Chapter 21

"Now and Then"

Loan

Assumptions.

If paradigms are like boxes, then assumptions are the sides, the walls that constrain our thinking. We can't think out of the box until we can question our assumptions, we can't question our assumptions until we can identify them, and we can't identify them until we can imagine a background which reveals them as foreground. Scaling this chain of barriers is a non-trivial endeavor.

A 'few' examples from history may help to frame the challenge.

Matter is continuous, until we discover the atom,

Matter is solid, until we discover the nucleus.

Waves are continuous, until we discover the quantum.

Electricity is electric, magnetism is magnetic, optics are light, until Maxwell says 'Eureka!"

Matter is matter, energy is energy, until $E=mc^2$.

The present is *now*, until it's a *plane of simultaneity*.

Gravity produces a force, until curved space.

The planets revolve around the earth, until they revolve around the sun.

The makeup of the sun is unknowable, until atomic spectra.

Zero divide zero is ambiguous, until we claim that how it's approached determines its value[1].

Same for one log one[2].

Can't have less than nothing, until we invent negative numbers.

All numbers are ratios, until we invent the irrationals.

The square of a number cannot be negative, until we invent imaginary numbers.

Numbers can be ordered, until we invent the complex numbers.

Numbers are single valued, until we invent the absurd numbers[3].

Paradox is meaningless, until we introduce imaginary truthvalues.

Objects can't be in two places at once, until superposition gives us ~~no~~…a choice.

Every effect has a cause, until nature demands we should all be better at statistics.

If this *or* that works, so should this *and* that, until nature interferes with our preconceptions.

What is way over there cannot instantly affect what is over here, until entanglement.

Do it with 4 lines, until you can do it with 3, until you can do it with 1, until you can do with 0, until you can do it with less than none. Are we always in a *friggen* box? How many boxes are there?

The list goes on – dot dot dot.

Time to add one more.

Which came first, the present or the past? Is that sentence even grammatical? Logical? In what universe would someone ask such a question[4]? Causal order is obvious, inviolable, baked into reality, it's plain common sense; past, present, future, period. It has always been that way, it will always be that way, and it is everywhere that way now: past-present-future. What's wrong with you?

Confession time: this one makes my head hurt. Intrepid Reader, are you tracking this? Have I lost you? What happens to our view of reality if the present can affect the past? Affect the future, sure, that one we are comfortable with, but the past? The past should be fixed, shouldn't it? It already happened, didn't it? At least our past should be safe. What happened to reality, it was here a moment ago.

Confronted with such conundrums the time-tested strategy is to change the problem. Consider metaphors, somewhat removed from physics, where the conceptual baggage limiting our thinking can be left behind. Games are a flexible source of metaphors, let's consider a couple.

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[1] Calculus

[2] Fast Calculus

[3] Ok, ok, it's a work in progress.

[4] Ours?

Recall quantum tic-tac-toe. Consider the collapse of a cyclic entanglement of all three moves on the third move. When was move 1 resolved? Oh, on move 3 – the present came before the past, or some of the past, or something. The tenses of natural languages throw more walls at us. Do we even have the language elements necessary to think about this, to communicate it, to question it?

If we are careful, maybe. Science fiction writers have explored this arena in depth for decades. Conceptually, it's not virgin territory. Our task is to formalize it, to characterize it mathematically, to frame so it is testable, falsifiable. Reality is not stranger than we can imagine, just stranger than we lazily imagine. Tackling this could turn out to be not only fun, but productive.

Here's another: consider a position in a game of chess, one which you can analyze four moves out. Let there be two obvious gambits, with different first moves, with different outcomes. One is better than the other, so, *after* thinking about move four of both gambits, you choose the *first* move of the better gambit. Did the future come before the present? Did the present come before the past? Common sense balks. Both should be ridiculous, but they are one and the same thing, the only difference being one of perspective.

Should *thinking* about a game constitute a part of the *reality* of that game? The eventual moves, the ones logged in the list of moves, are strictly temporal, strictly classical. In classical physics causality is past, present, future; every effect has a cause, every effect is preceded by its cause. In quantum physics…

Well…all bets are off in quantum physics. Does the universe 'feel' out the future, like a grand master? Are past and future entangled? Einstein convinced us that *now* is not a *relativistic* invariant, perhaps it is not a *causal* invariant either.

The warmup is done. We've stretched, we've hydrated, our trainer is giving us that infamous stern look, *wimp*. Let's grapple with the Realm – Paradigm wants to know *why*.

Classical physics would have us believe that the present is an infinitely thin line (oh, that paradigm again) between the past and the future. But quantum physics suggests that the present is a window around *now*, it has some temporal thickness, how much to be determined by the specifics of the system under scrutiny. Within this window, the concepts of past, present, and future become *ambiguous*; they are no longer invariants. When we try to talk about causality within this window, we find ourselves using the language of time travel – so be it, we are constrained by the tools at hand, but we can build better tools, if…we can figure out what new tools are needed.