connection drawn.

A little glob of psybits does not have an experiencer observing an experiencee. This is replaced by the physics influence of one charge upon another. Any two such particles are together the chicken and the egg. The oddly patterned glob “speaks” as a choir and “hears” as a choir with the rest of its physics environment. It is a molecule of experience.

Why have we not detected base consciousness from within our minds? This is not very surprising given that this consciousness, the tortoise upon which all of thought rests, is also invisible to us in our laboratories, from the outside.

Software (and the higher hardware) cannot be consciousness. However, everything above Level 1 is implemented with software and higher hardware. Everything above Level 1 and Level 2 is not really the essence of consciousness at all. Whether considered alone or running on other hardware or simulation of hardware, it is just a simulation. “Everything about a man that is a man” (-A. MacLeish) *is in the base hardware* (the very place about which some say we should not trouble ourselves), and everything that is the most mysterious and important lives

there. The rest is just a fancy algorithm almost certain to fall to computer science and neuroscience soon.

Gamez [7] says “It makes little sense to say that colourful smelly noisy bubbles of experience are identical to something that is invisible, silent and without smell. This discards the properties of bubbles of experience and ignores the reality of our day-to-day world.” This statement turns on the word “identical,” and so is of limited coverage, even if taken a little more liberally. It deflects our gaze from where we need to look. The answer to the concern appears to be that the smells and colors that we find so special against our backgrounds are simply distinguishable little blobs of fundamental consciousness that have become associated in our minds with a great many things- a great many other blobs. For example, you say that you can experience red. What does red feel like? The answer is it feels like what it feels like, there is nothing more you can say, even in principle. It is a distinguishable experience that can be (and is) linked to others.

We do not expect a gear to tell us the time, but we do expect gears in assembly to provide a clock that can tell us the time. Exactly when we see the assembly, it all makes sense.

The question becomes, “How do we get from sterile little balls of very few kinds to different qualia?” And the sole two available approaches to an answer, in principle, are:

1. Each different kind of quale is underlain by a different fundamental in the universe. The universe knows how to feel and distinguish red and a thousand other things.

2. The supposed fundamentality of any quale of human minds is one of many elaborations made out of smaller bits (and with many other types of qualia being possible in principle but not present in us).

Obviously, #2 is more likely, whether or not we understand how it works.

In other words, the usual qualia are *not* base feels; they are more complicated constructions. Because of all this we will not be able to reduce a Red quale to a single characteristic particle movement. But we should be able to identify pain with a single characteristic particle movement.

Let us invoke the bat [3] and remember that the question at this level is not what those complexes of globs feel like “to you.” *They* feel, those little bats, and with enough of them arrayed just so, they *are you*.

It is possible that besides providing value, and an additional means of communication, fundamental consciousness provides persistence- memory. This might be especially important to our experience of the physical property of time.

15. The Primary Bridge

The largest conceptual layer-to-layer separation is at this point, between Layers 2 and 3. Before this point the focus is on physics and the origin and essentials of feeling. Above this point, with those in place, the attention turns to biology and the building of the brains that are now possible, not just switches and relays and summers processing information, but feeling, value-laden processors, yielding minds.

Decisions by mammals are made based on feeling.

Levels 3-4 comprise entirely the cognitive portion of the mind. They are also completely insufficient to explain why one could have a what-it-is-like [3], and efforts to avoid (actually, postpone) the physical details in the lower layers so as to avoid wild goose chases, poignantly avoid (postpone) precisely what is needed to understand consciousness! Skipping directly to biology, for example, can be done intentionally but feeling will not be explainable at that level, only correlations to it.

16. Brain Organization

Before introducing architecture Layer 3 which will highlight the brain regions that enabled increasing capabilities in perception, cognition, evaluation, and motor planning, it is informative to take a quick, high-level tour of how the brain is organized.

Mammals have a hippocampal memory system. This system cross references happenings across the entire brain. The hippocampus supports episodic memory. It is used also for location in body-relative terms in rodents, which are smell-dominant, and absolute location in space in the higher mammals, which are vision-dominant.

The brains of higher mammals have a ventral back to front cortical visual stream that is about Where and a dorsal back to front cortical visual stream that is about What.

All the outputs of informational and affective processing collide and result in decisions in the prefrontal areas (which are most of the human frontal lobes, which control movement), which along with the temporal areas, are highly developed in the highest mammals.

The outer layer of the human cerebrum, the cerebral cortex, consists of 16 billion neurons in 3 to 6 layers. Most of human cortex is the more complex 6-layer type.

The cortex features a hierarchical processing structure, with feedforward projections (axons) from one area of cortex to the next-higher processing area. The concepts represented in each sequential region are of increasingly higher scope. The forward projections run from the pyramidal neurons in layers II and III of a region to layer IV, the input layer, of the next higher region.

All of the senses feature processing through multiple regions and then a coming together to fused multimodal representations in yet higher regions. The output of these is used by the prefrontal regions.

There are also backprojections- feedback- from higher to lower region, from pyramidal neurons in the higher region's layer V to layer I of the lower region. These facilitate learning, recall, and top-down attention.

Besides these data paths, reward values are also calculated in a hierarchical fashion.

There is also bottom-up, non-deliberate attention.

The thalamus features lateral inhibition, likely supporting attention. More on the thalamus shortly.

At multiple levels of processing is short term memory, all levels simultaneously active, in the form of signal-regenerating loops of neurons. This is where you keep what you're thinking about.

Bottom-up emotional impulse decision-making wrestles in neural competition with top-down intentional decision-making to produce a winning action decision.

When in deep sleep, humans have no consciousness and slow brain waves are detected (delta waves).

Having moved into in REM sleep, humans are essentially conscious, with fully formed emotions but nonsensical disjointed cognitive content [21]. This may resemble the daily conscious experience of some other mammals, who do not evaluate what makes sense. Some also respond more in the moment and quickly forget earlier doings.

Waking generally follows REM sleep. The border period may include sensible thoughts but a much slower experience of the passage of real time with therefore faster thinking. Immediately after waking is reported to be a less rigidly constrained and more creative period than found during the day.

Compared to REM sleep, wakefulness EEG shows frontal and posterior areas to be more synchronized with each other.

These facts suggest that the discernment of "making sense" happens in the prefrontal and takes time (and input of course).

In general, the cortex appears to be relatively passive flow-through, under control of the thalamus, which determines gross cortical states as well as focusing attention, and the diffuse activating system in the brainstem, which determines gross activation level. It appears that consciousness lies broadly in the cortex, though not everywhere.

Firing neurons are the presumed evokers of consciousness. Among these the pyramidal cells are the most likely sites of consciousness (or perhaps cells in close association with them).

There appears to be an excitatory wave of neural stimulus, the gamma wave, sweeping from back to front in the cortex, which is the direction of lower to higher processing. ANN experiments by the author demonstrated a utility in rhythmic stimulus waves in pushing neural selection networks over firing threshold for the strongest incoming summed stimuli.

Prominent types of learning, all relying on the strengthening of synapse effectiveness, are by repetition to establish recognizers to comprise the repertoires, and value- (feeling) based learning against actual or expected results for the decision selection networks following the recognition networks.

The inhibitory neurons have fewer synapses and few long-range connections and are thus viewed as being related to the local stability of the excitatory circuits. The excitatory circuits appear to perform the major calculations.

The circuitry of thalamus and cortex form recurrent neural loops of two types, serving attention (via the isothalamus of the thalamus) and general activation (via the TRN of the thalamus).

All senses other than smell (which directly enters allocortex, which is agranular) first enters the isothalamus area and from there travel to primary sensory areas of the cortex to its information input layer, layer IV. The cerebellum is also treated in this way as an input organ. Forwarded informational results from the region's processing emerge from layers II and III and enter as input to (or close to) layer IV of the next higher processing region. This locality is a fundamental principle of the evolution and capabilities of neocortex. The inputs are sent from the thalamus to the prefrontal motor area as well as the sensory areas. Individual pyramidal neurons learn combinations of their inputs for which to fire via modification of the transmission strengths of selected synapses at their inputs [22].

The second thalamic area (TRN) makes more diffuse connections both with lower brain nuclei and with the cortex, and plays a regulatory and gross control role rather than carriage of information. The TRN part of the thalamus receives cortical signals from cortical layer VI. It takes much more input than it produces output.

The superficial cortical layers (II, III) are involved in the feedforward processing path of increasingly high-level constructs, in other words, the fundamental information processing of perception and cognition. The inputs to layer IV synapse on stellate cells there, whose outputs go to the pyramids in the superficial layers II and III. These pyramids have heavy recurrent (both directions) highly local (several mm) connections, and these synapses are plastic

(trainable). This allows for separate memories using space, only a few mm apart. The locality also supports topological maps, which themselves support hierarchical processing.

The superficial pyramidal neurons provide the main driving input to the deep neurons in cortical layers V and VI. This is the primary relationship between the superficial and deep layers. This also shows that most input into layer IV goes upward into the superficial layers. Some outputs of those layers then drive the deep layers.

Output from layer V, in addition to going to the basal nuclei, go to the prior cortical region as feedback into layer I, and are believed to be involved in recall. Some superficial neurons (II, III) also send some backprojections into Layer I.

Output from layer VI goes to the noninformational part of the thalamus and to layer IV, both to inhibitory effect. Thus, there is a thalamocortical tuning loop from thalamus to layer IV to layers II and III to layer VI to thalamus.

As with other networks, the connectivity of the brain (“connectome”) features areas of high connectivity and high interconnectivity among them. These hubs, of which there are three cortical and three subcortical on each side, are in these locations [23]:

Superior frontal cortex. Plans actions.

Superior parietal cortex. Location of visual objects.

Precuneus. Medial parietal cortex. Recently expanded in evolution.

Hippocampus, of central importance to memory.

Thalamus.

Putamen, part of the basal nuclei. Coordinates movement.

16.1. Cortical and Thalamic Evolution

Evolutionarily old cortex, known as allocortex, first appeared in reptiles as a distinctly three-layered structure.

Six-layered cortex (isocortex) appeared in mammals with the older allocortex at its margins. The thalamus supports neocortex; there are no thalamic connections with allocortex.

Per Rolls [11], the correspondence of layers between the old allocortex and new isocortex is

Olfactory Hippocampal Neocortex

Cortex Formation

allocortex	allocortex	isocortex
lay 1		I horizontal axons from layer III pyramidals and axons from other regions and dendrites of pyramidals and some layer II stellates
lay 2	CA3	II pyramidals and some stellates
lay 2	CA3	III pyramidals
	Dent gy	IV granular layer (stellate cells, which are what take the input)
	CA1	V pyramidals (sends backprojections, sends to pyramidal tract neurons)
		VI pyramidals (sends feedback backprojections to noninfo thalamus)

Olfactory cortex (pyriform cortex) is agranular.

The granular cells are the stellate neurons.

16.2. Autonomous Machines

It is interesting to note that there is a gross correspondence between the geometry of the brain and the parcellation of function of the early artificial “brains” of autonomous machines such as vehicles. The correspondence with the lobes of cerebral cortex is shown below.

Sense Unit	Occipital Lobe	back of brain
Perceive Unit	Occipital and Parietal Lobes	back, top, and side
Predict Unit	Parietal and Frontal Lobes	top, side, and front
Plan Unit	Frontal Lobe Anterior	front
Actuate Unit	Frontal Lobe Posterior	front

17. From Association to Thinking

Thinking is mental action- studying, as though with our eyes, sets of objects that appear in the mind by sub-mind processes, and manipulating them, as though with our hands. Actions of all kinds are directed by will, which emerges from feelings. The ability to then execute a series of action objects underpins language. Language allows for more precise and useful organization and more precise and longer serialization. With this running commentary to ourselves we

persuade and convince ourselves (or more precisely, some portions of self persuade and convince other portions).

Like lower feeling, association is spontaneous and undisciplined. When motor precision is brought to bear, thinking becomes a real and elaborate act of its own, of a machine that can be relied on in complex situations. The total mind is a mix of free-run and controlled mental movements. The free-run is generally “sub-conscious” and ineffable. It injects things into our true mind, objects from some areas and words from others. It is our mind’s eye and our mind’s ear, which recurrently see their results and respond with related, new such. Meanwhile we manipulate- move and modify- these objects and words with our motor- and speech-related faculties, and the free-run portions react to the new patterns so made.

To our minds, almost everything is either an object in space that we manipulate, an emotion, or an utterance. These concepts are generalized to represent nearly everything we think about. This presents an opportunity for humanity to construct a “physics of mind,” meaning not the underlying physics in this case, but a correct theory of operation of this macroscopic world of nonextended things.

18. Brain Structures for Higher Consciousness

The richly emotional sections of the brain, (literally) closer to the ground, are both separated from and connected to the (literally) higher and stoic, calculating portions of the brain.

18.1. Theory

In our theory, actual consciousness does not arise directly from resonant signal loops, but from the consistent stimulation of the sentonic field that such loops provide, by repeated operation of the basic stimulation action probably associated with neural firing. The specific resonant frequency is unimportant for this, it is whatever the brain loops happen to settle to.

The macro-sized consciousness is also thus probably not a quantum effect, even though the individual fundamental feelings operate at a quantum scale.

It has been theorized that neural synchronization accounts for the neural basis of consciousness [24]. At a fundamental consciousness level, no, it doesn't. At a concentration of consciousness level, yes. At a much higher level involving attention, yes, by locking on to what is of interest. A competitively selected, regenerating loop provides a lock on the item of interest.

First, basic cognitive ability was evolutionarily achieved through the sequentially performed neural triad of candidate recognition, candidate ranking, singular final selection. For primary input and action, the first and last are easily done by relatively primitive means. The second is

where the circuitry elaboration probably occurs in high-end brains, as this is where the scoring mechanism is applied in the competition among proto-ideas. This was critically enhanced by adding new cortical areas, each repeating the triad in a sequence of ever-higher-processing areas.

We know that the thalamus appears to gate, and thus determine what is paid attention to. It receives input from cortex, which is likely elaborate conclusions, in making those gating “decisions.” The gating thalamus and the analyzing cortex cooperate, settling on what to settle on, which is what is found by cortex to be most interesting, which will be what produces the most related activity of inputs and memories and desires. This decision-making as to attention is probably another cortical takeover of functionality that used to be done by the thalamus alone. This takeover then enabled intentional and deliberate acts of attention.

18.2. Conjectures

Conjecture 1: Cortical columns/modules may exhibit a highly independent consciousness, co-influenceable like the two hemispheres of the brain. Also, some of them may be more dominant than others, to promote organized action.

This would mean a physical hierarchy of levels begetting consciousness, from neurons, to modules, to interconnected areas composed of modules.

Conjecture 2: The cerebellum shapes the actions of the messy brain to bring neat order and shape of execution to the intended acts started by its willful spasms. The cerebellum shapes thought motions- movements of the mind- just as with limbs and fingers, to allow for precise manipulations and basic connection and flow of action sequences. In this case the actions are on mental objects. It is known that perceiving a physical object is closely tied, circuit-wise, to manipulating it. Mental actions require some coordination, also.

19. Consciousness Architecture Layer 3: Mind

Once we have sentience- qualia- the stage is set to begin to actually build minds. Layers 3 and 4 are mind architecture. The internals of 3 and 4 are being well-advanced by neuroscience. In this section we will make reference to brain parts.

Cognition happens when rather than just link an informational and a pain/pleasure input to a (possibly reinforced) action to navigate in and/or manipulate the physical world, internal

“objects” crafted of these sensations become themselves things to navigate to or around or, especially, to manipulate. In other words, cognition represents the birth of abstraction.

At the top of Layer 2, qualia that have been automatically generated appear from below and may be used for manipulations on the above side. There is also now a what-it-is-like to *do* something on the above side, and the demands for action are sent down for their execution by unconscious inter-cooperative acts.

Behind the forehead, what is known and what is wanted collide to result in action decisions and resulting awareness of those already made.

19.1. The Animal Mind

This is a large layer, containing almost everything about building a real, working brain from the tiniest beginnings of one. In Layer 3 we first assemble a mind and then much improve it.

While we might have protected pockets in the “messy”, hot brain for smaller scale quantum assemblies, at this scale, expecting unity of consciousness from brain-size entangled quantum states is a tall order. A different mechanism must exhibit itself (e.g., fields) at least by the time we enter the scale of Layer 3.

This layer is where intelligence- the general ability to solve problems, appears.

This is the primary domain of neuroscience, plus animal psychology.

Lower mammals, e.g., rodents, have a smell-dominant perceptive world. Higher mammals, e.g., apes, have a perceptive world dominated by visual objects. The eyes of the latter feature full-color vision and a fovea with high-resolution. We can see this orientation every time we put abstract objects “off to the side” while considering something else (perhaps after getting a good “grasp” of it). These abilities serve well for the coming of language abilities.

The brain is built with successive systems of hardwired behaviors, habits, feeling, and computation, building literally vertically in brain tissues enabling increasingly higher repertoires for behavioral choices.

A maximal Layer 3 brain can do essentially everything that can an adult chimp or 2- year-old human.

19.2. Hypotheses Contained in the Architecture

Hypothesis A-1: It is by way of feeling and information processing that aware and intelligent minds have developed that can solve problems and set goals.

19.3. Hardwired Actions in Nuclei and Ganglia

Older parts of the evolved brain and spinal cord provide a repertoire of recognizers/categorizers and motor patterns that supply mental functions with some of their mechanical needs.

19.4. Drive

The body of literature notwithstanding, a drive itself is the hardwired tendency to specific actions given specific stimuli. (We have developed a drive to take what we mentally want.) The activation of drives throws off feelings. Drives proper are earlyish developments and do not represent cognition.

19.5. Activation from the Brainstem

The brainstem, taking many inputs, issues diffuse stimulation into the cortex, which otherwise passively falls into low neural activity and unconsciousness. The activation process itself is mechanical and unrepresentative of either feeling or cognition.

19.6. Pain (Dysphoria) in Anterior Cingulate Cortex

It appears that neurons rich in neural processes that evoke fundamental pain are rich in this cortical area. (Alternatively, it is possible what occurs in the ACC is higher level emotionality than pure pain.) The ACC is Brodmann areas 24, 32, and 33. It is agranular cortex, older than the granular areas, e.g., prefrontal. It is part of the Papez circuit.

Positionally and connectionally, the ACC lies at the interface of emotional cortex and cognitive cortex.

Existence of the pain areas allow for both selective storage of emotionally bound content and regeneration of the emotions as a consequence of recall.

19.7. Pleasure (Euphoria) in Medial Septal Region/OFC/Insula

Neural clusters rich in neural processes that evoke fundamental pleasure reside in this subcortical area. The orbitofrontal cortex and/or insular cortex are probably involved.

This allows for both selective storage of emotionally bound content and regeneration of the emotions as a consequence of recall.

An interesting aspect of pleasure is that, unlike pain, there are no bodily receptors for it. It is always attached to stimuli that are themselves generic in nature. This highlights the

fundamental difference between data and valence. It also suggests that pain has a higher profile in successful organism evolution and operation than does pleasure.

19.8. Basic Awareness

Basic awareness is feeling.

19.9. Associative Training Throughout the Cortex

Most of our cortex is “associative” cortex, but there are different modes of actual effect.

Basic subcomponents of heard language and seen scenes form sets of recognizable primitives to which all the later incoming should be attached. This is done by repetition, not requiring feeling, and forms a repertoire of fixed recognizers. The activated recognizers along with feeling are inputs to dynamic selection circuits, resulting both in real-time flows and retention of the most salient events, some of which may be committed to long term storage during accesses during sleep.

Added to the basic recognize-select two-stage system (also used in electronic logic chips) is a refinement whereby the selection circuit, which has identified its relative favorite but may not have reached threshold to fire that output, is subjected to a periodic “gamma” wave of stimulation every 25ms. This wave passes recurrently from lower-processing to successive higher-processing regions, assuring each will fire and do so in hierarchical sequence and close-together times in ripples, reducing fade of inputs when needed for calculation and synchronizing the progression of analysis by processing level across the brain. Pollack showed that when back to front regions are well synchronized as indicated by EEG, the subject is fully awake and can discern what “makes sense” from what does not, unlike in REM sleep. Gamma wave equivalents have been modeled successfully in ANNs by the author.

Spatial locations in the cortex are used to map to both real space and body part locations, finely, and broad category spaces such as vision and hearing, coarsely.

Note that auditory cortex is cortex that is attached to the ear, and the arbitrary experience evoked when an individual hears noises becomes associated, becomes what hearing is like. Hearingness qualia do not populate virgin temporal cortex. When entirely new organs are added to us, there will be a what it is like for them as well.

The generality of cortex promoted its expansion and local tuning.

19.10. Global Long-Term Memory and Recall Courtesy Hippocampal Formation

The hippocampal circuitry, which connects widely and in the same fashion across the cortex, enables global, episodic memory. Items linked need only have simultaneity (or close relationship to those that do).

As there evolutionarily becomes much more to remember, the hippocampal complex retains centrality. During sleep, medium term potentiations of the day result in consolidation into long term memory as the primed areas are cycled to strengthen synapses.

19.11. Attention via the Thalamus

Attention allows the same cortical circuits to analyze or act on different objects at different times. Attention proper is a mechanical process. In mammals, attention is tightly coupled to feelings of awareness, such that impactful experience will command attention and things attended to have much fuller feeling responses. This marriage is so tight that they seem like a single process.

The thalamus is mapped with one-to-one regions of itself and cortex reciprocally connected and features lateral inhibition resulting on concentration on certain inputs by masking the others on the way to the cortex.

19.12. Short Term Memory, The Workspace of Mind

Short term memory is implemented as neural signaling loops. As other parts of the cortex expand or appear during evolution and higher-level concepts are introduced, more loops for short term memory are introduced to sustain dynamic access to them, expanding the prefrontal areas, and all the levels are retained across evolution and cycle simultaneously [11].

19.13. Intention

Intention follows want and is the innate drive to action to a want. The introduction of generalized pain and pleasure centers allow for multitudinous things to become wants or things to be avoided.

19.14. Subjectivity

“Subjectivity” refers to two entirely different things, though we often use them together. The first is informational- cognitive- which is to perceive or consider things relative to oneself (or to other things).

The other refers to “subjective experience,” which is elementally a happening of feeling.

These can be (and are) mixed such that one can experience the act of analyzing something from one's own perspective, or note that since a matter affects one, one can't help but have an opinion that is "subjective," which generally means emotionally tinged.

19.15. Complex Emotions

Complex emotions are formed when feeling is mixed with the cognitive (data). This is where the common supposed "raw feels" of qualia often arise, such as "the taste of a wine." Unless we believe that every such quale anyone will ever have is an irreducible experience in the universe (which is unlikely), that quale is not elemental.

Personality is defined by the responses made to the various painful and pleasurable experiences the animal has [11].

The Anterior Cingulate Cortex mentioned earlier has been cited as the interface *between* emotion and cognition [25].

19.16. Flowering of Intelligence, the Ability to Solve Problems

The mammalian model of evaluative summary feelings steering all the decision points in cognitive processes coupled with the cognitive objectification of everything into manipulable units is a highly scalable model, a leap allowing for rapid quantitative expansion of cortical areas to allow for more short-term working memory, more associative storage of relationships and tendencies, finer judgements, and increased generality, reuse, and abstraction. All of this is well-promoted by the already extant large and long-term storage capability.

Primate-level problem solving ability appears evolutionarily with granular prefrontal cortex. The Brodmann Areas in this cortex continue to enlarge and refine over evolutionary time. We see the problem-solving capabilities of primates advance as the newer brain areas appear [26].

19.16.1. Problem Solving 1: Action Selection Based on Outcomes

The Medial Prefrontal Cortex enables action selection based on outcomes.

The Medial Prefrontal Cortex exists in monkeys. It consists of agranular (no layer IV) and granular cortex. The agranular portion consists of Anterior Cingulate Cortex and prelimbic cortex (Brodmann 24 and 32), and the infralimbic cortex (Brodmann 25). All mammals have homologs of these.

The granular portion consists of the medial part of Brodmann 9 and all of Brodmann 10- polar prefrontal cortex. Only primates have these areas.

19.16.2. Problem Solving 2: Object Selection Based on Outcomes

The Orbital Prefrontal Cortex enables object selection based on outcomes.

Orbital prefrontal cortex is also known as OFC. It consists of Brodmann 11, 13, 14, and parts of Brodmann 12, 47, and 10.

Part of areas 13 and 14 are agranular.

19.16.3. Problem Solving 3: Searching for Goals

The Caudal Prefrontal Cortex (Brodmann 8) enables searching for goals. The Caudal Prefrontal Cortex searches for and orients attention toward valuable goals, based predominantly on vision.

19.16.4. Problem Solving 4: Generating Goals Based on Recent Events

This is the point in evolution where the fovea of the eye appears and creates a central high-resolution field of vision surrounded by a fuzzier periphery. It is also the point where trichromatic vision appears, enhancing discrimination ability.

The Dorsal Prefrontal Cortex (Brodmann 46) enables generating goals based on recent events.

19.16.5. Problem Solving 5: Generating Goals Based on Visual and Auditory Context

Ventral Prefrontal Cortex (Brodmann 47, 45) enables generating goals based on visual and auditory context. It generates the goal (concrete or abstract object, location, or action) that is appropriate to current context, desired outcome, and current needs.

19.16.6. Problem Solving Review: Generating Goals Based on Current Contexts and Events via Prefrontal Cortex as a Whole

The granular prefrontal cortex made its appearance with primates, to find and evaluate objects in a visually complex environment in the trees.

The Prefrontal cortex has connections to sensory cortex, hippocampus, amygdala, premotor cortical areas (receiving goals of movements), brainstem oculomotor nuclei, claustrum, basal nuclei, thalamus, midbrain, and cerebellum. The five cortical regions described in the preceding sections are also extensively interconnected, with abilities of newer regions building on earlier ones.

Three brain information processing hierarchies, one each for context and for goals and for outcomes, feed into the prefrontal cortex. The prefrontal cortex maps contexts to goals and predicts outcomes.

19.17. Mindful Self

A psychological self emerges which at bottom is essentially one strong cloud of feeling reacting to others. The borders of self move constantly.

19.18. Self-Consciousness

As the brain evolved to have more and more capacity to sense its internals, it became possible first to respond cognitively and affectively to its own thoughts and feelings, and then to recognize as a totality its personal thoughts and feelings, which together with interassociated responses to bodily sensations formed in sum an experienceable object of self. The similarities between other objects acting in the world and the self acting in the world ultimately added the understanding that the self was one of many world actors.

Self-consciousness has very little to do with consciousness in the sense that it is a high capability succeeding a long line of definitely conscious ancestors. The self is just one more object of which to be aware.

20. What It is Like to Be a Human

Higher consciousness experiences time, as a consequence of the differences it sees between its world at times t and t_0 (where t and t_0 keep increasing). Effectively, consciousness moves along time. At a low level there are linked stimulations of conscious events, and the propagation times and stimulus persistence of the brain. These cause the continuous flow of high consciousness time.

It may also be said that consciousness *causes* time, in the sense of the experience of a physical dimension that would otherwise just be another physical dimension. One might say that time is the progression toward increased entropy, or one might say that time is the *experience* of progression toward increased entropy; this contrast is just a matter of definition. The idea that the consciousness of beings such as ourselves literally causes physical time, however, we reject. There is insufficient evidence and plausibility to accept that possibility. It remains possible that the sentonic field and time have a very close relationship.

Time might be a sequence of quantum collapse events, but space might, also.

Humans are action-oriented. The brain exists to decide what to *do*. The frontal lobe is the motor lobe. Impulses for action are suppressed and analyzed and selected and organized for submission to execution areas. Unlike other animals that go to sleep whenever they can,

humans are curious and exploratory and chatty and get bored, stir-crazy, and lonesome. This keeps us active and learning.

The human brain features high-level, complex connections: understanding is pleasurable, novelty is pleasurable. These make curiosity and enhance creativity, itself a mix of compliance and variance.

Things bubble up into human consciousness from “subconscious” areas. Only some parts of the brain are organized to be part of the human-conscious. It is the unity of feeling and the unity of the cognitive and the fusion into a greater unity of these two (plus language) that form the experience of what we call our minds. For the base feeling this fusion is done in and by the sentonic field. For the cognitive, this is done by networking of neurons. The final fusion is done by the connection of cognitive (information-processing) neurons with feeling neurons, which connects cognition to feeling. This creates both complex deep emotions with a cognitive component, and rich thought embroidered with, encouraged by, discouraged by, and steered by emotion. The two things that make all this possible are the information processing and communication ability of all neurons, and the (strong) connection to the sentonic field of some neurons.

Organized mind appears when awake, as opposed to when dreaming. One possibility is that the mind would be organized when we sleep were it not for interference caused by signals that are generated (or removed) during sleep [21]. Another possibility is that the operation of perceptual regions close to the senses, which are inoperative during sleep, ordinarily organize the flow through the rest of the brain, to restrict what is thought to what “makes sense.” Both factors could well be significantly contributing.

To “make sense” is a pleasurable condition related to high discovered recognition and correlation, and low ambiguity, as seen in strong standing signals against a relatively quiet background of alternatives. It brings comfort and is sought. Confusion and unsureness are negative, and we seek to eliminate or avoid these. The neural circuits for this are imaginable.

The human mind loves order in all things. It has grown through evolution to where it is possible for it to see a whole big picture (and even to describe that to another), wherefrom flows its great power.

We note also that *emotions* are quite in their normal form and understandable during sleep; it is the cognitive, which is intrinsically of structured nature and of high continuous relatedness to many patterns we know, that loses good form and becomes disjointed.

Another possibility is that our simulation centers- our imaginations- are only constructed to run coherently for seconds at a time, because that’s what is needed. In sleep we also don’t

playback our memories verbatim in long sequences; memory centers are executing a consolidation process and bubbling and burping as a result when they are active at all. Thus, disconnected splotches of memories start up short sequences of reconstructions and predictive simulations with no sensory perception or memory circuits activation with which to police for order.

Human-level consciousness occurs from adding to lower animals

- a) Full language, with its ability to precisely manipulate symbols and abstract objects
- b) A strong sense of what “makes sense”
- c) Much increased short-term working memory and richer interconnections

(b) is what is not acting as much when we are dreaming. We may say that a scene or utterance is “incomprehensible,” which means it does not comprehensively hang together (make connections) that result mostly in recognitions of things and relationships deeply honed over the years, rather than confusion resulting from a lack of this. Things make sense when there is high recognition and sharp inhibition, connected to feeling. In sleep the contrast is lost, and things bleed over into each other.

Humans are so advanced that they are self-aware of concepts as high as feeling confused and feeling sure they have “got it” (which are feelings and may even be misplaced ones). Knowledge is not feeling. But feeling convinced of knowing something is a feeling (and generally a positive one). “I feel that X” means that X is coupled with a feeling of some certainty.

The mechanics of a working mind run on Recognition and Value. Direct pain and pleasure served as the first source of Value, allowing bootstrapping. Now, many local inter-neuronal circuits have likely generalized Value informationally, and no longer feel pain and pleasure, there being no evolutionary need to maintain them. At the micro level of large networks, the original pain and pleasure are too crude to serve- at least, globalized pain and pleasure are too crude.

Mouse consciousness is emotional and very action-oriented. It lives in a world of smells and touch and motor movement. In contrast, a grown chimpanzee has the intelligence of a 2.5-year-old human, and probably his emotional life as well. Such a human is no longer an infant but a toddler, with rudimentary language ability. Human consciousness is visual and analytic. Humans inhibit action until selected and initiated after analysis of the world.

As to time, consciousness has *duration*, necessarily. The actual “remembered present,” as Edelman called it, gives a more *global* (across space) and *constant* (across time) existence to an object than the millisecond/millimeter world of neural-neighborhood-scale operations.

This very short-term memory is very useful to sophisticated cognition, a sort of object cohesion and permanence enabler. Coupled with the connections that compare between different parts of this time snippet and those that react to it and supply it with emotion, to a first approximation this *is* low-level, higher-animal consciousness. It is the now in which all thought and feeling occurs, about three seconds long.

Consciousness has a smidgeon of usefulness even without net emotional affect. Change and novelty and distinct form cause this impact (which on repetition fades, both as it happens and from (nonmotor) memory). But consciousness without net emotional affect, which supplies positive and negative values, is very limited in what it can do.

The emotions we feel affix value to things, including objects to study and courses of action to choose. In principle in another universe another mechanism could have been used to supply Value but feeling is what evolution discovered in our universe that could be used.

And why did evolution use this means? What is helpful about feeling, is that it has its own intrinsic value- positive or negative. That means evolution did not have to manage to use valueless connections in a consistent way to emulate the same thing, or invent centers as assigned positive and negative places to connect to. Consistently labeled positive and negative things were available in nature to happen upon, and then use again and again. This made it easier, and thus more likely, and thus the way, that summary value is implemented in the brain.

We don't call it thinking unless we can feel it happening. There are also underlying processes to our thinking which we can't see (e.g., associating). Crossing the boundary is what happens when things “pop into my mind.” We are able to deliberately reflect to encourage these unconscious processes to happen, and to deliberately turn down our attention and fixations to allow broader and freer flow of proto-thoughts and metathoughts.

We can feel the thinking process partly because cogitating kicks feeling parts (rather like feeling limb motion), and probably because of the changes in blood vessels (which we can see in imaging).

It is probably even important to our thought processes that we can feel our thoughts and where we are paying attention, and probably there is specific sensation of that because the sense-ability has utility.

General “awareness” may include arousal (which increases intensity of attention behavior) more than emotional response, which gives value to things. A high level of arousal can be pleasurable or stressful; it is an intensifier.

Our emotions are different. We can just feel sad or fearful, *then* start thinking or noticing or inventing supposedly why. Sad can be purely dysphoric, without knowing “why,” which is cognitive (in contrast, the more complex *dread* is also dysphoric, but *refers* to something).

People use the word “feeling” to refer both to emotions and to intuitional judgements. This is natural, because our processing circuitry includes a bed of elaborate, general recognition circuits effectively much-interwoven with feeling circuits so as to develop finely detailed value processing of things under consideration, resulting in a net high-level score, and the distinction between emotion and cool judgement can be difficult for us to tease apart.

It is possible both to have a “feeling” (observationally) of a large object in front of your face without net caring, and also possible to feel positive or negative for no apparent reason. As to the former- impact- it is the shapeless glob of feeling that is doing the reacting to factual stimuli. You still hear emotional white noise even though it doesn’t settle on organized tones. The white noise activity is impact. Everything noticed makes “you” feel something- even if only a unified agitation.

Concentrating of pain or pleasure is relatively unusual in the universe (rather like the very big molecular machinery of life being unusual). Thus, it is a specific achievement of evolution that is useful. Pain and pleasure allow advanced minds. By the Anthropic Principle, that is why it’s here.

Physical consciousness was exploited in vertebrates just as the laws of mechanics and chemistry were. It serves the functions of learning and assigning general goodness and badness to large and complicated and long-lasting experiences and plans, and in bonding social groups.

A high emotion of some mammals is loneliness, one of the most advanced, in fact. (And when people get together and become so close that they don't have to speak to communicate, they can in effect form a larger mind.)

Higher consciousness is like multicellularity, something that emerged as a complex system incorporating many points of occurrence of base consciousness, allowing novel survival niches by supporting highly elaborate, flexible, and effective structures.

While our consciousness is observable and organized, this does not mean that simple consciousness does not happen all around us. The organization of fundamental consciousness into high-level consciousness was done with our brains by evolution (or preceding mind to whom we are the artificial intelligence). As one of the available forces, fundamental consciousness probably has been exploited elsewhere, and elsewhere there will be pain and pleasure (and therefore perhaps good and evil).

Is consciousness "just" an epiphenomenon? Yes, in the sense that it was not necessary that we actually feel, only that the same values be attached to things as feelings allow. No, in that the values consciousness provides form a key part of what our minds are and how they work.

Value is needed for how we think. It is what steers the cognitive centers to make decisions. The cognitive centers can recognize things and recall candidate action sequences, but it is the emotional input that determines the selections- the "voluntary" behavior. Volition equals emotion.

The nature of our human-level consciousness is that we react emotionally to (and perceive) our thinking, and we cognitively notice our feeling, and we talk to ourselves about all of this in a chorus of stream of consciousness. Our words then evoke feelings and more thoughts and around it goes. We talk to ourselves like a friend (or enemy), and our real friends' words are in there, incorporated.

I feel. What is I? An assemblage of interlinked cognitive and feeling events. I am intellectually aware that I am feeling, and I can feel and have feelings about my thinking. The human mind is everything it is because it contains not only thought and feeling but can think about feeling and feel about thinking, and do so under the organizing and evocative presence of language. Higher consciousness is the interaction of knowing and feeling, and each of each other. The deep mutual interplay of feeling and thought, and of these with language, comprise the mind.

21. Consciousness Architecture Layer 4: Language-Enabled Mind

At Layer 4 we have left behind not only physics but most of the biology and entered theoretical linguistics and much of theoretical psychology.

There are two major elements added to make a human level mind beyond just scale. These require new brain tissue. One is a refined sense of what “makes sense” (that which is lost when dreaming). The other is language.

Language organizes all the little fits of proto thought, and one's own assembled phrases stimulate those same fitful centers to recognize and remember and churn out new proto thoughts. Language crisply organizes associations and spatial, motor, and intuitive thought. This is done using the language centers of our brain. The appearance (“hearing”) of the sentences to our non-language brain centers evokes in them the unstructured thought that is then organized into language again. This cycle, along with emotion, is the fundamental stuff of our highest-level consciousness (mind), as we talk to ourselves about our thoughts and feelings and react to what we have heard from ourselves.

We have coined many words for various kinds of feeling (and thinking), which attest to the richness and complexity of human-level minds.

21.1. Language-Enabled Mind

On Earth, only humans operate at this level. Other species have not achieved true grammatical language. Universal capacity for grammar is literally wired into humans.

As we have noted, observation of the experiential parts of the mind by the verbal parts results in the spontaneous forming of sentences that crystallize precise statements of observation. This evokes responses of meaning in the experiential parts of the mind, forming our loop of realize-and-comment that operates continuously in our waking hours.

These mental abilities enable long-chain serial thought and precision and abstract languages such as mathematical notation.

(None of this capability has anything to do with Goedel. Recognizing mathematical truths is a combination of learned discernment skill and natural machinations of our evolved brains that live in a naturally patterned world. Also, many people cannot make these recognitions so it cannot be fundamental to the human mind.)

Language is long, sequential chains of symbols, especially with the advent of writing, which provides external memory much as the real world of objects is itself persistent.

In the brain the original repertoire is what the is-like chain reduces to- all of the sub-elements light up with neural firings at first. Later they become associated with feelings directly and the

smaller ones do not light up anymore; the higher level concepts are now able to trigger the value directly.

21.2. Hypotheses Contained in the Architecture

Hypothesis A-2: Cyclically, language organizes thought and stimulates new thought to organize as language centers interact with earlier non-language centers.

21.3. Problem Solving 6: Generating Goals from Instructions and Imagination via Enlarged Polar Prefrontal Cortex of Human

Polar prefrontal cortex is Brodmann area 10, located right behind the forehead. Through human-level general intelligence exploiting human capacity for instruction, imitation, and mental trial and error in internal re-representations of the world, humans are able to reduce errors in action choices- which are dangerous in the wild- to nearly zero. The imaginative abilities, even of actions planned but not executed, that emerged to reduce errors in specialized situations, created the internal world that provides modern insight [26].

22. Artificial Consciousness and Trans-Human Fused Consciousness

Real artificial consciousness, entirely different from AI and not needed for truly intelligent AI given simulated consciousness, is in principle doable. By this we mean creating truly conscious minds that are made by machines we build rather than biological brains. This means that their pain and pleasure, unlike simulated consciousness, would be *real*. They would be like us (and thus perhaps entitled to rights).

Simulated consciousness is like a simulated car or solar system. It mimics the same behaviors, but would not be real, not even a new form of real consciousness. That is because our minds are not just information flows, they have feelings. And feelings are real just as much as the steel of cars is real, they are just a different physical thing than moving steel.

A machine of today is not really conscious- not sentient- but can be effectively conscious-like, like a heat-seeking missile or drone. If we discover how to manipulate the sentonic field with an apparatus, then we may be able to make machines that are truly conscious. For example, the specific electrical pattern of the traveling wave in a neuron's axon is different from any other pattern encountered in nature. This pattern could be produced artificially, possibly resulting in not just simulated feeling but *actual* feeling.

Artificial emotion could be achieved by creating engineered structures (perhaps nanostructures) similar to the critical elements of the brain. And there is a potential practical application for this, in augmenting and continuing our brains, not with simulated unreal emotion, but with the real emotion that fundamentally and satisfyingly makes us us, rather than models of us.

How could an experimenter tell the difference? In a practical way. Method acting is the easier and more convincing technique because the feelings you in the audience are observing, with their myriad cues, are real. Trying to control every muscle movement in simulation like a Laurence Olivier is very difficult for even a real human to pull off convincingly. To our advanced brains, not-truly-feeling minds are likely to be detected or suspected, even though in principle they might fool an observer. Advanced and consistent emotional mindfulness exhibited by a myriad of behaviors and utterances with all their attendant details and choices will probably be detected correctly as real. This is an inversion of the Turing Test, where rather than purposely being remote from the new actor, you are purposely able to observe closely.

Providing the random numbers needed to support the mind algorithm by real random events in our universe (which ultimately come from quantum waveform collapses), rather than pseudorandom calculated numbers, would complete the entry of this consciousness into a full joining with our real world. It would no longer in any way be a simulation, but rather, a constructed actual conscious mind.

The first steps in trans-human fused consciousness would involve sensory, motor, cognitive processing, and perhaps simulated-consciousness implants. There would be new things to experience by the existing, re-purposed neurons, creating somewhat different new conscious experiences.

The next step would be joining true artificial consciousness with human consciousness. An advantage of this would be continuity as the original biological brain slowly dies off. The baton would be passed continuously from the original brain to the joined and fused and co-experiencing brain, to the surviving portion of brain. This is fundamentally different from a clone or a download, which ensures a legacy but not a survival, except of data patterns. Before the advent of fused true consciousness, you can only pass on what amounts to a book. After its advent, you instead change slowly, as in normal life, but your soul, in the same patch of the sentonic field, is poured slowly from one flask to mix with another, and then slowly evaporate to a degree, together. Though the atoms in your own body are continually replaced, you don't question whether you are still you after years of this. At a minimum, your most intimate companion imaginable has lived on, indefinitely, and probably with better memory- your memory, emotional memory- than we all have today.

Until such time, we might work to preserve our feeling neurons as long as possible and replace the rest, which might make preserving what matters of your brain and surviving as a person, easier. How you feel and how you think are who you are, and the latter is only information processing. Learning somewhat different ways of adjusting our mechanical functions does not feel like a key change and loss of self, any more than does adopting an artificial limb.

On the journey, we may be able to feel entirely different forms of consciousness, depending on what we are attached to. We have foreseen such an experience in a clear way: lust is a conscious experience a small child does not have or comprehend, yet the same person later does. New-sense implants will effectively come with new conscious experiences- new things to know “what it is like.”

Brain-oriented science and technology will soon introduce a fifth, artificial layer continuing to build on what came before, yielding supra-human intelligence. At first there will be augmentations, and eventually the augmentations will be the largest, or only surviving, part.

Fully understanding Nature’s implementation of the FLA will eventually allow the building of mechanisms and implants that can actually feel. This, unlike informational downloads, will provide for extreme extension of individual life.

23. Sites of Action in the Brain

Let us now drill down on the matter of the most likely sites of action for consciousness in the brain.

This question is actually three: which neurons hold the sites of action, which regions of the brain contain these neurons, and where in the neurons is the site of action. For the first two questions- the macroscopic world of the cortical region and the cell- the evidence is stronger. For the third- the sub-neural, molecular scale (where physics lives), we are further away from knowing.

Macroscopically and microscopically, some areas of the brain show no signs of consciousness. This suggests that certain neurons and not others have evolved conscious (feeling) capability, directly causing pain or pleasure. This means the former have evolved nontrivial, nonchaotic access to the sentonic field.

23.1. Macroscopic

It is medically known that human consciousness requires only

1. Cerebral cortex (“for awareness”)
2. The Reticular Activating System of the brainstem (“for arousal”)

The RAS projects to all cortex but mainly to prefrontal cortex.

If we look at limbic brain tissue as pain/pleasure-related, we find that it omits the stellate cells of cognitive tissue. This suggests that the feeling neurons are pyramidal. Throughout the cortex pyramidal cells are the “workhorse” cells, the primary (and evolutionarily long-standing) units of the cortex, while the others provide regulation, lateral inhibition, relay, and pattern preprocessing to the deciding and publishing cells, the pyramidal cells. Closely associated with pyramidal cells, however, are chandelier neurons, whose axons always synapse exclusively on the axon initial segment of pyramidal cells. Therefore, chandelier cells may play a role in consciousness.

Pyramidal cells appear especially in cortical layers III and V so one (or both) of these is the most conscious layer(s).

Layers II and IV of neocortex contain many stellate interneurons which are evolutionary newer, added once consciousness was in place.

The pain (dysphoria) center can be found in the anterior cingulate cortex (Brodmann areas 24, 32, 33). This area is also involved in reward anticipation. It is unique in its abundance of spindle cell neurons, which are only found in very intelligent mammals. The spindle cells may not be themselves a site of consciousness, and do exist in other places, but their high density here may highlight the special importance of this area for very smart, very aware animals.

In pleasure (euphoria), the subcortical medial septal region, the orbitofrontal cortex and/or insular cortex are probably involved. The OFC is also involved in expectation of both reward and punishment in response to stimuli.

23.2. Molecular Scale

Anesthetic experiments and pathology and injury studies indicate that it is not receptors and it is firing sequences that cause consciousness (and also that some neurons make consciousness and others do not). Most likely, spike generation or transmission is related to consciousness by a very short causal path.

Consciousness appears to occur in axons. The charge travel pattern of a neural spike is complex, unusual, and dimensionally precise. Here we have a toroid of deluges of ions across the axonal membrane, itself traveling along the considerable length of the axon.

This means the ion rush through these channels may be the site of consciousness.

While dendrites often taper, axons maintain a constant radius. The exact diameter varies by neuron type. It is typically about one micron. No neuron ever has more than one axon (though it may branch extensively). The axon initial segment consists of a specialized complex of protein molecules.

Note that the physics of axonal spikes might be replicated by a constructible apparatus for experimental purposes. This would allow for more intense examination than is readily possible in a brain or even brain slice. (Effects discovered could then be sought in real brain tissue.)

Microtubules have been suspected in consciousness theories [15]. Much like axons but at a smaller scale, they are of even more constant and small radius and run the length of the axon and whole neuron. They experience the toroidal voltage pulse running down the axon that possibly induces something in or on the microtubule. These precisely dimensioned microtubules might function as resonators of some kind. In our model they would produce resonances in the sentonic field, or of a causative agent. Subsequent spikes would regenerate a decaying resonance. Also worth noting is that many differing molecules bind to microtubules.

It is not clear what the exact mechanism is, but it is clear that there are several possible pathways for what is needed, which is ion control of sentonic events and vice versa. At a slightly higher level knowing that is all we need, and we can await the elucidation of the details.

The sentonic field provides another means, requiring no direct cabling, for points in the brain to communicate with each other (“ephaptically”).

While cycling (and resonance) of signaling in the recurrent connections in neural networks may provide a regenerative effect that fortifies consciousness, it is not the base mechanism (cycling is a base mechanism of short-term memory, however).

24. Evolution

We have an architecture, which stands for study irrespective of the specific explanation as to how it is “implemented” by Nature. But as evidence of its truth, it must be a plausible destination of evolution. Here we summarize that journey.

The older and deeper parts of mammalian cortex form the connections to pain and pleasure that guide the cognitive circuits (literally) above. With this basic plan in place, the stage was set to scale up- with the same basic brain architecture- to more and more, and more refined,

cognitive mass. Summary good/bad/pain/pleasure/warmer/colder is a very powerful concept key to advanced brains. As the ability to manipulate objects became more abstract, true language first emerged and then became not just a communication feature but integral to human thought; communication itself became internalized and reflective. Metalanguage (grammar, new notations, compound constructed words, and descriptive theories) emerged and itself became introspectively manipulable.

Pain and pleasure have been discovered and harvested by evolution. (There are likely other worlds in which pain and pleasure don't exist to organisms, even complicated ones.)

Pain and pleasure might not actually be the same force. And there might be animals that feel pain but no pleasure. Use of one may have come first in bio-evolution (and that would likely be pain).

Intensity of experience increases by way of more spots in the field, and so indirectly, by more related brain interconnections.

Harvesting fundamental consciousness by evolution would mean "crafting" the shapes and/or construction and constituents of neurons, and possibly sets of neurons.

We can recapitulate the evolutionary development sequence because the needs and difficulties are obvious, and because we have the animals around us as evidence.

First needed would be basic stimulus/response. This could be viewed as the degenerate case of the cognitive. Then would come totally dispassionate ability for slightly complicated perception and actions. In other words, calculating ability- pure, passive cognitive- would appear first, and still exists in primitive animals.

Feeling provides for the first operant (reinforcement) learning opportunity, and certainly for more complicated organisms. It offers a broad whatever-you're-doing-is-bad (or good) signal for learning, and it provides the second needed, broadly distributed system- Value- which determines what action impulses are let through, the first system being Activation. Third is Attention, targeting and focusing the cognitive portions. Even before well-developed learning appears, feeling allows for generalized real-time changes in decisions in creatures with some neural complexity, and serves Attention.

The wholesale march into feeling began with the evolutionary outgrowth of the allocortex- the olfactory system and the hippocampus. The paleocortical piriform cortex, a.k.a. posterior orbitofrontal cortex (posterior OFC), is heavily correlated with the cingulate gyrus and the septal area, which is part of the basal forebrain. The OFC mediates the expectation of reward/punishment in response to stimuli. The paleocortical olfactory tubercle plays a role in transmitting positive signals to reward sensors.

Once all of these lower mechanisms were in place, the neocortex burst forth into high growth. Warmer/colder is a very powerful concept (complementing recognition and association).

Feeling continues to guide cognition at all levels. This allows three-pound brains to handle situations usually well enough that would be impossible to handle with combinatoric perfection, and provides an edge to conquer, in evolution, competitors and challenging niches. With bacteria and others optimized for the easier (in terms of complexity) niches, we populate the harder ones, requiring large-scale sophistication.

If not already on Earth, comets or asteroids could have provided batches of particles rich in sentonic charge. They could have come from anywhere or anyone. They are the seeds of advanced minds.

25. Technical Implications

25.1. Genesis

What we have presented means the original Big Bang flash was the essence of all the energies including consciousness.

25.2. On Attention, Will, Willful Attention, and Attention to Will

The cerebral cortex forms a network wherein almost all its (nonolfactory) input comes through the thalamus, with returning fibers going back to the thalamus, such that mapping is precisely maintained between cortical patches and thalamic regions. This means the brain can modulate what input gets through based both on unconscious tracking of conspicuous things like motion and loud noise, and on desires. The gating through the thalamus constitutes an act of attention, while the cortical input to it designates what is desired to attend to (the importance attributed to cognitive objects- by emotion or novelty or relevance- appears to be cortical).

The brain has evolved to the point where it can control even itself and feel itself thinking. Many actions and inputs are internal to the brain. The highest organisms are not only aware of themselves but aware of their ongoing thinking. Control is exercised using active attention.

To care is to have emotion. To care what happens and try to affect that, is will. The self-happening nature of feeling, interacting with the cognitive, results in “my” deciding based on my own “free” will, which amounts to emotion determining what you do.

Yes, feeling is the one thing that makes us different from a machine, it creates what we call "free" will. But genuine feeling does not necessarily provide genuine freedom. Will free from what? From the nature of other things and persons? Yes. From its own nature? No, will is a product of the brain's make-up.

Note that given emotional cortical processing, people to varying degrees can desensitize to the emotional activity volitionally. This amounts to a battle of emotions, since will itself is emotional. The degree of influence of will over immediate emotions indicates personal ability to run "cool" rather than "hot." We are also able to cognitively watch the battle itself occur, and react emotionally to it.

25.3. On Self and the Unity of "Me"

Evolutionarily, impulses precede a single, coherent self. Unity of mind as an acting agent precedes any awareness of unitary self.

The unity of an experience of ours, which is more elaborate than fundamental consciousness, involves:

- Adding and fusion in the sentonic field
- Co-stimulating of the field from multiple brain points
- Neural links, which may themselves stimulate the sentonic field
- Cognitive observation of the feelings occurring

In addition to a fused emotional experience, we *notice* a commonality of feeling; the noticing is a cognitive happening.

It has been theorized that thalamocortical oscillations from recurrent pathways between different brain areas gives the sense of unity of mind. This might work for the cognitive (and such a process is probably at least as much related to having many common associations firing and supporting each other and thereby inhibiting less well-known and more confusing currents), but it does not explain the unity and summary amplitude variation of feeling.

Let us further examine the sense of unity of mind. Imagine two or more people together, each feeling, and seeing each other feel, and personally reacting to each other, so that it is a shared experience. In such a situation as that, you don't actually share the same exact happening feeling, you experience another instance of feeling similar to the feeling the other person is

experiencing, which is evoked in you because you are seeing the same scene and possibly watching each other having similar reactions.

Now, internally, "you" is a family that knows each other well and experiences and feels for each other. This connected and coordinated happening is the unity you experience. The feeling part of you has this commonality in the sentonic field, not just as discrete emotional charges. It is real oneness.

Additional cohesiveness comes in at a higher level from the vast neural network *knowing* things, and then comes your higher-level "feeling" that you do know those things (a feeling of certainty, which is a composite incorporating positive feeling associated with a cognitive conclusion). There is also a cohesion of knowing and cognitive attention (the attention being driven by cognitive novelty or relevance or by feeling).

Conversely, "I" can also feel confused, especially before letting things settle for a few seconds, and have multiple feelings at the same time, so that there is not a single global net feeling. "I" feel scattered. The settling down is the process of some neural flows increasing, finding each other, and joining in positive regeneration, while others are inhibited and peter out (from what electrical engineers call Automatic Gain Control).

When we say we are having "mixed feelings," we usually mean (our attention is) flitting from one feeling to another at sequential instants, and thus have multiple feelings during a slightly longer "same time". We imagine it as with a butterfly flitting from place to place (per James), because of the such-like captures of our attention, but it is actually swells of various places of the emotional sea embodied in neural tissue.

When many (feeling) neurons light up, I may say that "*I feel* happy" because that is what my cognitive mind can understand. But what is happening is that joy is itself happening, located inside my head. At the same time, multitudes of neurons observe the same stimulus and each other and the simultaneous joy.

If some neurons die, your emotional and cognitive energies diminish, but even when many specific points of contribution have been eliminated the experience of unified feeling remains. It is more an experience like one with little currents in it than a handful of little light bulbs or other hard, separate objects that are on or off. Taking another cue from the rich source of established choices of words, we say we are "in" a good mood or "in" love. This lake of feeling is Me. A self is not as much an object, as a cloud.

The atoms of feeling are bound together and affect each other in two ways: cyclic regenerative pathways at a higher level, and addition and fusion in the sentonic field at the fundamental level. In the first case, each bit of feeling originally happens by itself, and in the second, one composed charge cloud stands united by virtue of locality and the laws of (complete) physics.

The initial reason for a human feeling to be strong, is that the initial cognitive channels of perception or recall synapse on many feeling neurons. Once so ignited, this group may regeneratively amplify itself for a period.

The singleness of self you internally *observe* may come purely from the cognitive connections. In many places in the brain these cognitive connections bring separate things together into a conclusive whole.

As a mind, *you* don't feel *something*, you *are* your feelings. You are the cloud of feeling your brain makes. You also have a cognitive processor, and these two things are heavily interconnected/intertwined. What makes us special, though, is not that we can calculate, as many things effectively do, but that we can feel. In making that so, evolution has caused each of us to value some things more than others. Ancestors with different values did not survive.

Realizing you are a cloud or a lake solves both the Observer Problem and the Unity Problem. And at any time, the unified you can lose a few cells and lose a little bit of feeling and you are still there, because you are not a single point but a cloud of these touching points.

"Feeling" "by" "Me" is a larger event than one senton (and for that matter a single photon is generally imperceptible to us, too). The feelings our selves experience are each thousands or millions of these tiny spots of emotional light.

When there is an accumulation of many matter particles in one place, they will pull hard with the force of gravity. So, too, many sentonically-charged particles together will pull hard- will create a large charge field. That charge (or its movement) causes feeling- *is* feeling.

There is a perceived sense of self. And there is a cloud of feeling. We have both, and they interact. The mind is this thinking + feeling. The emotion cloud travels with our thinking brain.

Cognitive unity does not seem much of a mystery as to how it is possible and how it could be made: connected neural processing networks. We can see (the removal of) such unity at work in split-brain epilepsy patients.

A sense of self could start with bodily self- the spatial- which for us is smoothly cohesive and continuous. Our sense of self is a confluence of integrated body sense, self-talk, and will, which is emotion. Some say that the insular cortex (which is emotional) gives the sense of self. The seat of sense of self has been located, some say, in anterior cingulate cortex. In any case, the prefrontal cortex does the high thinking, steered by the emotional cortex on the cerebrum's lower surfaces, with calculating and perceiving happening in its upper surfaces.

At your core "you" are your emotional feelings. Intelligence, which is cognitive, is poured atop that, making you not only able to feel but to reflect and imagine. Language is poured atop that and thinking becomes organized and step-by-step.

You are attached to the consciousness field, the sentonic field. "You" *are* your presence in the consciousness field, the consciousness field is you. Within it, each feeling point can feel others nearby, in the sense that each influences each (field summation), toward the same intensity and direction as itself.

The feeling is additive, the charge sums. The sentonic quantum field itself does this as you perturb it at multiple points. You are that sentonic charge cloud in the sentonic field.

Pain and pleasure are real. You don't feel *that* you are having pain, you are *in* pain. Mood is probably semi-widely distributed, while attention lights up the specific little brain regions of interest. All of this collides in the prefrontal cortex, and choices result, as a system-level effect.

25.4. Testability

Here we must accept another Hard Problem about consciousness, that it is very hard to test for as to essence in Nature. The policy- which is what it is- of "if you can't test it, it doesn't exist," worked well for smashing up matter and light, avoiding wild goose chases. The problem with it in the current context is that it isn't true. We know that phenomenal consciousness happens, and we typically have no idea how to test for that. Does that mean it doesn't exist? That it is unscientific to even utter therefore the concept? That was even tried- behaviorism- even though we know that clearly isn't true and in fact exactly missed the point of what makes a mind rather than a machine's machinations.

But with an Architecture one can “unit test the black boxes.” In this case that means testing the metatheory without having to have results, or rich results, on an entire specific theory.

25.5. Application

The concept of *value* summary interwoven at all levels of cognition is necessary to produce (simulate) something like our whole minds, which work by approximation and data reduction and parallel search and competition at many levels, guided by value.

A technology of actual feeling is utterly different from AI and AI fusion with us can increase the power but does not extend the life of our minds, only dead shadows of it. Integration with feeling technology allows actual consciousness continuity.

Layers 3 and up will be solved by “those people” and by the same token all the wiring, neurodynamics, and infrastructure for psychological operations do not need to be known to any depth by those working on the ultimate origins of feeling, who will be working in physics up to a neuron or few in the fullest theories.

The latest version of understanding of each Layer can be swapped in independently. This applies to Layer 1 and 2 also when we are able to evoke consciousness by new kinds of machine after determining what the brain is doing.

26. Conclusions

We have presented an Architecture (FLA) and compliant metatheory for every major constituent of mind from nothing but the existence of this universe up through human minds.

This metatheory does not presume that human-level consciousness is everywhere. It does assert that primitive fundamental consciousness is distributed throughout the universe and the field carrying it is everywhere. From this you can decide whether this is panpsychism to you. The universe does not understand things or feel as a whole in a unitary fashion. It does contain such “flecks.”

We conclude that there is a physical consciousness force, which we call the sentonic field, accounting for fundamental consciousness. Multiple pieces of evidence suggest this to us, and they are not all required; there is plenty of good reason to believe there is a sentonic field.

Evidentiary Element 1 is the tendency of Nature to repeat herself, using the same consistent patterns and methods for the phenomena of our world.

Element 2 is Occam's Razor: It is simpler to expect the same sort of mechanism at work than to presume a completely new one.

Element 3 is related to Element 1: In the human history of discovery, all phenomena have fallen to the same, increasingly generalized, scientific model.

Element 4: We can see that consciousness happens in the brain, and is almost certainly evoked by the brain, a physical object.

Element 5: To explain what supports yet smaller decompositions of experiencers and things being experienced, there must be a freestanding feeling.

Animal-level consciousness is probably the result of activity of networks of physical neurons.

The nature of our human-level consciousness is that we react emotionally to (and perceive) our thinking, and we cognitively notice our feeling, and we talk to ourselves about all of this in a chorus of stream of consciousness. Our words then evoke feelings and more thoughts and around it goes.

On the way to our solution, we have laid down postulates and presented hypotheses, to wit:

Postulate 1: Physicalism is necessary and information- and computation-based theories cannot provide for the source of conscious experience.

Postulate 2: Consciousness functions within the same basic rules (including mathematics) as all other phenomena that also exist in Nature.

Postulate 3: Something basic is missing from, and must be added to, our physics.

STFC Hypothesis 1: Fundamental feeling is freestanding and requires no separate feeler. At most there is a physical interaction between two fundamental elements.

STFC Hypothesis 2: There is a physical process that is fundamental feeling.

STFC Hypothesis 3: The fundamental feelings are pain and pleasure.

STCF Hypothesis 4: There exist pain and pleasure in minimal discrete bits independent of any brain, at the sub-molecular scale.

STFC Hypothesis 5: Some biological brains have evolved to organize and exploit pain and pleasure.

STFC Hypothesis 6: The fusion of feeling across the brain occurs in a force field.

Hypothesis A-1: It is by way of feeling and information processing that aware and intelligent minds have developed that can solve problems and set goals.

Hypothesis A-2: Cyclically, language organizes thought and stimulates new thought to organize as language centers interact with earlier non-language centers.

27. Forward Work

As in other endeavors, the layered architecture allows for people interested in consciousness science to specialize in one layer with confidence in the models and work done at the other layers. The layers were not chosen as arbitrary subdivisions but as the natural large steps taken by evolution.

Physicists and Philosophers and those interested in the ultimate source of consciousness can operate in Layer 1. Those wishing to elucidate the critical step from ambient, disorganized feeling to unitary fused bodies of feeling can operate in Layer 2.

People interested in how minds are made and operate, can work at Layer 3 and safely assume that some physical mechanism provides the platform ready for the integration of advanced computation. The physics (and chemistry) are done, and neuroscience and psychology take over here. Linguistics and higher psychology occupy Layer 4.

All this applies both to theory and to actually building a mind. The engineering also becomes a layered process where work on each layer can proceed independently.

With all four layers in place, a fifth layer can commence, which assumes advanced thought capabilities and is data-driven, knowledge-driven, and hypothesis/abstraction driven, where large knowledge models are built and manipulated (there is also separately the opportunity for very rich emotional experiences, both by discovery and exploration and by intentional construction and acquisition, which is a different endeavor).

All of this understanding gives us the first clues to creating artifacts that *actually* feel. By fusing with them, this leads to the possibility- indeed, the likelihood- of extended life of individual human minds, not just of dry images of them.

28. Summary

The fact that it is difficult to understand does not make consciousness any less a natural phenomenon than electricity or nuclear fusion. The Standard Model incorporates everything we completely understand so far, and in the long run never fails to accommodate extension and revision to cover new discoveries.

Being quite separate from the other phenomena, a new force and thus charge, field, and boson are scientifically called for. The new force interacts, by some chain of interactions, bidirectionally with the electromagnetic force, which is responsible for nearly all operations in the living brain.

Evolution has learned to harness this “new” force, which has existed latently for eons. Learning how to interact with it directly will allow the creation of feeling machines and the continuity of our developing selves for centuries.

Electromagnetism is already heavily used in making up the fine informational computation and transmission patterning in the brain. The new force provides something “out of band” from that for those to connect with to provide the emotional value.

Clouds of odd and differing shapes in a mist of consciousness “vapor” provide both valent experience as their essence and distinguishable larger-scale feelings that serve as meta-symbols (tags) around which clear and distinct mental objects can be constructed and then manipulated, like snowflakes around a mote of dust.

This paper has dealt with the necessity of explaining the *beginnings* of our minds in two steps:

1. The fundamental capacity in this universe to feel anything, at its most basic and indivisible.
2. The combining of this into the lowest level tier of experience that we can find introspectively from within our minds. This is the bootstrap from Layer 1 to Layer 2.

1 and 2 in place can then be assumed and provide the conceptual atoms and form the complete platform- the interface- upon which minds can be built, in layers/stages of cognitive capability.

With 1 and 2 in place there is sentience, and the mind from there becomes simply the result of increasingly fancy computation with connection to value, and self-observation, focus, and manipulation. We call that Layer 3. Work on Layer 3 is proceeding apace and is not the hardest consciousness problem today.

The platform of Layers 1 and 2 could be simulated with effectively exact fidelity, even without knowing the precise physical interaction used by our universe, allowing artificial

“consciousness” that does not actually feel but is just as efficacious. (The model also allows real man-made consciousness to be inserted when that is mastered.)

We must have stuff to move around in order to represent and manipulate information. Computationally, it doesn't matter what the stuff is. Any stuff that exists in self-local little pieces can be arranged.

We need a certain specific thing to be feeling- specific stuff. Feeling by itself on the local level has nothing to do with information, nothing to do with arrangement.

The fundamental magic of our minds is the marriage of information processing with feeling, and in particular, valent feeling. The information is the arrangement of stuff. The essential stuff is feeling.

We see:

- We need stuff that feels. Not just any stuff.
- We need stuff to arrange and rearrange. Any readily arrangeable stuff will do.
- The stuff can be entirely the same, that is arranged, or there can be a somewhat more complicated arrangement between the two. Either way, as a practical matter, just a little way up it is the same stuff.
- Feeling goes way down. Valence goes way down.
- Feeling does two things- fuse/join and thus generalize and simplify into grosser states, and provide on the same many scales a sense and score of good/bad.
- Subjective feeling is an epiphenomenon just in the sense that any natural mechanism that had the utility just described would do. In our universe pain and pleasure are available for the task and have been harnessed.
- Electromagnetic processes are both coupled with and have a high degree of separateness from feeling. The separateness provides new utility; feeling does a “processing” by which the electromagnetic processes are enhanced, as proven by evolution weaving feeling in.

Only three basic things are needed to explain the mind

- Physics-level understanding of feeling.
- Explanation of path from physics level to bottom-most mind (qualia in a unified place).

- Cognitive processing mechanisms, ultimately including language. These are coming in to view via neuroscience from microanatomy and various scanning and probing and psychological experiments.

These things are reflected in the corresponding architecture of the mind:

4. Language and formal reasoning.
3. Cognitive processing, pre-language.

2. Building from physics to bottom of mind leading to integration of cognitive with feeling and formation of bottom mind experiences and actions.
1. Physics: Manipulable objects to represent information, feeling action to summarize and evaluate.

Where there has been much confusion is in 1 and 2, and this is what tells us what consciousness *is*- in other words the difference between a simulated consciousness and an actual consciousness. We have not yet detected the base constituents. As with many other advances in earlier times with thin data, we are driven to our conclusions by reason, and this time we know how Nature tends to work.

Meanings not only feel like something in an active mind, they are made entirely out of feelings, in that even the informational content is patterns- patterns of feelings. This brings together the informational and the emotional aspects of knowing.

While information/cognitive is the patterns and independent of the stuff, pain and pleasure are stuff of a particular kind and independent of information patterns. The two become associated early and often and form the fundamental fabric of what is our consciousness. As this dance proceeds higher, we know what we feel and that we feel, and we feel that we know and what it is like to know.

The existence and operation of real material in our world demands both atoms and all the complexities of the separate-yet-joined-into-wholes way in which these atoms participate, and this looks to be almost exactly what is happening with our most basic experiences, as we should expect. A cell *is* made of atoms, even if upon hearing about atoms you still don't see how that could explain life. That just means there are more steps of explanation and structure than are describable with a simplistic hand-wave. What is required is not just to avoid oversimplified explanations but also oversimplified presumptions of what we are starting with.

The true brute facts occur at the bottom and amount to nothing other than the rules from which the universe is made out of its energy. There has to be *something* standing in that place. These will include the Physical Correlates of Consciousness that underly and explain the Neural Correlates of Consciousness.

A fundamental consciousness operating at the scale of quantum physics underlies all conscious experience. At this level there are only particles affecting each other, consciousness is a freestanding physical event, and there are no observers present.

Typical qualia occur at a higher level and are elaborations incorporating “psybits” of fundamental consciousness. That qualia are themselves composites is shown by introspection and by the realization that, otherwise, the universe would need thousands of different essential flavors of consciousness, an explanation which is both suspiciously bloated and very unlike the rest of the known universe. Additionally, varietal compositions (based on forces) are how all the rest of the known universe has organized into higher structures.

Since psybits affect each other at the physics level, so do the “molecules” that make up qualia.

Components of different qualia have distinguishable feels because the molecules of psybits have different exact makeup and internal arrangement, made inevitable by variations in the physical brain.

If we gradually anesthetize a brain, human consciousness eventually disappears, at a point before almost all neural firing has stopped. Likely, the longer and thinner links between locations of high self-supporting connections break first, leaving islands of independently conscious chunks of brain that no longer result in a unitary mind. As activity continues to fall, these islands of activity with their internal tighter loops will also collapse. At the most extreme nonzero case, sputters of fundamental consciousness will be evoked, but these will be both too weak and too simple to amount to any anything mental. They will be simply more noise in the universe. But they may someday be detectable!

A simple experience to us involves many neurons supporting each other’s firing, each (conscious) one of which probably causes many individual physics-level events. A simple thing to the mind is large on the particle scale. Even a weak feeling to a person is rather rich in absolute terms.

What we call our consciousness is that which is accessible in the unified mind. Outlier bits of consciousness will exist in other parts that are not connected in, in our own brains, other peoples’ brains, and probably in the whole universe. The boundaries of the unified mind are probably dynamic as things enter and leave our “consciousness.”

Researchers who see consciousness as fundamental in the universe without recognizing that it is assemblies that make qualia in minds, and psycho-philosophers who think their red is a natural primitive, are talking past each other in trying to make the connection between their worlds. Physics is not high enough and psychology is not low enough for that. Even introspectively, we can see that red is not an irreducible sensation, and neither is “redness” a moving particle.

We see that the large question as to what a whole human mind is made of can be well-split into two pieces, which are basically the domain of the Hard Problem, and a lot of information computation and storage. Therefore, the solution may be sought by different specialties and teams of humanity. As to applications, understanding of the feeling half will have limited importance for the creation of effective artificial (and stoic) “minds,” but be of central importance to extending our own conscious lives forward.

The key link in understanding the whole of consciousness is the explanation from self-less physics to the much higher level of qualia, at the bottom edge of the introspectable mind. Key clues might be found in pain and pleasure, which appear to have a much simpler and more direct link “upward” than the typical qualia.

29. Epilog: Philosophical Implications

29.1. Value Philosophy

The present theory bears on matters of Free Will, and Good and Evil.

Pain and Pleasure are found to be not human or animal but cosmic and therefore real without humans. Good and Evil are definable in terms of these. A group of people need only prefer a good world to a bad one based on these definitions of what are universals. Morality becomes neither god- nor human-dependent.

Human life as most precious then derives not directly from higher intelligence or godliness but from the ability of the larger mind to suffer and enjoy in more ways and more richly, along with long-term memory.

29.2. Destiny

There is indeed a breath of life- an animation. That breath is (organized, concentrated) pain and pleasure, it is the “soul.”

This thing- the soul- is indeed different and apart from the matter we know, and real. But on death it dissipates as does all the other matter and energy, and in the same manner, and returns to the background, a background of dimly feeling dust.

As children of the Universe, we will return to this nameless dust. (Of course, the Universe itself will at least grow cold if not die, so even if you lived up to that point, it would make no difference beyond it.)

Will is nothing more than what you want to do, overall, and that is whatever causes the most pleasure and the least pain, overall. This is why we train children to be pained by doing things that are designated wrong, with our mammalian traits of empathy and kinship complementing self-interest. And we can train ourselves.

There is no practical conflict between “free will” and destiny (though for some reason many have anguished over it). Like everything else in Nature, you perform to your nature. You say you are free to do what you want. What you are definitely not free to do is what you don’t want to do, all things considered. But, by definition, that is not desirable anyway.

You are a mechanism, but one that can experience pleasure, and can (and shall!) seek more of it. And pleasure is as fundamentally real as light and matter.

29.3. Why Consciousness?

This question applies to consciousness at all its levels. Why this, and why this way? There is no Why this exact way, nor is there a Why necessary in any way; it is one possibility.

Higher consciousness evolved. But fundamental consciousness did not evolve (except perhaps during the earliest physics of the emerging Universe).

Why is there consciousness at all? Based on the Anthropic Principle, there is consciousness in our universe because that is a way that intelligent beings can exist, to then ask that question. This also answers why there is suffering (and pleasure) in the world, which amounts to the same kind of question.

The question of why, then, are there such beings at all is not really different from the question of why there is anything else. The answer is that it is possible and there is no reason for there not to be, so there can be, and there happen to be.

That everything needs a reason is a human notion, based on the goal-directed and problem-solving urges (pains and pleasures) and behaviors we have evolved, having discovered macroscopic causality, so that our genes would survive rather than others’.

There are probably other “places” that also exist as much as ours does, where much of what we have here does not and cannot exist. For nothing to exist anywhere at all, would be a very special and unlikely case! A preference for that is a quirky human prejudice.

We know that it is possible for things to exist because things do exist. There is no ultimate base Why, or any fundamental requirement for one. Whereas humans are possible, and so might exist, and happen to, many other imaginable things happen to not exist.

The answer to “Why is there consciousness?” is:

“Why” is a human concept and need. Consciousness is possible and serves the evolution of creatures that can ask why, and thus we find ourselves in a universe having everything necessary for our consciousness to be possible.

Conflict of Interest Statement

There is no conflict of interest for the work of any article written by me through in 2021 or Jan.-Mar. 2022.

References

- [1] K. Sipfle, "The Primary Pitfalls on the Road to Understanding Consciousness," *Journal of Neurology and Neurobiology*, vol. 7, no. 1, 2021.
- [2] D. Chalmers, "Facing up to the problem of consciousness," *Journal of Consciousness Studies*, pp. 2: 200-19, 1995.
- [3] T. Nagle, "What is it like to be a bat?," *Philosophical Review*, pp. 435-450, 1974.
- [4] K. Sipfle, *The Nature of Consciousness*, New York: Barnes and Noble Press, 2018.
- [5] R. Penrose and S. Hameroff, "Consciousness in the Universe," in *Consciousness and the Universe*, Cambridge, MA, Cosmology Science Publishers, 2017, pp. 8-47.
- [6] R. Poznanski and E. Brandas, "Panexperiential materialism: A physical exploration of qualitateness in the brain," in *Quantum Boundaries of Life*, Cambridge, MA, Academic Press, 2020, pp. 301-367.

- [7] D. Gamez, *Human and Machine Consciousness*, Cambridge: Open Book Publishers, 2018.
- [8] A. R. Damasio, *Looking for Spinoza*, London: Heinemann, 2003.
- [9] J. E. LeDoux, *The Emotional Brain*, New York: Simon and Shuster, 1996.
- [10] G. Edelman, *Bright Air, Brilliant Fire*, New York: Basic Books, 1993.
- [11] E. Rolls, *Cerebral Cortex: Principles of Operation*, Oxford: Oxford University Press, 2016.
- [12] R. Penrose, *The Road to Reality*, New York: Vintage, 2004.
- [13] Kane, *The Particle Garden*, New York: Basic Books, 1995.
- [14] R. Poznanski, "Theorising How the Brain Encodes Consciousness Based on Negentropic Entanglement," *Journal of Integrative Neuroscience*, 2019.
- [15] R. Penrose, *The Emperor's New Mind*, Oxford, UK: Oxford University Press, 1989.
- [16] K. Sipfle, "The Nature of Fundamental Consciousness (preprint)," *PsyArXiv*, 2018.
- [17] R. Pepperell, "Consciousness as a Physical Process Caused by the Organization of Energy in the Brain," *Frontiers in Psychology*, 2018.
- [18] F. Schiffer, "The Physical Nature of Subjective Experience and Its Interaction with the Brain," *Medical Hypotheses*, 2019.
- [19] R. DesCartes, *Principia philosophiae*, Amsterdam:: apud Ludovicum Elzevirium, 1644.
- [20] K. Sipfle, "The Solvability of The Hard Problem of Consciousness and its Relation to Fundamental Consciousness and Human Consciousness," *ResearchGate*, 2019.
- [21] K. Sipfle, "A Neurobiological Theory to Explain the Lack of Rationality in Dreams," *ResearchGate*, 2021.
- [22] D. O. Hebb, *The Organization of Behavior*, New York: John Wiley & Sons, 1949.
- [23] M. P. v. d. Heuvel, "Rich-club organization of the human connectome," *Journal of Neuroscience*, vol. 31, no. 44, pp. 15775-86, 2011.
- [24] F. Crick, *The Astonishing Hypothesis: The Scientific Search for the Soul*, New York: Simon & Schuster, 1995.
- [25] J. M. Allman, "The Anterior Cingulate Cortex: The Evolution of an Interface between Emotion and Cognition," *Annals of the New York Academy of Sciences*, vol. 935, no. 1, pp. 107-117, 2006.
- [26] R. E. Passingham, *The Neurobiology of the Prefrontal Cortex*, Oxford: Oxford University Press, 2012.

[27] K. Siple, "Distinct Kinds of Consciousness," *RG*, 2019.

[28] K. Siple, "Support for the Sentonic Theory of Fundamental Consciousness (STFC)," *RG*, 2019.

[29] E. Kandel, *Principles of Neural Science*, New York: McGraw-Hill, 2013.

[30] N. Chomsky, *What Kind of Creatures Are We?*, New York: Columbia University Press, 2016.