A RESPONSE TO "Beyond the Causal Veil", BY BILL MEACHAM. FOR THE MONDAY, 3/11/13 MEETING OF THE "PHILOSOPHY FOR REAL LIFE" GROUP.

As I read it, you have made these points:

1. Neurological behavior is influenced by unpredictable quantum events. This proves that macroscopic events like choices are not deterministic.

"In other words, at the most fundamental level, brain functioning is not causally determined."

2. Therefore, absolute determinism is not an acceptable basis for an argument against free will.

"At this point we move beyond what physics can tell us, but clearly it leaves open the possibility that human will is free and even that something that transcends our ordinary notion of the physical – a soul, perhaps, or a god or a plethora of deities – intervenes in the physical world."

Let's address the second point first. I agree with those critics you describe, who say that uncertainty in the decision process does not imply freedom. In fact, it undermines both the "free" and the "will" components of free will. If a decision is shaped by an unpredictable external event, quantum or not, to what degree did you, as agent, intend the outcome? The only sensible answer I can come up with is, less than completely. To what degree were you free to choose among all physically possible alternatives of which you could be aware? Again, my answer is, less than completely.

Suppose you're doing your taxes. You're itemizing deductions. A cosmic ray causes one neuron to misfire, and you entirely fail to remember that you have a major deduction for medical expenses, so you end up

paying tax you didn't need to. Is this outcome what you willed? Were you really free to make a choice among all the alternatives that were available to you? I claim that the randomizing cosmic ray constrained both your freedom and your will.

Indeterminacy merely converts a binary view of free will (you have it, or you don't) into a probabilistic view (some statistical percentage of your decision process is outside your control). We don't need to go to quantum theory to talk about this. Arguments against free will that are based on absolute determinism can be adapted to the probabilistic framework, so removing absolute determinism doesn't change the discussion.

But quantum theory was mentioned, so let's address the first claim.

You described how the release of neurotransmitters into a synapse is triggered by calcium ions imported into an axon terminal via a channel in the cell wall. The key claim is:

"A given calcium ion might or might not hit a given triggering site; hence, a given neurotransmitter might or might not be released; hence the receiving neuron might or might not get excited (or inhibited)."

This is true in a trivial sense. A given calcium ion might not hit a given triggering site, due to a quantum event. But in order for this to have macroscopic consequences, the "caused event" (release of many neurotransmitter molecules into the synapse) would have to be statistically sensitive to single quantum events. In fact, a terminal has many calcium channels. A transient quantum event that causes one of them to stay closed does not significantly affect the concentration of calcium ions that end up inside the terminal. It is also possible that a quantum event

steers a particular calcium ion away from a particular binding site on a particular vesicle wall. Given the high concentration of calcium ions in the terminal, it's extremely likely that the net effect is zero - for every ion pushed away by a quantum event, another is pushed toward. If this were not the case, we would be dying of heart attacks before reaching puberty, since neurons that drive the heart muscle must be subject to the same quantum effects. We wouldn't even survive sunlight; our species wouldn't exist.

It's an example of biological fault tolerance. Critical systems like neurons - cells in general - are resilient to error through physical redundancy (multiple vesicles, multiple binding sites per vesicle, multiple calcium channels, thousands of available calcium ions per neuron). DNA has two complementary strands that encode the same information, in mirror image. For diploid cells, like our own, there is a second, informational, level of redundancy in the fact that there are two copies of each chromosome, one maternal and one paternal. These encode the same *kind* of information, but not in exactly the same way. Biology strives to eliminate single points of failure.

From the cell on up, we are evolved to be powerfully insensitive to small numbers of quantum or other random events that occur at or below mesocopic scale (micron size, small groups of atoms).