Trespassing on Einstein's Lawn: (my thoughts).

Many have already praised Amanda Gefter's book. It is very rich in ideas and new philosophy of physics for the cutting edge of physics. Its main concern is how something somehow came from nothing and how the existence of somethings is presently defined. Following Wheeler, she learns to place an emphasis on observer dependence for reality: each observer sees different events and a different section of space-time. In addition, a quantum "state" is not a separate entity from its measurement or observation. A state is contextual and depends on its measurement setup. If the primary determinant of what is real is its degree of invariance and observer independence, then she sees few particular objects or concepts that have complete all encompassing invariance for ultimate reality. Lists of candidates for real objects don't hold up well. For example space and time are frame dependent and have separately gone away to be replaced by space-time. Gravity can be transformed away locally. Electricity, magnetism, and light are merged into electrodynamics and QED. Her general theme of individual realities is disconcerting, but perhaps she is casting too wide a net or a too-narrow definition of "reality."

Although the book's fascinating new ideas and exclusions come from respected theoretical minds, we should remind ourselves that the key cutting-edge concepts she discusses lie mainly in the realm of speculation. We have no measured testing for the existence of Event Horizons (and hence no firm "actual" black holes), no Planck-size objects, no detected Hawking radiation, no SUSY, no superstrings or branes, no holography, and never any tangibility for eternal inflation, multiverses or landscapes nor even for gravitons. We do not presently have any "M-theory." And John Wheeler didn't really achieve his long sought final goals of understanding basic reality, so the book is unable to present an ultimate picture.

But the limited universe that we can perceive is still huge and has a stupendous and highly satisfying degree of invariance. We can be deeply appreciative of this level of reality. We can now see most of the way across our portion of the universe. We have roughly 10^80th electrons and protons in our universe, and all of them are exactly the same (same rest mass, same spin, same charge, same magnetic moment). There are now many kinds of recognized elementary particles and all of each type are also exactly the same everywhere and apparently for all time back to the earliest microseconds of the big bang. They are all made from the same "templates." More than individual observed instances or snapshots of observed reality, what we hold dear are the general abstractions from all the myriad particulars. We have a large set of basic physical constants of Nature that seem to be really constant and are invariant over space-time. We have basic laws of physics that seem to be obeyed everywhere. We have a new and deep appreciation for the nature of the physical Vacuum (our present vacuum is ``not nothing''). It is possible that our things and a primordial Nothing (the "H-state") are manifestations of the same basic nature of the Vacuum – the basic thing from which all things are made.

As a name for our basic abstract reality, I like to call it ``Form Heaven'' (after an early appreciation for Plato's theory of Forms or Archetypes or basic Ideas which tend to be invariant over distance and time). In modern language (way beyond Plato) this may be equivalent to the Vacuum and its various fields (fermion matter fields and boson interaction or `force' fields—and more). The fields are the potential to make matter from energy according to the information in the fields. Wilczek calls the collection of all fields the `GRID.' The Vacuum is the storehouse of all physical knowledge. What is included in Form Heaven has to also include changes under symmetry breakings.

Mathematicians like to claim Plato for themselves: all true math pre-exists in "The Book." But perhaps a core math evolved from and became filtered by the precise and invariant order of

physics. The physics part is testable because one can pump energy into any space-time point and get out one of many types of particle-antiparticle pairs. Pump in a LOT of energy and go beyond the breaking transitions. And one can re-measure a constant of Nature or retest one of Nature's laws and always get a repeat. The math part is more an overall feeling and faith about the pre-existence of math somewhere, somehow.

As a poor analogy for information carrying ability (there aren't many), consider DNA. Each cell in each part of our body has the information and potential to make any other cell in our body. The information is duplicated cell by cell but masked according to need. Similarly, each cubic nanometer of space-time has the duplicated knowledge of every other space-time bit and has the potential to create any of a number of identical particles. No one knows exactly how this is accomplished, but its reality is so complex that the need for extra dimensions might be implied. As another analogy, in 2 dimensions, strings have no knots. But in 3-D, there can be lots of different kinds of knots. In higher dimensions, patterns can be much more complex.

Gefter didn't say anything about this abstract invariant duplication of nearly an infinite number of instances across the universe.

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http://sackett.net/ThoughtsOnGefter.pdf