

PHYSICS HAS EVOLVED BEYOND THE
PHYSICAL:
A REPLY TO VALID CRITICISMS OF THE CRISIS
IN PHYSICS

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ABSTRACT: As philosophical critics of modern science point out, contemporary physics is, indeed, at a crucial crossroads that impacts our ideas about the nature of mind. Through the development of computers, and as the crucial application of mathematical methods has grown, the limits of our specific methods and applications have become far more clear, more quickly than they ever could have, without massive computing power. Yet even computing itself is hitting limiting walls. The limits hinted at by Gödel are becoming more specific and applicable rather than vague idealizations. The very nature of our computation methods have become fundamentally unsuited to meet our requirements in attempting to re-create human-like intelligence. We have recognized the necessity for “massively parallel” systems even if our current incarnations of them are less than truly concurrent.

Simultaneously, physics as a field is not ignorant of its own issues and has begun to probe the strange borderline between information and energy that was first encountered with questions of the EPR paradox. In the face of the physics community recognizing its own need for revolution, some critical writers have suggested that the solution should be an abandonment of physicality as a basis for understanding the world. This fully oppositional, reactionary response is the most common response to any seemingly intractable problem: to throw away the baby with the bath. Perhaps, instead, there is a middle ground which abandons nothing of physicality while embracing some additional understanding of complex phenomena, formerly labeled “spiritual,” which can add to our understanding, via perspective shift alone. Schrödinger believed we could simply transform our perspective instead of abandoning it and that wisdom is what may serve us today. Perhaps we have already begun down the correct path without fully, yet, embracing it, and perhaps we are about to enter the “information age” in earnest.

KEYWORDS: Contemporary physics; Mathematics; Computing power; Schrödinger

MIGHT WE ALREADY HAVE THE ANSWERS AND JUST NEED TO ASK THE RIGHT QUESTIONS?

“A widely accepted school of thought maintains that an objective picture of reality -in any traditional meaning of that term- cannot exist at all. Only the optimists among us (and I consider myself one of them) look upon this view as a philosophical extravagance born of despair in the face of a grave crisis. We hope that the fluctuations of concepts and opinions only indicate a violent process of transformation which in the end will lead to something better than the mess of formulas that to-day surrounds the subject.” - Schrödinger from "Our Conception of Matter." [reprinted in "What is Life and Other Scientific Essays" (1956)]

John Archibald Wheeler was a man of no little impact on our conceptions of the world through physics. One of his first explorations of “non-physicality” was through the lens of Claude Shannon’s information theory. Wheeler’s “20 questions” concept was an interesting take on the idea that our interaction with nature may simply leave an impression of the tools we grasp at it with. During an interview, he expressed that he and his fellow explorers were still “trying to get the lay of the land” and “learning how to express things that we already know” in the language of information theory. The effort may lead to a dead end, Wheeler said, or to a powerful new vision of reality, “the whole show.” In that same interview, he read from a book he co-wrote: “Someday surely we will see the principle underlying existence as so simple, so beautiful, so compelling that we will all say to each other, 'How could we all have been so stupid for so long. I don't know whether it will be one year or a decade, but I think we can and will understand. **That's the central thing I would like to stand for. We can and will understand.**” (emphasis mine) Wheeler was once on a parapsychology panel and quipped about the whole endeavor that “Where there’s smoke, there’s smoke,” yet he humbly acknowledged it *could* all be smoke. This humble ability to doubt our precious “fundamental truths” which greats like Wheeler have always exhibited, still serves as a wellspring of inspiration and a roadmap forward.

In that same interview, discussion turned to Wheeler’s mentor Bohr, and Niels’ son had relayed to Wheeler, after Bohr’s death, that Niels had felt that we might never reach any satisfying ends in the pursuit of an ultimate theory and that the increasing difficulty would eventually overwhelm us. Commenting upon this Wheeler remarked: “I guess I’m more optimistic than that, but maybe I’m

kidding myself.”

Today we face a culmination of the basic instability of our “mess of formulas” that Shrödinger alluded to, and the “grave crisis” he referred to in physics is even more unmistakable than it was when he said it. It seems, however, that both of these greats in the history of physics did not focus upon some choice between consciousness and materialism, but instead, they appear to have recognized a dichotomy between *optimism* in the human pursuit of understanding *versus* the *despair* of a belief in a disunified subjective reality which can never truly be understood.

“I don't like it, and I'm sorry I ever had anything to do with it.” - Schrödinger, on probabilistic interpretations of QM

THERE IS A SINGLE AXIS UPON WHICH THE FUTURE OF THEORETICAL PHYSICS TURNS

In a time of “God particles,” the “end of physics,” dark stuffs dominating the known universe and the “vacuum energy catastrophe,” it is a question of choosing optimism or despair. Do we declare the end of our pursuit or renewal at the beginning? The character of these conflicting views combined with the continued discussion of how to interpret quantum phenomena lead us toward the ultimate question which divides the human approach to conceiving of reality: Do we believe that there is something outside of our mental space that is real, and can we find the immutable anchor points that physics searches for, or is it all a hopelessly amorphous blob that is nothing but a collection of mental imprints? Is the pursuit of physics fundamentally valid?

Ultimately do we continue to optimistically believe that the universe is a unified thing that can lead to understanding or do we “despair” as Shrödinger remarked, and count all our discoveries as illusions and accept the futility of attempting to believe in any specific thing is truly real as the copenhagen interpretation intimates? Will we simply declare ourselves done because the way forward seems completely blocked from our current interpretation of the evidence? Will we blind ourselves to the unmistakably huge problems and missing pieces and just delude ourselves into pronouncing the task successfully completed?

Spiritual faith can be a comfort to those in despair and each of us must personally accept some limitations to both our reach and grasp. There is a time

to turn away from attempting truly impossible things. When we reach our limitations it is often a healthy habit to utterly give up instead of searching for a new way through or another avenue or method of reaching the higher goal. Sometimes there simply is no other way and continuing beating against the hard walls of reality is a waste. Giving up is the only viable strategy in many cases. Faith in any orthodoxy can be an alluring comfort that one's work is finished.

However, my appeal is to the optimists and another sort of faith. Perhaps it is faith in the future and in the human spirit to entertain an unlimited growth potential and an unstoppable curiosity that will surpass each of us individually and ultimately, humanity will achieve something beyond the individuals. This seems to be the optimism Schrödinger refused to give up and the future Wheeler believed we could continue to pursue.

PHYSICS, BY INVESTIGATING THE ROLE OF INFORMATION, HAS TAKEN THE OPTIMISTIC ROUTE AND EVOLVED BEYOND THE PHYSICAL

It is in pursuit of optimism that I suggest that the dichotomy between mind and matter is a false one while also insisting "mind," conceived of as information, is something that cannot be ignored as some bare after-effect of the material world. We argue variously between two viewpoints that either mind comes first and defines material or conversely argue that the interaction of matter produces the "mind" we apprehend. Might we all be collectively entertaining a false dichotomy? Did someone trick us with a new version of "The chicken or the egg" when we already know the answer to that misleading question type? Did we arbitrarily halt like a computer program running out of memory and break out of the infinite regress by selecting "chicken" or "egg" instead of both?

Obviously the configuration of anything in the universe is itself information. If we have all the parts to a car engine, we do not have an engine unless those parts conform to a certain configuration, and, as an analogy to information, it is only a *specific* ensemble of facts or engine parts that can produce something more than the parts alone possess without that configuration. Is the configuration of physical objects itself also material or do we easily conflate physical configuration with material existence? Obviously configuration *itself* is not purely "material,"

yet the configuration is something much like our concepts of potential energy so we can easily see the direct connections between ideas of energy and information that Shannon explored and Wheeler favored. The hardest materialist among us has no problem with potential energy yet it does represent something that is not, itself physical. Even the very idea of the dichotomy of alive versus dead can be found in the potential energy notion of configuration data if we allow it the “over-time” assumption we frequently associate with energy. In psychology, we call the static configuration of an engine and its ability to produce something greater than the parts, a “gestalt” instead of potential energy.

When an engine “dies” or “is dead” it’s just as ambiguous as what we find in attempting to categorize death in biology when examining things such as stasis. A cell is only “really alive” when the engine it represents is running. It’s only “really dead” when the configuration of parts can no longer support the feedback loop of energy flow we associate with accomplishing and proving that the whole is greater than a simple sum of parts. Only when the configuration is capable of guiding the looping flow of energy does the engine or the cell “live.” There is a feeling of magic and mystery here that science can still quantify, or at least grasp, with its tools.

Might the very idea of mind and energy actually belong together under these associations? The most anti-materialist among us will embrace the idea of energy and mind being a single thing even if they dislike the materialist’s ability to quantify energy and use it in mechanics. These same anti-materialists have heralded the failure of information theory, but have we really explored all the avenues through which it might inform our view of physics and grant us something more? Might we need some small adjustments to our interpretations in physics - represented by the current crisis - to remove the blockade to the progress Wheeler anticipated would be achieved through information theory? Can the necessary revolution within orderly confines be accomplished simply through re-interpretation?

It is the direct ability to recognize a meta-data relationship between the components of reality, which allow it to behave in particular ways, that we attempt to represent as formulas and symmetries in physics. The configuration of brain cells we call a “connectome” represents a set of data and interactions we associate with conscious thought and though we do not yet have a perfect

understanding of that organ, perhaps through this lens of investigating mind we are seeing the other side of the problem we are trying to solve in physics. There very well could be a top-down view from neuroscience that gives an alternative picture of the bottom-up view we are working on in physics. When we create a set of formulas to describe all of reality, we are insisting there is something there with a basic structure and set of core behaviors. Yet for a brain to work properly we also know that it's not just the connection pattern that matters, but also the synchronization of the data access that creates an additional layer of information generated by the correlations of activity. The timing is part of the processing. (and the running of the engine or a cell is what makes it alive)

Maybe physics has almost all of the pieces correct but they are not properly interconnected to allow the "engine" we are building in theoretical physics to "fire" properly, and we are left without the right timing to more perfectly process the complex data systems that emerge from simple principles via the arrangement of the parts. Maybe we do not need to throw the engine away but simply tweak the timing. Where some see crisis and intractable problems that seem to lead to an utter scrapping of the fundamentals, those of us in the optimist camp see an open vista of transformation, not destruction.

PHYSICS ISN'T IGNORING THE WINDS OF CHANGE, IT'S DECIDING HOW TO SET THE SAILS

The suggestion of this letter is that Gödel's incompleteness is actually the source of our problem and that the broad application of the incompleteness concept to our problem-solving systems is not a commentary on the fundamental failure of logic, but a pinpoint identification of the failure of *linearity* in processing. The halting problem or simple attempts to evaluate statements like "this sentence is false," are overcome by humans because of concurrency in the human brain. We are also at the cusp of overcoming this problem in our mathematical methodology and in our computer technology as we attempt to finally produce strong artificial general intelligence.

"The thing that got me started on the science that I've been building now for about 20 years or so was the question of okay, if mathematical equations can't make progress in understanding complex phenomena in the natural world, how might

we make progress?” - Stephen Wolfram

The transformation of our perspective is already underway in various areas of mathematics through the exploration of concepts in concurrent processing and the emergence phenomena of deterministic chaos. From cellular automata to Clifford algebras, we are working towards complex methods anyone would be hard pressed to call “reductionist” as those of us labeled “incorrigible materialists” are often accused of being.

In computer technology, an older methodology of analog-digital hybridization is being revamped in various attempts such as “Memcomputing” to take advantage of the parallel computation found in wave interference and analog computation. The chips initially developed by NVidia emulate a sort of analog computation and show significant performance enhancement through even these first half-measures. The “Quantum supremacy” paper of 2019 on a new chip design is, however, a strong reach toward this analog-digital hybridization goal which can achieve the concurrency we see in nature via the superposition of waves. It’s a massive paradigm shift in basic computation methodology.

Similarly, while we still grope with the problem of Dark Matter much like physicists of the late 19th century wrestled with the necessity of an invisible substance, perhaps like this move towards analog technology, we’ll also take a step back to revisit older “analog” ideas in physics - such as those of Madelung et al - and therefore reuse some of the still valid concepts found in the analogy between fluid dynamics and quantum mechanics, in some sort of neo-aether synthesis of spacetime, to account for the strangeness of dark matter and energy as Einstein attempted in 1920 when he said “Space without aether is unthinkable.” In such a viewpoint we may recognize a false dichotomy exists between normal matter and the less “ponderable material” of the stuff between the stars. In our final redefinition of dark matter, perhaps we might even find a computational substrate for Shannon entropy to play a role in the apparently stochastic processes of quantum mechanics and uncover yet another layer of our universe.

“In the above hydrodynamical comparison, the ensemble of all invisible molecules does play the part of the hidden thermostat. This latter by its continued interaction with the granule gives it a Brownian motion according to a well known concept of statistical thermodynamics.” - de Broglie (1972) “Interpretation of quantum

mechanics by the double solution theory”

“I have come to support wholeheartedly an hypothesis proposed by Bohm and Vigier. According to this hypothesis, the random perturbations to which the particle would be constantly subjected, and which would have the probability of presence in terms of [wave-function wave], arise from the interaction of the particle with a “subquantic medium” which escapes our observation and is entirely chaotic, and which is everywhere present in what we call ‘empty space.’” - de Broglie (1960)

THE FIELD OF PHYSICS ISN'T A BUNCH OF STODGY HOLD-BACKS, BUT INSTEAD A GROUP OF VERY OPEN-MINDED EXPLORERS. PERHAPS EVEN GOING TOO FAR.

Occam's razor, when abused, asks us to simply accept a given illusionist can pierce himself yet remain unharmed because no other data is available, yet the *unspoken mechanical requirement* inherent at the root of science recoils at such absurdity and charges forward optimistically until it finds the *mechanism underneath the magic*. Perhaps we gave up too early and too easily in our attempts to understand the quantum vacuum and the denial of its material existence has stymied our progression, but it is time, again, to give up despair, embrace optimism and break through. Perhaps by falling back upon the mechanical view that first birthed science.

Physics is miscategorized as searching for a way to describe everything in “simple” terms but it is deeply recognized that massive, non-computable complexity can emerge from simple principles and physics has never claimed to describe everything that ever could be; it only seeks to find those “simple principles” that serve as central axes which might lead to the emergence of the myriad complexity of reality we experience, from a rational unified basis. We earnestly and optimistically believe there is some “connectome” of data and meta-data that plays the role of a basis for reality or core of it, but we also recognize that only when all of it is set in motion together does it create something greater. “Physicalism” is simply the belief that there is some workable configuration of parts that leads to the gestalt that those in softer sciences also recognize as mind. There is a point at which the trees and the forest are the same no matter how differently we happen to describe them.

There have been leaps of faith made in physics that sacrificed deeper

mechanical understanding in the hope that if we just “shut up and calculate,” the additional information would eventually be produced to see the big picture. It is this letter’s extra--optimistic view that perhaps we already have produced that information and, we have already produced the “parts” of the engine we have been pursuing but now we only need to back away a step to assemble the right parts in the right places and to adjust the timing of their contributions.

“The best is the enemy of the good” - Voltaire (1772)

“I have not failed. I’ve just found 10,000 ways that won’t work.” -Thomas A. Edison

Physics undeniably has reached multiple failure points but that is not a failure of the process itself but a triumph of it and the very direct and unambiguous goal of the process! Though, it must be admitted, we do all sometimes (temporarily) forget that fact in defending science from the onslaught of science denial. However, the optimistic method at the heart of discovery is not to experience discouragement at multiple fundamental failures, but spine-tingling excitement at the anticipation of what those failures mean: A new frontier to explore is just over the rise!

WE HAVE CHOSEN OPTIMISM OVER DESPAIR.

The question many of us are asking, however, boils down to something in particular. *Do we abandon physicality and a mechanical basis for interaction altogether?* Many of our experiments have been interpreted as such and physics has adapted to those apparently world-breaking results while just carrying on, unflappably forward. Yet we now find ourselves at an apparent dead end and a decision. If we cannot move forward must we take a step back? Will we fulfill Bohr’s pessimistic prophecy or can we defy it?

The process of science and its reliance upon mechanical interaction is what led to the modern world. It was the abandonment of all non-mechanical explanations for reality that brought us this far. Though we sometimes deny it, both science and religion had a common cause that started with the childish question “why?” It later became something more akin to “what caused it,” but there is a quest for something deeper that fuels our curiosity. The only thing that truly separated science from religion was defiance against “magical” explanations of events, and that specific differentiation boils down to requiring mechanics for all events and processes. Unfortunately, we’ve found that this pursuit can become

the halting problem of infinite regress if we approach it from a linear step-wise process or system of logic. We found that limiter of Godel incompleteness in our own brains. Yet in our exploration of human intellect we've sensed a new (mechanical) methodology exists if we can just master the problem of integrated concurrent processing. The solution, however, may be very close at hand

THE PHYSICS COMMUNITY IS ACTIVELY ADAPTING AND WILL RISE TO THE CHALLENGE OF SELF-REVOLUTION AS IT HAS SO MANY TIMES BEFORE.

In "Physics Must Evolve Beyond the Physical" published in *Activitas Nervosa Superior*, Deepak Chopra has thrown down a gauntlet with the very real weight of experimental evidence that seems against materialism and with that charge an inferred condemnation of the human potential for rationally understanding the universe at the heart of it. It is a tacit agreement with Bohr's pessimistic outlook on the enterprise of physics. It is the path of despair for the endeavor of science. We must admit, that along with a great deal of modern experiment, it also has the weight of thousands of years of human experience, wisdom, and perspective found in spiritual practice behind it. It carries fundamental human questioning within the challenge. It really cannot be ignored any longer in the face of the many failures and crises facing physics. I would like to respectfully suggest that the challenge be taken up by going utterly in the opposite direction Chopra suggests to arrive at the very same point he believes in. There is something beyond the physical, information, and we are already addressing it.

I believe the young upstart we call science, can beat its older brother, religion, at its own game and that we've already begun the process. Those of a mechanical/materialist persuasion have been accused of being "dualistic" or "binary" yet those on the side against this "physicalism" wish to discard the baby with the bathwater and insist there is nothing true or real about reality and that only some vague, subjective, and amorphous "un-thing" is "out there."

Let us take up the gauntlet of challenge and reply in kind to the anti-physicalists by responding with the charge of hypocrisy in their support of "binary-dualistic" concepts of a universe consisting of one superior state - mind - alone. Let us burst in boldly to the "holy of holies" where we are warned to never dare tread and define even the "spiritual" in the rational terms of information

science and physics: configuration information and quantifiable energy. Let us say the spiritual is here and now and sensible as an aspect of this world, not something else far away. Let us insist that there always is data being processed by physical interaction and that data is energetic conformation and configuration well within the realm of the sensible and rational domain of science. It can be *labelled* spiritual while being treated as complexity science. Therefore no line exists between what is perceived as spiritual and what is perceived as material. There is no difference between the water and the bedrock when we say “river” because it is only defined by the action of the two in combination. “*The rock moves the river and the river moves the rock*” and as magical as that seems, we can still approach these sorts of truths with tools like partial differential equations while developing ever better tools. “Mind” is the energy in motion flowing through the machinery of physical objects combined with the way special configurations of objects we call potential energy allows greater interaction profiles. Let us be the ones to prove out a non-dual perspective.

Let us further ask if we’ve allowed ourselves to be led too far towards “magic in the middle” concepts of our experiments and question the nature of our cognitive biases that might have brought us to this crisis in physics. Might it have literally been our leniency toward non-mechanical descriptions that have led to this “catastrophe?” Was it our attempt to be open-minded that led us astray? Was Einstein right all along that the universe cannot be non-mechanical at its core? Have we not paid close enough attention to Einstein’s “aether” and not redefined our concept of dark matter far enough, or is there something else we’ve missed?

Is this resurgence of pilot wave and the Couder “walker” experiments an indication that determinism needs to be revisited through the lens of chaos theory and other new tools that were not as developed or available to the greatest minds of yesteryear? Maybe dark matter will lead us to realize that both the “faces and the vases” are complementary parts of reality. That mind and matter are a single yin and yang through *structured* energy and matter. Perhaps the “white space” of the vacuum is more concrete than we initially thought.

“We choose to examine a phenomenon which is impossible, absolutely impossible, to explain in any classical way, and which has in it the heart of quantum mechanics. In reality, it contains the only mystery. We cannot explain the mystery in the sense of “explaining” how it works. We will tell you how it works. In telling you how it works we will have told you about the basic peculiarities of all quantum mechanics.”

- Richard Feynman

This once was true... but simply *is no longer* true! The walker experiments at MIT give a real, sensible, and intuitive set of mechanics for what only *appears* stochastic, yet that mechanics can be arranged into “probability waves” thus showing that it is only our ignorance that requires the tools of probability to describe a system of mechanical determinism underneath. How many new avenues are wide open now that we know for sure that alternatives like this must be explored more seriously?

“But in 1952 I saw the impossible done. It was in papers by David Bohm. Bohm showed explicitly how parameters could indeed be introduced, into nonrelativistic wave mechanics, with the help of which the indeterministic description could be transformed into a deterministic one. More importantly, in my opinion, the subjectivity of the orthodox version, the necessary reference to the ‘observer,’ could be eliminated...”

But why then had Bohm not told me of this ‘pilot wave’?... Why did von Neumann not consider it? More extraordinarily, why did people go on producing “impossibility” proofs, after 1952, and as recently as 1978?... Why is the pilot wave picture ignored in textbooks? Should it not be taught, not as the only way, but as an antidote to the prevailing complacency? To show us that vagueness, subjectivity, and indeterminism, are not forced on us by experimental facts, but by deliberate theoretical choice?” - John Stuart Bell. (1987), p. 160.

When we first see strange things like a hologram which can be cut into ever smaller pieces while preserving what appears to be the whole image on each successive piece, our minds often break at what appears completely irrational and without time to investigate fully, we settle on some sort of vague “put it off for later” memory that is a non-mechanical concept in our minds by default, but when that vagary is left too long it becomes simply the “magic in the middle.” The history and genesis of science has been a process of proving out, however, there’s always a mechanical basis. Unfortunately, some processes have massive concurrency such as the profile of interference at play in the creation of a holographic image upon the eye. Our step-wise, plodding linear logic systems sometimes cannot solve such difficult problems well, yet we are at the cusp of being able to solve even this systemic problem with digital-analog-hybrid computation methods.

If one zooms in too close on a holographic plate, what is seen is not even a

commensurate component of the image but a jumble or smear that gives no indication of the larger image because each tiny section is reliant upon information from other parts of the whole surface to become ever clearer and more precise. The information is “non-local.” It is the zoom-in itself which we think of as increasing precision that instead directly increases imprecision.

In the walker experiments, the non-locality is not conceived of as some instant magic-at-a-distance but simply the concurrent evolving spread of wave configuration eventually impinging, in a causal manner, on the continuation of the very existence of the walker. It is the persistently emergent nature of the droplet that relies upon all the distant incoming causes for its existence. It exists holographically and we now finally begin to understand how complex that process is. We now see in the analogy how we can be fooled into seeing the magic of “probability” where there is only mechanics and determinism.

“At some point we have to give up and say that's just the way it is. Or, not give up and push on.” - Leonard Susskind

DO NOT MISTAKE OPTIMISM AS COMPLACENCY NOR THE MEASURED CARE OF SLOW CHANGE FOR DOGMATIC ARROGANCE.

This optimistic view of scientific pursuit could be misconstrued as another excuse to doggedly “stay” the failed course of orthodoxy. Support of orthodoxy can sometimes be just emotional and reactive opposition to the calls for utter abandonment of the project of science like Chopra’s challenge seems to be. True optimism, however, is instead, an active and fundamentally

self-doubting pursuit. It is a concerted effort of purposeful transformation of the knowledge system without destroying it utterly. It is resynthesizing of what we already have instead of throwing away the baby with the bathwater, but in so doing still holding recognition that the bathwater must be drained. It is simply defiance against despair.

Perhaps the anti-materialists have zoomed out far enough to see an image of “the hologram” that we “physicalists” could not see because of our level of zoom. Perhaps there are important lessons to learn from the spiritual community that we must not deny, but should, alternatively, translate through sensible metaphor as we work on understanding the actual surface projecting that image which they have seen. Let us not jump wholly from one extreme to the next, but synthesize

the truths and refine our picture through the proper combination of our perspectives.

I suggest it is possible that we've already created all the tools necessary for the revolution we require and the revolution isn't quite so revolutionary as Dr Chopra might prefer, but the shift in perspective Wheeler predicted is a revolution of interpretation and approach. It can still be fully revolutionary while remaining constructive instead of destructive.

The complex, yet solid, "crystal" of experimental evidence and mathematics we have developed in physics need not change dramatically and certainly shouldn't be destroyed or discarded!

However, if we simply change the angle of incidence from which the light of interpretation shines upon it, the image that comes out the other side will change quite dramatically.

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