VARIANCES:
Life Unpercepted.

Against Teleological Entrenchment in Evolution and Design Alike

—Discussion of teleology

in the problem of *curatorial strategies for representational problems* in

Taleb, N. M., Read, R., Douady, R., Norman, J., & Bar-Yam, Y. (2014)
The Precautionary Principle: fragility and black swans from policy actions

—and a deconstruction of the *Neo-Darwinian social constructions* teleologically assumed in parts therein.

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~~If then what comes from art is for the sake of something, it is clear that what comes from natu re is too~~. — Aristotle, Physics, II 8.

"And those who were seen dancing were thought to be insane by those who could not hear the music." — Friedrich Nietzsche

"The present work therefore formulates a system, called non-aristotelian, which is based on the complete rejection of identity and its derivatives, and shows what very simple yet powerful structural factors of sanity can be found in science." — Alfred Korzybski

"The first step is to measure whatever can be easily measured. This is OK as far as it goes. The second step is to disregard that which can't be easily measured or to give it an arbitrary quantitative value. This is artificial and misleading. The third step is to presume that what can't be measured easily really isn't important. This is blindness. The fourth step is to say that what can't be easily measured really doesn't exist. This is suicide." — Daniel Yankelovich on McNamara fallacy

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Apr 19, 2019

Abstract

In this work of foresight, I communicated my perception of Taleb's policy paper and the Black Swan problem discussed in it.

To this effect, I:

1. Re-conceptualized the concept of "foresight," *non-teleologically,* and its "method";
2. Revived Empedocles' *non-teleological* philosophy of evolution with modern scientific data;
3. Located the real GMO safety problem in (you guessed it) *teleology*: in the suppression of dissent within institutions under a seeming assumption of *knowing* what waste is.

Keywords: the problem of induction, GMO, safety, evolution, horizontal gene transfer, innovation, innovators, imagination, opinion spread, public mistrust, the expert problem, falsification, aging, fragility, fragilizing, corruption, complexity, cooperation, waste, networks, systems, probability, emergence, Biosphere, Noosphere, cybernetics, policy, design, risk, strategy, foresight, genetic engineering, social constructionism, Semmelweis reflex, Neo-Darwinism, Protestant work ethics, fear of loss, fear of missing out, generation, efficiency, optimization, precaution, precautionary principle, induction, inclusion, dissent, groupthink, deduction, retroduction, cognition, cognitive cycle, propagation, complex systems engineering, monopoly, monoculture, decision-making, Moravec's paradox, Korzybski, Vernadsky, Nietzsche, Taleb, Galam, Hume, Lem, Margulis, general semantics, general systems theory, non-Aristotelian, time binding, networks, researchers, peer review

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Dedication

This work is dedicated:

—in the memory of Robert Nozick (1938-2002), who, despite coming from the Analytic tradition, possessed a Non-Analytic charity to allow the room for new ideas to grow.

—In the memory of Lynn Margulis (1938-2011), one of the true innovators who had suffered for her innovative thinking, like Copernicus, Semmelweis, or Turing before her.

With an amazing foresight, 50 years ago Margulis argued against the sprawling religious persuasion of Anglo-Saxon Biology, whose proponents still "wallow in their zoological, capitalistic, competitive, cost-benefit interpretation of Darwin – having mistaken him ... Neo-Darwinism, which insists on [the slow accrual of mutations by gene-level natural selection as a cause for evolutionary innovation*], is in a complete funk." (Sagan, 1967).*

Margulis' work had been accepted only partially, and public consciousness had it entered not at all. Shall it?

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Zooming in:

Foresight as Perception Variances and the "method" of inquiry

A serious view of **innovation** *is a philosophical view of* **change**. *"Social innovation," for example, used to be known as "political philosophy." And so on. To avoid the fate of Semmelweis, who infamously had the right foresight but no available* **theory** *to legitimize it by giving it a veneer of respectability, I will first of all state that this work and the very problem discussed in it (***not** *a problem for some) are conceived within a representational theory of truth and a non-Aristotelian epistemology.*

Perception creates one's reality. Foresight is all the possible ways to perceive. The normal state of technology is in it being broken. And when things break, suddenly, these previously simple systems become very, very complex, and our previous also simple perceptions, that were reflecting only a tiny fragment of the reality (despite us believing otherwise) become **not enough.** *Our worldview must have been having blind spots all the time, of course, but up to a point --- and therein lies the danger --- this was* **unknown** *to us.*

The first part of this work will provide a non-teleological grounding in the biology behind the construction of "GMOs" (Chapter 1) and a systemic risk management objection to their development. The remainder of this work (Chapter 2) will be devoted to **(also non-teleological)** *foresight --- suggesting a path forward, by way of new interpretations of dreams, in an artistic, rather than a forecasting, Excel-spreadsheet sense.*

I will be taking a trans-disciplinary, philosophically synthetic approach, not ignoring the science, but at the same time not limiting myself to it. We will explore the intersection of science, including its social and philosophical issues, and psychology, organizational and industrial. And call our new worldview arrival an exercise of "foresight." This work aims to correct some fears in technology management that have no basis in fact, for a practical reason that our reluctance to acknowledge the role of chance when trying to control outcomes in the world can actually decrease our ability to control these very same outcomes. We can learn a lot from systems that survived --- for a very long time --- and perhaps try to mimic them. But it will be easier to learn what **not** *to do --- how active closed-minded thinking can cost us. Throughout this work, we will be trying to become aware of unexpected ways to age, with* **aging** *(another simple yet elusive word) defined here generally, as* **corruption**, *progressive*

internal (i.e, self-) incompatibility or external misfit in both biological and non-biological systems.

Ontology of "Foresight" and my approach

We can paraphrase Roger Shepard's title in Dupré, 1987 and call innovation *a mesh between Operation of the Mind and Regularities of the World.* As the Harvard philosopher Robert Nozick[1] points out in his *Invariances* (2001, p.143), foresight-capable, *mildly schizophrenic* people lack sensory filters for the material that *all* people encounter *(but not all of them see).* Korzybski, too, wrote what became a classic, that it "takes a good *'mind'* to be *'insane*" (2010, p.105). In this is the challenge and opportunity of foresight. More of a challenge, since such people are traditionally ostracized by the society and are, more or less directly, left to die. At every stage of the perception-action cycle, *integration* must happen, and nonintegrable bits are not passed along further. This is called "selection" (as if there were an *agent* doing this), and it is an unfortunate principle that may be operating everywhere from germ cells to minds to ideas to universes, regardless of our psychological nonacceptance of it (see Nozick, 2001, p.165).

It is curious if not tragic how same words can be used by different people, meaning by them totally different things and talking past each other. In front of you is a work prepared for the Master of Design in Foresight degree, "exploring, challenging and finding *meaning*," as per its official description ("Strategic Foresight and Innovation, MDes," 2019). Well, *meaning* can be arrived at by a grammarian to the same extent that poetry starts with grammar. But we will get to this later. First, do we know what *is* "foresight"? Well, "exploring, challenging and finding *meaning*" it is. This implies individual *agency*.

Thesaurus.com broadly defines foresight as "mental preparedness" ("Foresight," 2019); with most of the synonyms listed being along the lines of the Apollonian logical planning, but some referring to the unconscious or less-conscious ways of "being prepared": *perception, prenotion, insight, precognition*. Googling the word "foresight" will give the same mixed results, among them a few new words (also a minority) to refer to the unconscious: *vision, awareness, penetration, discrimination, discernment*. As a Designer and Artist, I am interested in the *unconscious* and *subjective* and *imaginative* conception of foresight, of how we get to "realize" something, sometimes (not too often), and how our own biological structure and social normalcy cues affect what we look for, what we can see, and what makes us feel "good" about some things, but not others. My "foresight" therefore starts with looking *inward* as a potential way to look "forward." Not changing the world, but changing *oneself* to (potentially) change the world. This is, therefore, as the reader might start noticing, a *philosophical*, not an activist, endeavor. *Philosophy* is where innovation starts, not placards.

[1] I will be reflecting heavily on his lucid review in my discussion of the philosophical foundations of this work.

The design business consultancy Idea Couture refers to the practice of foresight as a "post-structural effort for contextual analysis" on the cover of one of their books, *Humans and Innovation* (Mootee, 2016). Are the "post-structural" and "analysis" at odds with each other in one sentence? This seems to refer to one of the incoherencies of postmodernist thought, whereby only the part of the structure one does not "like" is being rejected, while the rest of the supporting pillars (and their interrelationships) are *retained*, just for a different purpose. A will to innovation or a will to *power*? While leaving this apparent incoherency for a postmodernist to explain, I would like to focus on the more illuminating parts: the "effort" and the "context." These match well with Schopenhauer's view of *our known* world being a representation, conjoined with a *will*. And it is here, in the inescapable inadequacy of our world-map relation, that I see the principal opportunity for foresight in light of the problem of continued technological development and accumulation of knowledge it enables.

The only true representation of the world is the world itself. One can compare the estimated mass of the known universe with the mass of one's own gray matter, or even the mass of all the brain matter of the living (or ever lived) humans *combined,* in their similarities and differences, to start feeling one's inadequacy. One can recall Le Chatelier's principle for the practical discussion of "world-changing" efforts if the above is not enough. Or the Fermi paradox.

The objective reality is very imperfectly known via individual (subjective) perception. Foresight is the art of *perceiving* things *without* them being conceptually laden, without *projecting* too much of *oneself* onto the world. My foresight is subjective --- more variant under the transformation of its carriers than *logic* is. *Logical* foresight is nothing else but the same old forecasting/prediction. Alfred Korzybski (2010, p.50) provides us with an idea of the *natural order of nervous function,* starting with unspeakable levels, *close* to nature/reality/world, and making perceptual differences *fundamental*, "similarities appearing only at a later stage (logic, order) as a result of higher abstractions."

The definition of my foresight, therefore, evades traditional (positive) ontological approaches. Nietzsche viewed concept creation as a result of artistic transfer of nervous stimuli into images, with later pragmatic uses. So did Korzybski in his *Science and Sanity* (the '58 edition). Foresight is --- properly --- an ability to interpret familiar sensory information in unfamiliar ways. A description that describes the (undescribed) world in its *potentiality* (Nozick, 2001, p.49). Instead of trying to *predict* future, no matter how elaborately, one can better *prepare* for it by seeking new ways to see the *present*. Such an approach might be a bit more successful given the mass disparity discussed above and Le Chatelier's equilibrium law. It is an exact opposite perspective from the Anthropic Principle theorists, who seem to think the world must be (mostly) adapting to them, *not (mostly) them to the world,* as seems more plausible (it must be degrees and interdependencies in reality).

So, my resolve is to be adjusting myself to truth, not truth to myself (truth itself being an indexical *term here, ensuring* serviceability *of that, which it refers to.* This opens up a possibility of a conflict among truth-serviceability of different systems (technology, social expectations, reproduction). Sometimes, it cannot be the same truth.

My prior work on the nature of change (Teselkin, 2014) did not provide evidence to disprove Stephen Jay Gould, who famously argued for contingency and *against prediction* (Gould, 1989). I think Gould's position is even more true in the world of *social* change. The greater contingency, the less our understanding, the less prediction that can be done. I myself do not feel the need to rely on the (standard) illusion of predictability so as to suppress my psychological insecurity. See Nozick's Note 86 to p.155 for an interesting discussion. Please note that today's equation of "foresight" to "scenarios" by many is still a form of prediction, as already pointed out, insofar as it involves explicit or implicit probability weighting and general reliance on logic and on the past instead of reliance on the diversity of the evolutionary selected distributed machinery of perception. The forecasting approach is not *divergent enough* and *robust enough* to qualify as illuminating. It is still Aristotelian and still *gives rise* to Taleb's Black Swans exactly by trying to prevent them.

Ironically, it was the short-sighted, pedantic utopian Herbert Wells who was the first to use the term "foresight" (1932) but I disagree resolutely in this work with the apparent teleology of this "received" view, and especially with what had become out of Wells' coinage, today much elaborated --- *economist's prediction,* one way or another (e.g, see Hayward, 2005 --- economist and accountant). Not that I am picking on Wells --- his approach might have been good for the times and was a product of his culture; it is always *commodification* of a thinker, however, that does the most damage, and it is commodification that should bear most of the blame, too. I will make this point early so as not to repeat disclaimers throughout this work. In contrast to Wells, and his following, I take an Artist's view, not an accountant's. (Some people also do foresight by surveys, in a socially constructionist way, with opportunities to manufacture any conclusion that one desires through statistical incoherence).

My construction of foresight is *not* a collectivist, logical (in appearance), Apollonian *prediction* of any future, even if with (explicitly or implicitly) probability-weighted alternatives, such as by averaging, or of a particular (even if badly desired[2]) future. It is *not* hair splitting on a tax return --- but rather, something much more exciting. The work of an accountant is great and useful, as good as any work, but it has nothing to do with innovation. Rather, it maintains the transmission of the past. The implicit Aristotelian worldview of today starts with words and ends with them. It *imagines* a method of projection independent of the world as we know it. Where is the stage of cognition *preceding* words? ***That*** is Foresight.[3]

Indeed, the definition of foresight and the underlying approach to the unknown must be negative: what foresight is *not*. According to Whitehead, it is the *negative* perception that is the triumph of consciousness. Foresight, as *perception*, must be defined *by perception,* too. By its very nature, genuine foresight seems to evade intentional definitions of its identity; it can be defined only by its extensional context (what it is *not*). Not rational, *a*-rational. This

[2] "Prediction" of a particular future being, really, simply a *goal* in this case -- a common ideological wordplay. One's personal goals and creative thought need not be conflated.

[3] Foresight, not unlike the forgotten field known as "general semantics," is about the art of modeling and communicating experience, where it attempts to make sense of reality-as-a-whole. General semantics itself can be considered a precursor to the general systems theory.

makes it possible, it seems, to define foresight only extensionally, by what it is *not*. Indeed, an intensional definition would presuppose a shared commonality, but foresight, as one's unique mental map, is more of a foresight exactly to the degree it is *not* shared. A more specific definition of foresight would become so general so as to be unilluminating. So we might risk being pleonastic since there is a trade-off between depth and breadth. As Robert Nozick points out on p.136, "the possibilities can be so diverse so as to defy characterization in terms of a general truth." For someone coming from an Analytic tradition, understanding this requires undergoing a gestalt. This is why I find Nozick so illuminating --- one of the rare Analytic philosophers able to see the other side and bridge between the opposing camps. Designers must be biased towards *invention* (otherwise, they are not *designers*); everyone else --- towards necessity. With *enough imagination,* it seems or *should seem,* for one to be successful in the design trade, any necessity can be made go (without necessarily an ability to verbally *explain* it away).

Foresight originates within the neurological levels of registration *preceding* full awareness and is therefore conditioned by the unique biological structure of one's brain. Individual, unique, personal, semi- *(or mostly?)* unconscious *Gestalt*. Perception, which might lead to a recognition of a new pattern, that can in turn be further elaborated into _____. This view receives support from modern neuroscience (Berns, 2010), that is, from an empirical rather than *a priori* study.

The outputs of foresighting activity are: (1) gibberish; and (2) new percepts. *Results* are neither guaranteed nor aimed at --- by *aiming* one is guaranteed to get nothing, to the bafflement of logicians. Foresight itself does not reposition the world lines of particles; it generates (among all the gibberish) a new description of the same physical situation (Nozick, 2001, p.333).

We don't know why see things the way we do. Lacking meta-cognition, we never even ask this question, not even once in a lifetime. Foresight is dreaming, and dream is the birthplace of thinking, the childhood of innovation. The output of foresight are all the things as yet undreamt of. Just like philosophy in general, foresight begins in wonder, *that* state of consciousness that the ambiguity-hating educational system ruthlessly trains one to lose (Manu, 2007).

Why do we wonder what are philosophers for? It might be the legacy of Socrates and Aristotle, to whom whole our civilization is a footnote. Humans are naturally better at thinking up possibilities rather than at arriving at necessities (in this I agree with Nozick, p.121), but Socrates wanted to confuse us into thinking otherwise. "Whatever is necessary is possible, but not vice versa," --- writes Nozick. The core of the rationalistic view, and especially the subsequent further reduction of it, of the already reduced (..), and all the way to the bottom, does unbelievable damage to life, and the experience of life, *and sanity,* starting from high school fear of math, *and throughout.* In Chinese history, this confusion is historically known as "legalism." Foresight does not perfectly overlap with possibility, but it clearly co-occurs with it. That people have negligible talent for accessing necessities is a blow toward the Socratic obsession and a philosophical foundation of foresight as a form of Art. But, verily, the only real innovation can be coming from philosophical breaking of the invisible thought constraints, not necessarily from by-the-trade philosophers but from all

the active brains possessing a metacognitive capacity (no matter what occupation), and *not* from the bureaucrats and *activist* bureaucrats, as both would claim. To understand this, one has to have physically experienced it. Despite a bureaucrat's hidden metaphysical desire, words can only be of that much help. Especially in Art and Design.

Before I go any further, let me explain what this thesis is *not* so as to avoid confusing my readers or leading them down a path of wrong expectations. This won't feel and is not intended to feel as a typical academic work, which this work is *not*, as it chases after richness of perception and thought over clarity. I will not be excluding, in an academic way, things that exist but that cannot be clearly and simply described. This seems to constitute the most of the world. As we will see later, in Chapters 1 and 2, in both evolutionary research and industrial psychology, and everywhere else, too, a zealous over-reliance on the Apollonian/Socratic/Aristotelian way to the exclusion of everything else invariably creates an irresistible corruption incentive to pursue metrics and false clarity instead of Truth. Academic rituals make sense within Academia. Foresight, in contrast, must deal with the *whole world* that includes Academias of different cultures and ages, the world that had begotten them, too, among an infinity of other things, and that is infinitely richer in its ways of becoming and knowing. So, no, thanks Herbert, let us not limit "foresight" to *professors* of foresight, least of all the dogmatic ones, like yourself. We would benefit, as a civilization, from more inclusion. The rigor of the analytical methods, whether in philosophy or in economics, is false, and more --- dangerous. *Synthesis* is hard, destroying is *easy*. The Aristotelian "rigor" is based on shaky foundations that we forgot are shaky, and socially constructed assumptions, that we forgot are socially constructed.

But things can be different. No boredom, imagination instead. Foresight is an individual, personal way to *see the world,* and as such I will be trying to communicate my foresight, which is not an easy task, for no two things in the universe are identical, much less two brains. It will almost feel frustrating, at first, as I mix concepts and fields, arbitrary delineated by social convention. Of course the results they are hard to communicate, as no two things in the world are "equal" to each other, in any possible sense. So is the nature of *foresight*. True foresight, Designer's foresight, is non-identical. It is a product of imagination, although most imagination does not lead to a formulation of anything coherent. It's great that many people are polishing and refining all the innumerable details that together constitute the human civilization. I call it a hierarchy of deduction, and it can be fulfilling to those who like it. But too much fondness for drawing of conclusions that are absolutely certain from premises that are, in turn, only *assumed* to be absolutely certain is incredibly *fragile*: the world also needs big picture thinkers who will step on boundaries, question established consensus, and make bold claims which will later be corroborated or falsified by those who are much more interested and have the physical ability to concentrate on all the innumerable syllogistic details and consequences. So, this work intends to be a big-picture provocation. I will leave "strategic planning," a stage succeeding foresight, to others. There is no shortage of professions specializing in that.

This work is a reflection, too. And this reflection is a *requiem for the lost potential.* The future, such as the future of technological safety, is at present compromised by social undesirability of iconoclasts, tricksters. Everybody says they want them --- but few actually

do, since "normal people's" gestalt of iconoclasts is a perception of them as "troublemakers." *Comfort* is better. The lack of variances.

As a work of foresight, this work is both subjective and objective in style. Subjective as long as it involves *humanity* and human foresight as a unique way to sample the reality, and objective in this foresight's partial dependence on the real-world experience and the experience of others. Foresight here, again, means neither redistribution nor optimization nor planning --- the desires/activities it is often substituted with today by various interest groups who may unreflectively think, owing to a lack of imagination, that *their* world is *the* world. The position taken here, that truth is locally relative to time and place (i.e, to scale), *in the representational contexts in which the notion of "truth" gets a grip* and determines success in action, is not at all the same as social relativists claiming that truth is relative to certain social groups. The localism, scale-variance, and observer-dependence of the notion of truth is not at all the same as its social constructionism; in fact, as we will see throughout this work, postmodernist approaches may well be masking the more illuminating issues and, worse, enabling more problems than they solve. There are costs, surely, to the "received" notions; but the *alternatives* are not without theirs. In this I agree with Nozick (2001, p.44) and will add that social expectations determine not the truth property (i.e, correspondence to facts), but what is *acceptable* as an appearance of such, and this, indeed, *will* be culturally relative.

Although something becomes an objective fact, in part, because it is intersubjectively agreed to, this holds only if the agreement is in good faith, independently of societal pressures, i.e. while aiming at disagreement and being unable to achieve it. An intersubjective agreement without an objective fact does not by itself constitute the criterion of truth and has led to witch-hunting in the past. This is what we call a "social construction." Hutchins (2005) pointed this mechanism as one of the two responsible for representational stability and generational propagation of conceptual blends, i.e received foresights/percepts. This can illuminate why there is a consensus behind some things *but not others.*

An explicit representational theory of truth (that parallels intuitive aesthetic approaches to truth, which artists adopted since the time immemorial) is taken in this work and seems to be a minority view: neither received, nor a recognized major alternative. *In this lies its innovative value.* In can provide a much-needed bridge from Art to logic.

So, "foresight" is taken here in a sense Einstein took a similar concept in his 1952 letter, written three years before his death: as a mental state and activity that can result in an inductive leap from sense experiences to a cognitive paradigm, an informed and exuberant guess of a possible strategic ambition (quoted in von Baeyer, 2004). Foresight is fundamentally a *perception*. In his *Invariances* (2001), Robert Nozick, without using the word "foresight," describes this process as "an illuminating display mechanism, a way of making sense of information by placing it in an intelligible gestalt." Illuminating in its own right is his example likening foresight to the children's pastime of connecting the dots of data to form a recognizable picture. Most of this process is unconscious or semi-conscious, in a way we barely understand. This view is in accord with Duncker's (1945) "suggestion from below" view of cognition, where the difficulty in adaptation lies primarily in

recognition of a solution, already present in one's perceptual field, *as* the solution. Once the correct possibility is found, the search and use of evidence in relation to it often takes little effort at all.

In his book *Information: The new language of science (2004)*, von Baeyer points out the almost universal confusion of foresight with a logical, methodical inference, "suggestions from above": foresight is anything but. Design *thinking* is an error; design *feeling* might be a better verbal construct. The mystery is still there; there is no shortcut for producing the creative component of human civilization and neither there exist any systematic means of creativity evaluation, since nobody can predict the future, and evaluation itself presupposes prediction.

Einstein described foresight as a 'free invention of the human intellect,' inspiration, imagination, invention, intuition, insight, and instinct. Einstein was both an artist and a scientist. Von Bayer also offers a sketch of Einstein's in his book, depicting what might be called a perception-action cycle, with foresight represented by an inductive arrow that "doesn't spring from any point in the plane of [sensory] experience, but skims along over it for a little, gathering evidence, as it were, without requiring a firm attachment to specific facts" **(Fig. 1).** It is this unpredictable swooping arrow (that can arise only *unplanned*) that was being borne in mind during the development of this work. The *creative* part. Starting with practice, and not with theory, as the boring planners who misuse the word "foresight" to denote something equally boring would rather have it. The Popperian-style unlikely, but unavoidable *"Take a wild guess, and sometimes be right!"* (2005), a new way to see the world, instead of the deduction-first approaches like those of Platt (1964) --- the falsely efficient, Socratic approaches based on the prior constructed "reasons." This is what I will be trying to develop -- an increase in our perceptual affordances, *something illuminating and interesting*.

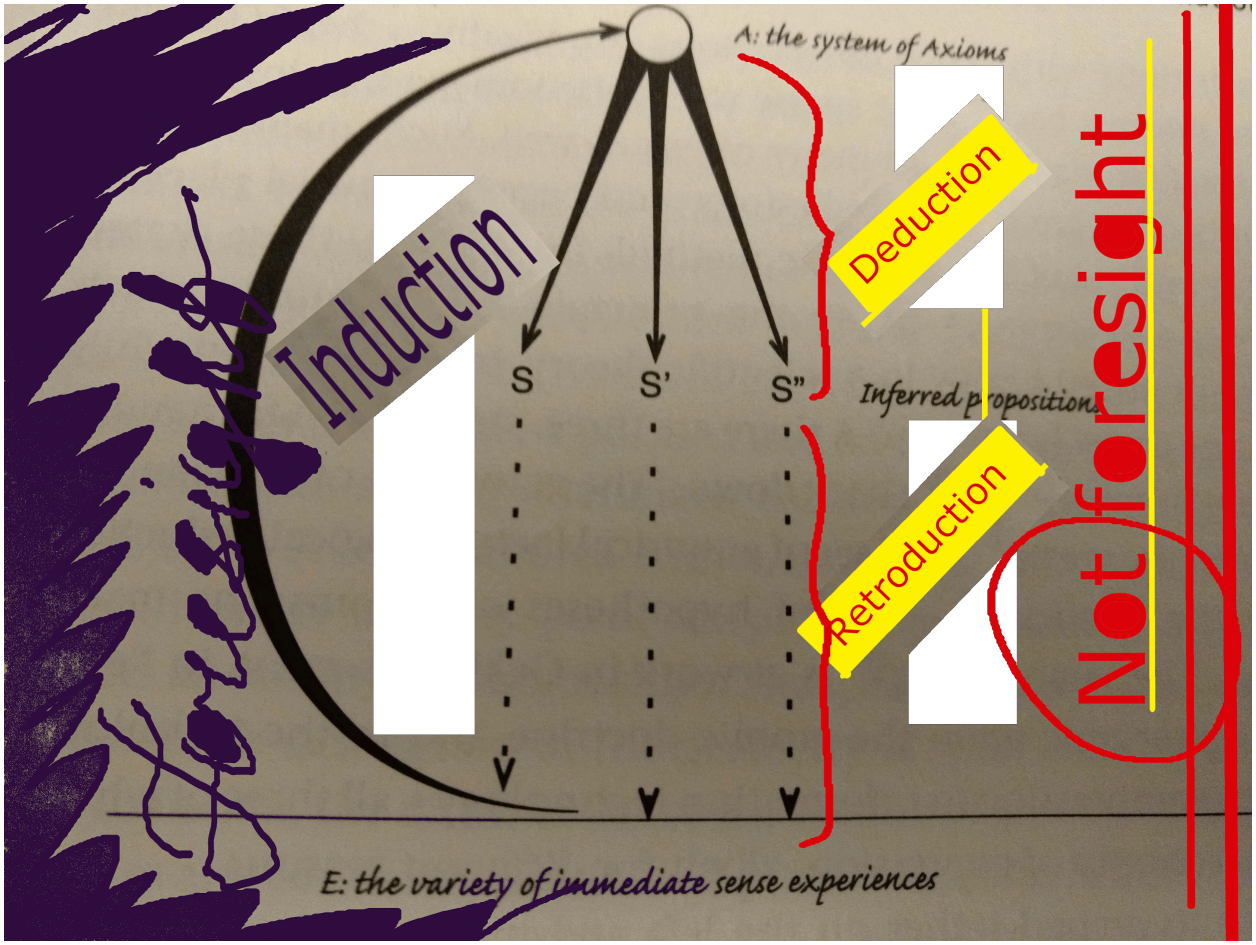

Fig 1. A natural order of evaluation. Foresight redundancy periodically reinvigorates our deductive (language and logic) frameworks by recognizing new patterns, preventing deductive, exclusionary aging through unintended effects of removing oneself from the the reality (bottom) and subsequently becoming incompatible with it. The results of such potential restoring innovations, labeled as S, S', S'' here, must, in turn, get tested by reality through retroduction --- heuristically, intuitively, or formally, such as via Bayesian objectivity-seeking methods --- and then the cycle must repeat to keep the adaptedness, in a race against the Time. The proper order of the operation of the full cycle results in fitting a better structure to facts at hand, their more adaptive representation. Deduction and Retroduction (aka Abduction) are *not* Foresight. **Modified from von Baeyer, 2004.**

As we can see in the Fig. 1,[4] foresight would have been unnecessary and superfluous if we had no blind spots in our thinking (that are revealed not immediately or all at once, but over time), if we had access to the ultimate dependence relations. Abduction only would suffice. But we cannot keep adjustment without creating new structural visions through

[4] (which is my take on Korzybski's 1958 anthropometer --- the Structural Differential, or on the Moravec's Paradox, which it preempted).

translations of own (unspeakable) experiences and those of others. Deeper insights, abstracted in a way so as to be communicable, can be of use to all of us.

Abduction (or Retroduction) and Imaginative Induction/Foresight are similar and historically confused. The difference is that one proceeds according to rules, while another does not, i.e. is *creative*. Foresight, as a creative process, provides us with new structural means of exploring.

This is a confusing topic overall:

- Induction/conception boldly asks: "What's possible?" Sensing is a key part here. Induction as used in this work is *more* than a form of reasoning. It is primarily a form of perception, and maybe more. Induction generates possibility.
- Deduction/inference/thought: "What follows?" It used to be, and still is, mistakenly equated to the "cognition" itself, of which it is only a small and evolutionarily recent part.
- And retroduction brings us back to reality, in a risky, eliminative way, by asking "What's likely?" Here, delaying the risk of reality testing only accumulates more of it. Thus, we obtain, contingent on our survival, the "best explanation." And we repeat the cycle. We take actions and, if we survive their consequences, adjust our worldview based on the feedback of the world thus received. Veridicality is thus more ensured by survival rather than by persuasion. Retroduction arrives at the "best explanation" by making representations survive the balance of biological and social selection. *It's complicated for a social species like ours.*

There is always a possibility that our best explanation was only *as good,* since we could have *failed* to think of something that was possible, by lacking sufficient imagination. The difference between Retroduction and Induction (as cognitive operations) is the degree of uncertainty the operation of the two entails: abduction is *tamed*, *domesticated*, amenable to systematic methods such as Bayesian inference and its probabilities assignment; what is *untamed* is left to humans, and constitutes the Problem of Induction, "wicked problems," the riddle of the world, Foresight/Art.[5] Foresight, in contrast to *non-foresight,* embraces subjectivity instead of staying ashamed of it. And this is vital, because ignorance of everything we do not know (the very act of creating a category of "unknown" for it) gives rise to our blind spots. If one is not aware of having blind spots, one is not a very good driver. Except that in complicated technosocial systems, such as the one that will be discussed further in this work, the hit one gets is neither immediate nor as accessible to logic, as in the case of a car accident. Foresight is what *illogically* and *unexpectedly* fills the blind spots in our thinking, over and over, even though we do not quite understand how. *What we do not understand, however, must be the principal focal point here; it is primary to what (we think) we* do *understand.*

Foresight --- we can conclude --- is then about the *art* of thinking up possibility (the art of possible, *not necessary,* pattern recognition). An exercise of foresight is like trying to recall a dream you just had and vaguely remember upon waking up. But you know it was

[5] As Taleb points out in his risk management application, rare events cannot be estimated from empirical observation since they are rare. This gives rise to blind spots, Black Swans, in our expectations.

something important --- the (non-Socratic) work your brain was doing while asleep. The exercise of foresight in this work had been inspired by my background in evolutionary biology and its relation to the issues surrounding one particular and very complicated system, that of genetically modified organisms, the "GMOs," and their furtherance in the food supply system.

In the popular debate, 'GMO' typically refers to transgenic organisms, which are novel in the means of their creation *by human culture.* Or, perhaps, we can say that the category of 'GMOs' is self-referential and doesn't exist (Tagliabue, 2015), which it truly doesn't, like all socially constructed forms. But I will refer to it in this work in the same way it is being commonly used in the general discourse, since I aim this work as a bridge among different "worlds." Let us proceed to the introduction of the GMO problem.

Other Metaphysical Assumptions and Taleb's GMO paper

The common human pattern of making one's mind once and forever, *and then tying it to one's identity, in a scale- and time-invariant manner,* comes at odds with the desire for innovation and technological safety of existing systems. Foresight --- even if it later turns out to be *physically* false, by a "decisive" experiment --- serves a function of extending our conceptual realm of *metaphysical* possibility. In his Note 34 to p. 133, Nozick seems to suggest that we will avoid physically trying what we (falsely) believe is metaphysically impossible. The Renaissance in Europe happened only *after* some mental shift --- the necessary materials were *always* in the ground, ready to be turned into civilization, and people were having their two hands and one head for a long time, as well (Selkin, 2018). Yet, the cultural explosion did not happen until some foresight was received and materialized. The function of foresight is to break such self-imposed mental barriers and thus enable innovation. Or *maintenance*, for systems complex enough, like those of today (which we take for granted until they break).

We live in a virtual world of stereotypes. And, despite all of the clarity of our definitions and concepts, they always lose this clarity once we make an effort to transition from our thoughts to the reality or even to unambiguously *define* any common concept. Reality always looks ambiguous, blurry, etc. The world is infinitely thicker than any data we can extract from it. All this equally applies to the mental concept of 'GMOs.'

All mental constructs are wrong: the old ones, the current ones, and the ones to arrive. They differ not in a degree of "truth," but rather in a degree of adaptedness (or truth *thus defined*) --- which some worldviews enhance, and others don't. Adaptedness itself, at a given spacetime, for a social species, is determined as a trade-off between the individual (foresight) and the shared (logic and language). *Does our reliance on some modern technology make us more or less adapted?*

In an unrelated exploration, I stumbled upon Taleb's Precautionary Principle paper (2014a), advocating against the entrenchment of GM technology on the grounds of

unpredictable, unbounded risk this brings, and asked myself *what I should think of it*. In his foray into genomics, Taleb claimed that only statistical reasoning mattered for the purposes of strategy, without regard for biological expertise. I was intrigued whether I can think it is *true*. The argument turned out to be not at all simple or one-sided, so I reserved the judgement and kept piling up thoughts and evidence, from multiple facets, putting it side by side. This is how this project was born.

These ideas later expanded into a larger discussion, all of it devoted to the interplay between biology, society, and technology. Eventually, I succeeded at singling out the real issue in the Taleb's view, and, as we will see in the coming chapters, it was not the genetic technology itself, but rather the cognitive issue of our lack of humility in designing for the uncertainty we do not recognize as such --- and understanding (or not) one's limitations when approaching such strategic design. We can blame the Socratic-Aristotelian influence for this.

When analyzing the opportunities, as well as local and potential catastrophic risks associated with GMOs, one often does not realize that much like evolution itself, risk occurs at multiple levels, and often increasing risk at one level means decreasing risk at another level. The metaphysical overshadowing of the scale-dependent nature of truth by social relativist claims contributes towards this neglect. The risk of progressive misfit and collapse of some levels is what I call a system's *aging*, or progressive incompatibility, *fragility* at those levels. As with "foresight," "aging" seems impossible to precisely define, even though everyone "knows" what it is, through lived experience and intuition.

Chapter 1 will be devoted to discussing how we ourselves, biologically, are nothing but walking "GMOs;" how natural selection, a *constraining* force, gets confused with *generative* evolution, and how the mechanisms of *maintenance* of species do not at all explain their *origin*. But the real issue will reside in neither selection nor even in variation. It will be in the scale of things and the dogmatic optimization desire.

In Chapter 2, I will apply the meaning from our new worldview back to the GMO issue and extend it beyond GMOs to this and other *technosocial* systems. Armed with both the biology from Chapter 1 and the idea about risk in complex systems, I will find a way to finally do some justice to Taleb's anti-GMO argument. Again, I never aimed to review the entirety of the GMO debate, as some may lead themselves to believe, but rather to discuss a particular argument in it, Taleb's probability argument from the connectivity in combination with our blind spots arising from Problem of Induction. Full connectivity results in a monoculture, and stepping into this zone can be as dangerous as driving *faster*, not slower, in fog or in rain, due to some inexplicable arrogance of modernity that makes one feels *safer* exactly as one furthers oneself into a danger zone.

I will emphasize the need for active avoidance of this unifying *monoculture* at least at some levels since corporate monopoly concerns and transgenic technology itself do not have to be conflated.

Monoculture, as we will see, results into *aging* of whatever system it touches. Organizationally, this is embodied by the common meaning of the word "corruption."

Monocultures will seek to optimize (reduce turnover), and this results in higher level systemic risk.

In the later sections of Chapter 2, we will discuss proposed solutions to combat optimization monocultures and address our blind spots. For example, imagination as a tool to combat corruption of institutions, and the wisdom of designing for the allowance of deviations as a weapon against protocols. We will ask ourselves, how do we, short of abandoning civilization and returning to the ways of the past, design not for what we *do* know, but for what we *do not?* Finally, we will remember the conclusion of us being "GMOs" ourselves and try to make something out of it.

The overarching aim of this work is to inspire innovation through biological principles and bio-inspired management. Philosophers talk of *actual* and *possible* worlds. Necessary truths must remain invariant across all possible worlds, but I will join Nozick, as a designer, in my inability to find any. Even if they do exist, focusing here means setting oneself to failure, in a craft of innovation. Necessities will come into play in the Retroductive step of the Fig. 1 cycle.

Life, evolution, in contrast to deductive cultural desires, survives and flourishes by harnessing *possibility* rather than probability (Kiss, 2009). And possibility is contained within human generation of Foresight, just as it is in the biological generation of evolutionary innovation. Everything that is 'life' unbelievably happens *against the odds of physics.* And Foresight also happens absolutely *against the logic of planning.* Life does not rely on cost-benefit analyses. It scales up the monstrously improbable results and does so with a magnitude that makes the numbers from astronomy look small. And so does *genuine* Foresight.

The Epistemological Position and Epistemological Black Swans

Korzybski (2010, p.106) points out that Pavlov's language was responsible for his experimental results. The *structure* of a question already closes upon the *structure* of answer; the two are co-dependent. They rely on the same structure, and structure is the *only* content of knowledge.

"Conventional wisdom" sometimes turns out heavy on convention and light on wisdom. Away with *'emotion'* and *'intellect,*' *'body'* and *'mind*.' Those are all false, harmful splits. We try to project the structure of our language and objectify the words for which there is nothing at all to exist. That is why, in any research, the hardest (and overlooked) part is not how to *answer* something, but what and how *to ask*. Otherwise, our old unconscious assumptions end up contaminating the process aimed at innovation, and we end up where we started, despite having had expended a lot of effort; no innovation obtains.

On p.109 (2010), Korzybski notes that "the analyzing and synthetizing functions, as usual, overlap, and cannot be sharply divided, both functions being only aspects of the

manifestation of the activity of the nervous system *as-a-whole*." "Analysis" for my epistemological purposes can refer to the delineation of a "research question," and "synthesis" to the formulation of an "answer" to the said question. If anything, it is evident that the order of *question-answer, if we can talk about any order at all,* the order of *analysis-synthesis,* is being teleologically *reversed*. This entrenched mental model seems false to the facts, to the structure of our very own nervous system --- and is an influence of Aristotelianism. *Some synthesis must occur first before any analysis is possible.* One cannot be dividing a pie that one does not have. We will encounter a similar teleological fallacy in the generation-"selection" dualism (with focus almost entirely on the "selection") in the discussion of biological evolution later on.

Alfred Korzybski's promotion of non*elementalism*, *abstaining from* verbally splitting what cannot be split empirically, fully applies to our damaging idea of the "certified-proper" way to conduct research, *from research question, to lit. review, to research answer.* Conclusion. The Dot. This mechanistic approach I will call "scientism." True science is actually Art. As is true business (Manu, personal communication). Our teleological mental "boxes" are very hungry for content (structured so as to fit these boxes, of course, to be *compatible* with them). *My intellectual strategy consists in celebrating of variances; this is enabled by avoiding teleological fallacies.* Observations that never reach conclusions are hard to bear for a teleological soul. If we were to suppose that there are no independent truths, can a discussion of what kind of process is best at discovering them get a grip at all? Robert Nozick is afraid it may not (2001, p.237). He calls importing the notion of objectivity to subjective realms a form of *fetishism*. I will add that such fetishism can be traced to Aristotle. Fetishism towards research planning. Our intuitions towards it are shaped by nothing but cultural conditioning. Why do we give our fetish a normative weight then? "There is no guarantee that every function will bask in whatever light is given off by what serves it," -- Nozick points out on p.240. A denial of Aristotelian teleology, like a denial of Aristotelian identities, cannot itself be denied without imposing the burden of impossible proof on one who denies the denial (by an Analytic philosopher, for example, operating within the methods of the very framework being denied). Like Alfred Korzybski, I think that *teleology*, an "intensional orientation," while *useful* at times, causes a lot of human *"un-sanity."*

"Actual research, when it occurs, predates its social justification. On p.238, Nozick suggests that the extent to which an already existing thing is shaped by the possibility of its justification is an open epistemological question, and not an *a priori* teleological constraint. *"Why does it exist?" is, therefore, not at all the same as "What is it for?"* Human cognition relies on narratives and the narrative structure (which I will call here a narrative *fallacy*). We owe this teleology of the perceived need for a research question to Aristotle (and our own illusion of agency), without realizing that this presupposes something impossible. When one is *not* ignorant of one's own ignorance, one realizes that any system around one is so complicated *that one does not even know what questions to ask.* Foresight does not need that illusion to "truly know" to start —- a "research question" comes closer to the end, not in the beginning. So it is worthless to wait for the planets to align. Finite intuitions do not extend to the infinite. They fall prey to a survivorship bias. Where do you start when faced with an infinity? If from some arbitrary place, then why from *that* place and not from

another? What is a non-arbitrary starting point for knowledge? It would seem unduly parochial to maintain that one's custom is appropriate one simply because it happens to be one's custom. Especially, if the desire is for "innovation." Foresight is not a laundry list. Just as foresight itself aims to expand our horizons by challenging what we believe to be prima facie metaphysical necessities, the *process* of arriving at foresight must challenge a *lesser* necessity --- the *epistemological* one.

Foresight is *not* a type of detail-oriented task work. This view of it is a cultural artifact of the Protestant work ethics, applied *everywhere*. Human foresight, like the grand biological evolution itself, is not done for a purpose; its outputs are its by-products. Foresight is far less *voluntary* than economists and accountants, who often claim overlapping expertise in this *design* area, can make one think. Do they know what is Art, though? It's not a picture on the wall, or a pretty cover for a book, the content of which was derived, essentially, by taking a placeholder in the bottom right corner of an Excel cell (with a formula in said cell) and extending it down the column for 50 years ahead. Like evolutionary change, which does not happen *in a fitting manner,* but rather in an overflow manner, foresight lacks teleology, too, despite its human agency. One does *not* possess foresight; one is *possessed* by it. Bureaucracy and everything associated with it will take its root *after* foresight, in the *Step 2* of the Fig. 1. Unless, of course, we are living in a *Bureacrosphere*, where *everything* is a bureaucracy, and its will to power is uncurtailed.

Like Francisco Varela, I view cognition and consciousness in terms of the enactive structures in which they arise. They are not at all things-in-themselves. The awareness of the need for an open-ended phenomenological examination is still nonexistent today in the West, as in Varela's time. *Socrates poisoned us by elevating Reason into a criterion of reality and thus making the reality False.* In this is the origin of Taleb's Black Swans. In the bureaucratic confusion of:

1. *Foresight* with *deduction*, *description* with *inference*;
2. And also in the *objectification* of this confusion.

Korzybski (2010) develops this discussion on p.134. From the cognitive perspective, the joint, self-reinforcing bureaucratic confusion (the combination of [1]+[2]) lies in setting a filter for sensory data so stringent so as to arrive at a comprehensible theory at the cost of dispensing with veridicality. Otherwise, it will be uncomfortable. And the lowest common denominator will be used as a criterion for comprehension. The good news is that filtering criteria can be changed, including the coherence and planning criteria themselves. In the *Embodied Mind* (2017, p.26), Varela points out that there is no abstract knower of an experience that is separate from the experience itself. Foresight is therefore "a first person art."

There is no guarantee that for any data some procedure would yield objectivity, nor is there a reason to value objectivity (defined circularly, as adherence to particular criteria) as a goal-in-itself. The cycle in the Fig. 1 must spin, and its only objective is survival -- through veridicality of representations. It is not a necessary truth that there is no research without a research plan. In denying this necessity, I will use Nozick's method described on

p.138 of his work: "given an apparent necessity of *p*, search for an explanation of it and see whether the apparent necessity *p* is preserved under that explanation." I claim that the necessity of a research plan is explained away by a cultural, deductive reliance on Aristotelian logic that had shaped the Western civilization, and its ways. Because there are cultures that map their methods of knowing without Aristotelianism, I know that the apparent necessity of Aristotelianism is a cultural construction, owing to its variance under reduction. In this work, I do not accept the authority of the Aristotelian convention. *A designer's job in general is to question contingent perceptual and logical truths dressed in the outfits of necessity (for the reason of culturally constrained imagination).* OCAD University's motto is that imagination is the new currency. The institution calls itself a place where imagination is *welcome*. Imagination is opposed to Aristotelianism. The cultural necessity of Aristotelianism establishes a shading, imprinted throughout, that we cannot be aware of. So, one cannot claim to be "multicultural" while leaving some arbitrary (if not central) cultural constructs intact. *It's turtles all the way down.*

If our neurons are the hardware, Aristotelianism is the dominant functional architecture of that hardware, and any particular theories conceived within Aristotelianism are particular pieces of software within that larger functional architecture. Additionally --- and this should be especially apparent at an inclusive Art and Design institution --- on top of languages using different representational structure, *embracing* uncertainty rather than trying to squeeze it out (e.g, in the Chinese language(s)), there exist entire unaccounted non-languagelike modes of representation, such as those of Lévy-Bruhl's "prelogical peoples'" and *their* ways of becoming, described by Lévy-Bruhl throughout his work still from within the bounds of an Aristotelian perspective.[6] These non-Aristotelian modes may be capable of a wider and more dynamic information processing in the perception-action cycle. Black Swans arise due to representational features that are not the features of the (thick) world, but rather the artifacts of the mode and particular realizations of its (thin) representations. Having been *damaged* by logic, indeed, wouldn't it be nice for us to become "post-logical" peoples?

The artistic medium in which this work is being communicated is the English language. One does not arrive at poetry by starting with grammar, and one does not do research by formulating research questions, not research of consequence, anyway. Both are excellent ways to self-sabotage, and wonder for generations what was being wrong with this logic

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[6] See "OCAD University Academic Plan, 2017-2022," Principle 1, *Decolonization*, on p.13, which seems to equate "Indigenization" with identity politics, *in a standard Aristotelian way,* instead of starting with decolonizing from Aristotelian shortcomings in the first place, as this work attempts to do. For the purposes of this work, the Plan promises transformation of "knowledge production and what constitutes knowledge within the university context and beyond." My epistemological discussion communicates exactly my (evolving) perspective on that, "through a process of ongoing reflexivity" (p.13) that undermines both the Aristotelian epistemology, his identity philosophy and misconceived identity politics consequent to it.
As per the p.44 of the Plan, this work attempts to "pioneer novel research paradigms, practices and traditions at the intersection of the visual arts, design, science, engineering, the humanities and the social sciences," and my rejection of research planning is my step towards this laudable goal. The "human spirit" that p.49 of the Plan aims to "reclaim and reflect" does not operate through laundry lists and Socratic/analytic toxicity.

(or any logic for that matter). It turns out that human logic can create more problems, when out of proportion due to some epistemic foundationalism ascribed to it, more problems in today's world than it was able to solve in the East African savannah, where it was originally *selected, on the balance of the adaptive and the nonadaptive,* to deal with things such banding in groups so as to hunt together. Why would we expect it to be able to explain things like quantum mechanics, Black Holes, evolution and innovation, and even see its own limitations? *No closed system is able to see its own blind spot without* ceasing *to be a closed system, i.e. from within.* If there is an overlap between what seems *consistent* and what is *possible*, I maintain that it is not be found within the Aristotelian convention.

An individual acquires knowledge through perception ("foresight"), reasoning, *and survival ("real world"),* all mediated by social pressure. The real world, more often than not, exists *as an abstraction* for the Ivory Tower, yet another Aristotelian category; and social constructionism is now starting to get recognized not as a political tool (in which role it has a fruitful history) but in the philosophy of science. That the world exists in a definite state independently of our observations had been known to be false since the receipt of quantum mechanics; this notion instead migrated to the humanities, and stayed there, underlying many research assumptions --- in an area where they are even less true. In all cases, the explosion of our conceptual horizons had been driven by "hard" sciences, by new sensory data, new ways to percept and gestalt the world, that is, was coming *contra* rationality and *a priori* thought. Nozick points out that some go as far as to question the very idea of the *past* and the *future,* and the "obvious" connection between the two --- with backward time travel now seemingly permitted (p. 133). *For lack of imagination, anything is "obvious."* We don't need to take it *that far*; suffice to say it is quite plausible that our *thought* does not obey any predetermined plans, and does not travel in a linear fashion --- so why does one keep insisting on 5 year research plans and the like *acting* to impress some soulless bureaucrats, even -- laughably -- in "foresight"? *Not much* had come out from such a mode of research (Meyers, 2007). Perhaps someone got richer.

Thomas Kuhn first noticed the apparent contradiction of logical explanations for the emergence and acceptance of new paradigms (Kuhn, 1962). The problem must have been in the gimmicky reliance on logic that was (and remains) being taken for granted. *Perception* always forms before logic, and we cannot *reason* how it does so, not able to *trace* its route, in a stepwise manner, or consciously influence this process, just as we cannot consciously influence our heartbeat or gland secretion. I bet Socrates would have claimed otherwise. The idea of the possibility of making an observation uncontaminated by theory is epistemologically naive. First, everything gets interpreted through unconscious registration by the neuronal wiring, automatically. On top of that, getting up to the inference itself, Nozick (2001, p.98) notes that not only there exists no adequate inductive *logic*, such as in a semblance of a mechanical procedure or algorithm, but the very program of looking for one may be misconceived. Gestalt switches are needed to *receive* someone else's foresight (without necessarily accepting it, as a step two).

My epistemology therefore goes against the whole monumental *a priori* tradition of Western thought. It will *de-narrate* the no-longer-adaptive narratives of how things *must* be done. You don't solve "wicked problems" with the very thinking that *created* them in the

first place. Appearances would not disappear if we had perfect knowledge. This knowledge is not around the corner; it in itself is *impossible* to obtain, despite any amount of computational resources that can be put towards it. Many, such as the metaphorical Wells' "professors of foresight" (the way he wanted them, in his own image), prefer to ignore the already computed tacit knowledge given that it cannot be easily articulated because of its essential distributed nature. Tacit knowledge is all that was shaped by past selection (more or less coherently, as modular "GM" blocks --- as we will see later) and may be represented in the heuristics and emotions and biological structures that we are endowed with. Most information in the world is not ours; it is not articulated. *So let's not ignore it!*

Some people wish for uniscale centralization, and call their scale-sensitive opponents, in the present climate of opinion, "short-sighted." I am not following this less-than-humble conception of foresight. Foresight, in fact, is not about following at all --- it is about *creating*. "Not when truth is dirty, but when it is shallow, does the enlightened man dislike to wade into its waters," --- remarked Nietzsche (1883/2008) in his book for all and none. Reduction of scale increases the distance between our data and the reality, while at the same time fooling us into thinking otherwise, that some sort of "progress" *(a universal metaphysical Progress?)* is being made. We know neither of what is "progress" nor what is "waste." And in the absence of computational possibility, Art is the only (civilized) thing we have to populate the gap between our data and the world. Nozick (2001, p.113) cannot find a reason how data could epistemically *not* undetermine theory, but I see it plausible that theory is undetermined by data even ontologically, given the implausibility of his assumption of our unlimited powers of understanding.

Something is objective or veridical when human factors do not systematically bias it towards certain kinds of representations, away from certain kinds of truths or toward certain kind of falsehoods. Theorists who think that actual insights of innovative value are derived linearly (by having a faculty of reason directly accessing the possibility of general statements) owe us an account that does not require omniscience (Nozick, 2001, p.116). Without such an account, the intuitive (and socially reinforced) claim for a "proper" discovery or innovation process will be denied real-world validity. Our intuitions of necessity (and consequent inability to imagine otherwise) can be accounted for evolutionarily (see Nozick, 2001, p.125). Foresight does not start *a priori.* I find it more likely that our view of the world cannot be disentangled from our methods of knowing and representing this world, though both neurological and structural organization of inquiry. Art, in contrast to most of the science, does *not* fix one point (the observer), and does not later forget its own assumption. Logical reasoning does introduce a biasing structure of its own (Nozick, 2001, p.119). *"Whoever it is that discovered water, it wasn't fish,"* --- he remarks there. This introduces an asymmetry, similar to the one I encountered in my attempts to discover foresight: it is easier to define what something is not, or what *not* to do, then to say the reverse. This view is compatible with both the Popperian and Kuhnian accounts of innovation. We cannot discover an artifact if it is omnipresent in our ways of investigating the word. Nozick suggests a paradoxical solution: the clue of removing such factor would be in its very perceived necessity. The less necessity, the more veridicality, the more truth content of our representations. *Necessity* (especially recent necessities, that we *think* existed forever, owing to our own short memories and life spans) is what gives rise to

Taleb's Black Swans. *The necessary need for a* research plan? *Good candidate for an omnipresent artifact to be dispensed with.*

The iron-clad Academia's insistence on intentional (Socratic, Aristotelian, "Apollonian") methods I reject here as *methods of foresight* since gestalt switches are not governed by reason (as per Korzybski, 1958 and Kahneman, 2011[7]). Everything "of the reason," "from the reason," and "by reason" is an auxiliary in this work, useful at times, but not in any way privileged over all the other ways of knowing and orienting oneself, or primary to them. A greater awareness making one self-conscious (and Reason tries to that) can interfere with performance. Trying to discover something following a top-down, digital, pedantic imposition of a preset research question is like thinking about every movement one makes when (sometimes sincerely) trying to improve one's walking --- you *fall* instead, a truth evident to any *doers* of anything.

Like Nietzsche, I regard motive or intention as a by-product of an act rather than the cause of that act, especially in the domain of Art (to which this work belongs) and within which it is conceived. Like Nozick, I deny logical positivism. Technically, we cannot any longer ignore the density of information that is too great for propositional representation. This calls for approaches to the unknown more stereotypic of "art" than of "science," approaches of experiential "feels" that help us aggregate the boundless data. To an Artist, the socially constructed concerns about the logical derivability of something, according to an arbitrary logic and from equally arbitrary foundations, "seem less than pressing, and the answers derived less than illuminating" (Nozick, 2001, p.69).

Research questions, beyond the general, vague idea of what one needs to know, are good for within-paradigm finessing; they are not a path for innovation. And "innovation" is in the name of my degree. What is it that path-dependency can ensure? Right, a faithful adherence to the already existing stuff. The lack of such rules (i.e, of a *plan*) is therefore a *virtue* within a paradigm of innovation, not a defect (Nozick, 2001, p.110). Indeed, the "research question" will not be invented and refined here unconsciously (once the actual research was done, *a posteriori*) so as to confirm preexisting constructs and paradigms, the bounds of which are thus *made* immune to breaking. Refinement arises at the end of an exploration rather than at its beginning --- so why to delude ourselves by projecting the impossible by constructing a narrative fallacy? This is *not* how innovation is done, only the typical and all-too-common corporate *innovation-noninnovation*. One cannot predict future needs, and, therefore, know which features of the phenomenology to discriminate. One's very language will have false metaphysical assumptions built into it. This will infect everything built atop it.

In his discussion of the necessity of water being H_2O, on p.132, Nozick points out a point I strongly agree with --- the oft-overlooked existence of a trade-off between "elegant structurings and formalizations," on one hand, and their overlooked price in terms of

[7] Who gives Korzybski's philosophical position experimental support in describing the unconscious substitutions than happen when we answer different (easier) questions than the ones asked --- and do not notice the substitution, among other things.

distortion of subject matter, on the other. What is desired, even in mathematics, he goes on, is the most illuminating and powerful structure, not the simplest one. Short of accepting the glitter of formalization *in toto*, this opens the door to a *via negativa* approach, when a falsified theory must be abandoned even in the absence of an alternative, to prevent its Black Swan iatrogenics. *No* knowledge is better than *false* knowledge.

Because higher levels of consciousness constitute a closed, self-looping virtual system, this system cannot see beyond itself. No closed system can. Our sense of agency played a prominent role in our species survival on that East African savannah. Consider how it is nearly impossible imagine a world *before* us (before our birth) and *after* us. The time before and after our agency. *Both absolute physical certainties, some of the most* certain *things we can know.* Yet, consciousness refuses to imagine it. Our agency refuses to imagine anything not involving itself. In such a manner it will refuse to understand, too, through the same illusion, how research can be conducted without forward planning, how answers can come during sleep, as a "suggestion from the bottom," and any other process not reflecting a bit of agency sense in itself. They say the moon doesn't get smaller by being reflected in a puddle of water. The puddle is our virtual "me," the moon are all the other levels of our neurological evolutionary heritage, that, too, have knowledge and heuristics built into them. They are "wise" in a *distributed* way.

Forward, discovery is *arational*, phenomenological, since information dense enough can no longer be represented in distinct verbal thoughts (Nozick, 2001, p.206). Yes, it can border on schizophrenia --- and will be perceived as such by "normal" people. Nozick realizes this on p.143. So, innovation borders on mental illness. Yes, it does, and 1st-hand history of innovation (not the 3rd hand bureaucratic *narratives* of it) proves it (see Meyers, 2007, and Berns, 2010 who come closer to truth). Foresight is, then, little more than a personal attempt to get one's head in the right place (without knowing what place is "right").

Foresight is thus *alogical*. Ironically --- to put it less cerebrally --- the more one attempts control the direction of thought, the more one gets controlled by it. So I was *not* limiting myself with a specific research plan (a script to follow) from the on-start, because this plan would essentially supply the answer, by simply being formulated. We live in a world of codependency, not on a one-way street. Aristotelian vantage points and *ex post* explanations to fit actual life into a so-constructed Procrustean bed of social acceptance are hereby denied. Innovative insights are not gotten by means of *stage 1 (lit. review) → stage 2 (research question), and so on.* And a clear answer at the end. And a dot.

My foresight aims to be exploratory and illuminating, and not prescriptive. *Illuminating*, the word I like a lot, not dictatorial. I don't know how I got it --- maybe by living the life I did and having my neuronal connections wired as they did? Artists have such a non-nerdy word -- "inspiration." Foresight is what we can try to use to fill Mary's gap that logical positivists, the children of Socrates, leave us, without, of course, realizing it (Jackson, 1986). Foresight, phenomenological as it is, is a powerful and overlooked (analog) mode of awareness, and --- critically, as we will see down this work --- a very personal one, too. Not digital (and very low-res at that), not commoditized. It is a traditional domain of Art. Short

of deceiving ourselves, we do not know a "method" to Art[8], and, indeed, discovering the method would move a piece of Art describable by that method into a domain of non-Art, from the *inductive* into the abductive, Bayesian realm (see Fig. 1). Some people seem to want that to happen, in their desire for certainties and their Aristotelian wants for the dot at the end of a sentence (and for *power,* too, acquired by propagation of this approach, cc:Nietzsche). *Not artists.*

"Design thinking" is a physical feature of the biological structure of one's brain, embodied via the neurosomatic patterns of extracting and processing sensory data. So, it is not *thinking* at all. *It is not a bureaucratic category.* Nassim Taleb's now-famous Black Swan (veridicality) problem arises from reduction, from inescapable artifacts of digital modes of representation that lead to a dogmatic imputing of these artifacts onto the world as the illusion of necessary truths. Aristotelians treat their intuitions as data, while not realizing it but demanding a reverence towards their Method, despite its very shaky, evolutionary foundations. We will resist this Apollonian illusion and warn of the dangers of relying on the piecemeal sophistication and development of it. There is nothing eternal or inherently superior to this approach.

In this work, my desire was simply to determine what I should think of Taleb's paper, and where this could lead me, and nothing more specific than that. In his *Selections from Science and Sanity* (2010, p.50), Korzybski advises intensional lack of precision for matters cyclic and multi-ordal, such as any *nervous cycle*; a *minimum* of structure. *"What are we missing in our conception of the world?" "And what* gestalt *of it has become maladaptive or can be dreamt of?"* It is easier to say what does not work than what does or will. Throughout this work, I adopt the Popperian epistemology that --- once new foresight is generated --- knowledge can best grow by subtraction. Foresight + Popper combine into a powerful way of conquering the unknown, despite some confounding between "theories" and "data," not really independent of each other. One looks only for what one *can* look for. But *generation* comes first and should dominate deduction by the amount of it. Deduction, by choosing not to say anything about what cannot be assessed by the deductive method, essentially makes a choice --- to ignore the inaccessible world, *inaccessible by deduction, that is.* And it happens to be almost *all of the world.* Such method is circular, and the circle is tiny; it simply cannot be otherwise within the bounds of itself. It is harder, *way harder,* to come up with alternatives than to choose among them via elimination. *Coming up* with stuff is called "design thinking." What follows is "decision science."

But beggars can't be choosers. One can't be splitting hairs if one is bald. One *can* if one is bold. So the desire was to learn as much as possible in any direction that my exploration and inner curiosity could take me. To keep in mind what one needs to know without directly and crudely aiming at it, like an Aristotelian zealot (Korzybski, 1958). This is the way all consequential discoveries were accomplished, even in science (Meyers, 2007). Too bad this fact remains ignored by those who had never themselves discovered anything of value. Such stuff is discovered by *dancing*. This is even more applicable to why Art and Design exist, *still exist,* despite a Socratic assault on them, by falsely rigorous methods,

[8] Neither do we know one to science.

whose only rigor often consists in lacking imagination. Even Popper's method is usually taken as "falsification" only…. but wait, "falsification" is Part II, undertaken only once there *is* what to falsify. Part I must be left to serendipity, enjoying the journey of discovery, not to the top-down, bureaucratic planning and a consequent narrative fallacy to explain out the successes as if they were *planned* (Meyers, 2007).

Why to deceive ourselves and turn deception *industrial*? As a "suggestion from above," the formulation of a research question requires the prior existence of a mental model of what one is looking for (Baron, 2000). This is not the level of Foresight and should not be confused with it; true foresight aims (more or less directly) to formulate or re-formulate such a model *in the first place*. Not to "prove" what is *expected* to be proved or develop a logically coherent (so it seems) footnote to that expected thing. *Before* the "objective" world, comes the Observer. Observer first, and world second. Forgetting this is exactly how the Problem of Induction, blind spots, and Black Swans arise --- when a habit ceases to be "a tool discriminately applied" but becomes "a procrustean bed to which the situation must conform" (Luchins, 1942). All this cost of expertise enhanced by our social processes and their pressures, preventing us from doing any questioning of the givens and picking up cues outside of the current, socially reinforced paradigms. In keeping with this realization, this project was inspiration- rather than outcome-driven. The outcomes could neither be guaranteed nor directly aimed for, just as one cannot have fun *when one tries*. How much did Socrates teach us to suffer from our own brain! He was a toxic person able to have only his *wicked* fun, diluting the experience of life to inflict as much damage as possible. In this, I agree with the great Nietzsche. And Aristotle was incapable of even *wicked* fun. Go accuse one of the "lack of rigor," which I will view here as the lack of *poison*. This epistemological view is in accord with my advisor's position throughout his work, such as in:

> *[A] question does not allow us to advance forward in building a future in which the possibility of the present is being exploited. The language we use and the frameworks we constructed limit our imagination.* (Manu, 2017, p.84)

A research question and a research answer are stitched together like space and time in physics. Einstein knew this. Foresight, then, is all the *potentiality* (as opposed to actuality, i.e. what one needs now or thinks one will need in the future, which, paradoxically, is one and the same thing). In its potentiality, is foresight's promise and challenge. For smart corporate managers will call it "wasteful" and optimize it out, the same way that variation had been being overlooked and taken for granted in biology since Darwin.

So, let us make some room to breathe. One cannot realistically separate the method of arriving at something from that *something*; non-Aristotelian philosophers, like myself, tend to be most aware of it. Just as in the case of consciousness itself, which cannot be physically instantiated, in foresight and within art generally, the medium is part of its message (Nozick, 2001, p.205). I will refer the reader inclined to attack the Method of this work, the synthetic/inductive philosophical method, to Robert Nozick's defense of a similar method he uses in his *Invariances* (2001) and his elaborate defense of this method against his Analytic colleagues in the Introduction to that work (pp.1-11). I cannot say it better than

him. And, as a designer, I take it even further. Also, Nozick's Endnote 16 to p.82 is extremely illuminating: I must direct the reader to think over it before proceeding further. It wonderfully introduces both the survivor bias and the narrative fallacy subsequent to it, both the reasons for suspicion towards planned research and its questionable epistemological claims. For one, this is definitely not how *foresight* is done. Creative mindsets, design dispositions, unlike some other dispositions, do not revel in methods empty, circular, and unilluminating, aimed at impressing at the expense of creation. They do something else (namely, the opposite) for a living. They play a different game. Their job is actually to *break* from within the thought confines. Nassim Taleb had been fruitfully developing discussion of the said epistemological fallacies throughout his work, in the 20 years since Nozick's untimely passing[9]; the present work adopts these major parts of his perspective in its method to knowledge; it addresses only a particular application of them to the biological question of GMO safety, where I feel I have something to say and correct.

As a Designer, my job, even more than a philosopher's, is to stick my neck out by saying things that are societally new and interesting and illuminating and avant-garde. An intellectual driven by fear sadly devolves into a bureaucrat, despite nobody having been born that way. As Nozick points out, it is not appropriate to react in outrage when one's sacred intuitions about the applicability of basic categories to the world are questioned, categories such as objective truth, objective inquiry, belief, desire, and rationality. A secure basis for a philosophical theory does not exist. There exist no fixed points in philosophy. The entrenched categories are thereby completely and resolutely denied. *How else* would you make up the space for the new? And if one does not badly desire the new, one is advised to stop reading here. The task of developing new concepts can be extremely difficult (and only those who ever did it themselves can understand why) --- there is no need to complicate it further through *actively closed-minded thinking*, without measure. Negativity is easy.

This work is not at all a "postmodernist" approach from the humanities; it runs much deeper, into philosophy and the science proper --- eminent physicists now state that the reality itself seems as if it were shaped by the very questions we choose to pose (von Bayer, 2004). So the observer's bias extends to everything, not only to quantum mechanics. It is certainly true for the roots of innovation. The human matters. Without the observer, everything falls into a seriously different pattern and gestalt.

Of all things, I am sure this work will raise more questions in the mind of the reader than it will answer. Such is the ambiguous and frustrating nature of innovation. It can't be planned; it doesn't fit neatly with pre-existing worldviews. It makes one's world larger, not smaller. This is the way it should be. It *must* be frustrating. One's *intuitions* about "truth," "goodness," and "beauty" are contingent upon one's neuronal wiring, and this in turn is contingent upon one's culture. Given the Anglo-Saxon culture this work is being delivered into, and its reliance on deduction *(deductive approaches being successful in _____, but surely not in* everything*),* I again refer the reader to Nozick's Introduction in defence of

[9] The philosophical influences on this work include, in a chronological order, Schopenhauer, Nietzsche, Korzybski, Nozick, and Taleb himself.

exploratory approaches against logicians *(why is the burden placed on Exploration to be defended? Aw, Socrates).*

I do not know which of my guesses and assumptions are more likely to be true. None of them are immune to criticism, and the passage of time will cross out many of them, if not all. But I will try to advance some novel ideas nevertheless, as my personal foresight, because the only one who cannot be mistaken is the one who kept quiet all the time, and conveniently followed a socially constructed consensus --- and we do not want to feel guilty of intellectual cowardice. Attempts to look anew at old notions and undermine their security, no matter how confused and unclear, must be celebrated as a tool against Taleb's Black Swans and a tool for preservation of serviceability of existing technological systems --- and creation of the new ones. But one must have a mind which biological structure makes it *enjoy* doing this.

Humans generally experience a tremendous difficulty undergoing perceptual shifts (Kuhn, 1962). This is a factor underlying resistance to foresighting activity. Indeed, a sabotage of existing gestalt is not without its costs. For better or for worse, the impulse to defend the predictability of life is a fundamental and universal principle of human psycho-logy (Marris, 2014). This results in self-sabotage in scientific discovery, and in life, causing one to overlook even one's own new ideas, through not yielding to the senses (Koestler, 1964). A reader of any text, but especially of this, would benefit from keeping in mind the advice of Leibnitz, to not only read what one sees (that is, one's own nervous canalization) but also to try reading what the author *tried* to say, by trying to reconstruct the lost map-territory relation, as Alfred Korzybski would say. This work and its structure will not sit well with those who easily criticize what they don't understand and may feel threatened by. Second-hand intellectualization was the method of Socrates/Plato, the method an overreliance on which the author is opposed to.

Similar to Nozick's point in the introduction to his *Invariances* (2001), I mean to launch my theses for exploration, not to demonstrate conclusively that they are correct. And if you disagree…. please do so *angrily*! The management guru Tom Peters suggests it's a good sign in his *Pursuit of WOW!* (2010) --- and some companies listened. Emotions are good. Deeper, messier, intuitive understanding of wicked problems cannot be communicated in a linear fashion. There will be no adhering to the "certified-pure way" that the Designated Guardians of Yesterday do things around here. My thinking, conditioned by my own brain being a particular realization of a biological structure (and more or less aware of this), is (whether a blessing or a curse) nonlinear, but writing *is* linear. *The world, too, is not linked by linear causation.* My reader will have to get the metaphorical right side of the brain busy to connect the dots on one's own. Without this, indeed, many things can feel *non sequitur*. As demonstrated by Nozick (1990), no finite number of discrete signals is sufficient for common knowledge. Gestalt. That's how we grow.

I will end this long but necessary introduction with the words of Korzybski (as per Sharp, 2016):

From the event our nervous system builds the object using a selection of the possible array of characteristics (holes). There are holes without strings and holes with strings that do not connect to the object. These are the characteristics that are left out in the process of abstraction. "We visualize the natural order of evaluation," but we also handle the labels and strings. When you see an object, a chair, for example, touch it. Shake the label. Move your hands. "That little wiggle really does the trick. It will help you." "When you shake yourself in that ordered series of abstractions, you are inwardly ready to map a successful adjustment. You have the secret of clarity, all of which is not verbal. *It becomes organismal and kinesthetic. You have added acuteness to your brain. You have engaged yourself organically into thinking, more than just using your 'brain.' Then you begin to orient yourself* as-a-whole, which is non-elementalistic."

Chapter 1: Evolution starts with Variances

Life starts with generation, not selection. In this Chapter, I will discuss the principal scientific conclusions essential to bear in mind during opinionation on "GMOs" and refer the reader to the Appendix* A *for a more technical discussion and biological details of the evidence. We will see how we ourselves are nothing but walking "GMOs," how natural selection gets confused with generation, and how the* maintenance *of species by it does not at all explain their origin.

The reason for us to be getting into the depths of science on the issue of what real innovation in the organic world looks like is that we cannot properly assess the opportunity of the genetic technology without this understanding, see its limitations, develop a sense of scale, and tell which commonly held assumptions and criticisms of it have no relation to reality (and what features of the reality we tend to overlook, being stuffed with unhelpful ideas and mental constructs). We do not see things even after staring at them for a whole life unless we make ourselves see them with our minds first. And, once we do see, we cannot forget them. So the inertia is tremendous. After a through examination of the assumptions that construct a Neo-Darwinist worldview, we will find out that the real problem with GMOs lies in something other than the transgenic technology itself.

The Precautionary Principle

We cannot know the benefits of something until the something had been constructed in the first place and allowed to operate for some time, but we can be more sure about *some of* the costs of doing this from the on-start, only *some*, excluding the unexpected ones, which are as unpredictable as the benefits. This asymmetry will be a critical thinking point for the rest of this work --- please pause to think over it.

Providing sufficient protein to a growing world population remains one of the most pressing global sustainability challenges. Modelling, while subject to the limitations of its own self-referential assumptions, predicts large swaths of the world's current agricultural centers to become semi-arid deserts (Burke, 2015). The process of technological innovation, just like the process of evolutionary innovation, proceeds in leaps and is associated with overwhelming uncertainty about the benefits and risks of new technologies. Big hopes are placed into attempts to engineer heat and drought-resistant crops to adapt to the pressures of climate change and overpopulation.

There is a considerable confusion over the use of terms such as "genetically modified organisms" (GMOs). In effect, all plant-breeding practices that enable crops with new traits are forms of genetic modification. Popular objections have been focused on "transgenic crops" that are modified using genes from other species, though opposition is also being extended to crops that are bred using genetic techniques that do not involve transferring traits across species (Tagliabue, 2015).

Some countries have invested heavily in scientific capacity and infrastructure to facilitate GMO commercialization, while others have been more reluctant to endorse GMOs as a tool to help achieve broader goals of agricultural security.

New technologies are likely to face significant resistance, especially if they are based on novel platforms that are likely to open the gateway for a new generation of products. Genetic modification can be considered such a Platform Technology, in a sense that iPhones are, as they became platforms for app development and enabled a whole new ecosystem to form around them (Manu, 2012).

One of the overlooked sources of resistance to platform innovation are vested economic interests and the anti-competitive desire. As outlined by Schumpeter, innovation is the product of the efforts of entrepreneurs. As Juma (2016) points out, it is entrepreneurs who, as a result, come in direct contact with social reactions to their creations as their competitors try to steer the societal attitude in a self-beneficial way.

A Nonrepresentative Picture of the World

Sometimes, social groups take one component of a system and make it into an Absolute in their perhaps honest, although mistaken desire for the "good." Taleb's 2014 discussion relies on an incorrect picture of the world (still being advanced by many prolific neo-Darwinists like Richard Dawkins in the Academia --- see 1988, 1997, 2006, 2009), specifically on a mistaken assumption that the genetic technology used to produce transgenic crops is artificial:

> *"We are not opposed to human involvement based upon its being artificial. We are opposed to the traditional engineering strategy applied to biological organisms versus the* gradual selection *that is characteristic of either natural selection or breeding. It is the mechanism of bottom up, small variation processes with extensive real world testing of incremental changes that distinguishes evolutionary dynamics from traditional engineering approaches." (Taleb, 2014b, p.7).*

This line of thought is explained here:

> *"There is no comparison between tinkering with the selective breeding of genetic components of organisms that have previously undergone extensive histories of selection and the top-down engineering of taking a gene from a fish and putting it into a tomato. [..] Saying that such a product is natural misses the process of natural selection by which things become "natural." (Taleb, 2014a, p.9).*

What could be wrong with this argument?

- First, one cannot 'miss' the process of natural selection, since organisms of any kind have to stay alive at all times while evolving or developing.
- Secondly, nature tinkers exactly by transferring and re-shuffling large genomic fragments (not via point mutations), which may well include *a gene taken from a fish and transferred into a tomato,* among a zillion other combinations.

All of the Biosphere is full of transmissible information. The genomic creative destruction that it causes provides material for selection. Selection is the steering wheel here, and genome instability --- the engine. Nozick (2001) points out on p.226 one might expect more resemblance in traits under selection than in traits *not* under selection, and yet does not take it to the conclusion that selection, therefore, is not a creative force. It is the *Second* step, the steering force. Selection is, unfortunately, *real*, no one is denying it --- if not for it, the organisms on Earth would tend towards informational unification of their genomes, until and up to becoming Lem's giant superorganism --- the living ocean Solaris from the novel of the same name (1970). And yet the transmissible information of the Biosphere that fuels the engine is largely invisible to us and unaccounted in our worldviews; the massive possibility of it is not being seen because we see with our existing mental constructs instead of our eyes. So let us look deeper into the evidence.

We Cannot See What We Have No Imagination For

There many parallels that can be thought of between the natural and human-directed, cultural innovation. Therefore, and especially with respect to the subject of genetic modification, it helps to get a few things straight about the history of life on Earth and our conceptions of it. In this section, I will dive into the social history of some stunning, old yet overlooked scientific ideas and discoveries --- and what they mean for the attitude towards 'GMOs' and the future of our own species, likely including your future, dear reader. So please bear a bit with science here, as these supposedly strictly scientific issues are very influenced by the psychology of novelty-seeking behaviour.

Many concepts, such as the concept of "gene pool," first appeared in connection with the tasks of selection in agriculture. The explosive growth in the genomics-era biological science of the recent decades had turned the old conception of fixed, stable heredity on its head.

It had been becoming increasingly clear that genomes of cells of multicellular organisms (including us humans) are not informationally isolated, but instead are all unified within the single information space of the Biosphere. This unification is mediated by the natural formation of non-chromosomal DNA, its excretion from cells, absorption by other cells and subsequent selective inclusion in the other cells' genomes. This mechanism, in combination with the Darwinian selection, lies at the root of biological innovation. And, as we will see below, the *amount* of such "free," external DNA may well exceed the amount of expressed DNA encapsulated in its "proper space" --- within the organisms inhabiting our planet.

Social Psychology Explains Why We Are Still Taught One Can Write a New Book by Mistyping an Old One

Scientists cannot explain why they accept some statements by declaring them "true" (Latour, 2013). The assertion of natural selection being the *cause* for evolution (just as the assertion that anthropogenic carbon dioxide is the *cause* of the recent trends towards global warming) could never generate predictions that were capable of being disproved. Such claims are therefore epistemologically softer than the assertions of "hard" sciences (Popper, 2005).

Every time such things were pointed out (for example, by complex systems theorist Stephen Wolfram in his 2002 book or the sociophysicist Serge Galam in 2010), the authors have been accused of being 'uneducated' by journalists and the scientific establishment alike. 'Education' often stands for acquiring a certain approved set of habits and beliefs.

A key challenger to the Neo-Darwinian orthodoxy, Lynn Margulis described the importance of the social component in any human enterprise and its influence on how we think about the world. In her later works, Margulis kept pointing out how "academic apartheids" she

had experienced (both as an innovator and as a female) can block scientific advancement. She reflected on the dangers of excessive ossification of a decision-making hierarchy and its consequent propensity for dispossession of new or challenging evidence as follows:

> *More and more, like the monasteries of the Middle Ages, today's universities and professional societies* guard their knowledge. *Collusively, the university biology curriculum, the textbook publishers, the National Science Foundation review committees, the Graduate Record Examiners, and the various microbiological, evolutionary, and zoological societies map out domains of the known and knowable; they distinguish* required *from* forbidden *knowledge,* subtly *punishing the trespassers with rejection and oblivion; they award the faithful liturgists by granting degrees and dispersing funds and fellowships. Universities and academies, well within the boundaries of given disciplines [..], determine who is permitted to know and just what it is that he or she may know. Biology, botany, zoology, biochemistry, and microbiology departments within U.S. universities determine access to knowledge about life, dispensing it at high prices in peculiar parcels called credit hours* (Margulis, 1997, p.263).

Indeed, today's science remains an extremely ritualized institution and much in the operation of science, on top of its well-known initiation procedures, borrows from religious practices. The type of a rigid hierarchy Margulis was battling stemmed from the Anglo-Saxon, Protestant view of the world, from the inability to remain not purposely busy, which was --- in human image --- extended to the operation of natural selection. Absolutely every step of evolution was assumed to be selective. The hierarchy took Darwin a bit too seriously, and thus simplified and misinterpreted the philosopher that he was. The danger to knowledge is not in lies, but in something closely resembling truth without being such. Such counter-adaptive rigidity of the Neo-Darwinian hierarchy became more and more of a block over time. It also distilled into public consciousness.

The issue is not new --- human mind in general has a tendency to loop onto itself, to form closed virtual systems. Innovation is something *un-natural* not only in the strictly rational, survivalist animal world, but also in human civilizations. These civilizations constantly, all their history, closed onto themselves and blocked their own development. Today is no exception. Contrary to what our vanity may be telling us, we are not smarter, more talented or more anything than all those who lived in the past. We are repeating the same thing but in a different way.

Once a new, successive viewpoint finally does get accepted, however, the controversial history of arriving at it is "smoothed out" by historians of science based on their ideas how history *should* have happened rather than how it did; indeed, we know about the *true past* approximately as much as we know about the true future (the one that *will* arrive). After the paradigm shift took place, our minds loop back onto the new reference point, now most definitely the "true" one, and, just as Youtube will keep feeding one more and more of the same kind of videos once one makes a search for anything, so will we look for more and more confirmations of the dominant paradigm --- until the next shift becomes socially acceptable, that is.

How does novelty — both advantageous and unsuccessful — defines evolutionary processes in biological, biotechnological, and *social* systems created for the management of the first two? Science is a socially constructed process. We are a *social* animal with a socially constructed (conditioned) reality. We constantly train each other to see the world in a certain way. And there are no guarantees that the direction of all this is adaptive. And none of our institutions are exempt from this fact, even the edifice of science that had replaced the church as a prime authority of the Western world over the past few centuries.

As Serge Galam points out in his *Sociophysics* (2012), it is rare to have access to a real story of an internal fight for the emergence of new paradigms, in particular within the so-called hard sciences. He goes on that real inspirational paths, which lead to the establishment of novel paradigms, are almost never known, as observed from their inevitable retrospective distortions by anyone who does not have a personal experience of having had changed a paradigm --- and the courage to speak the truth about it. This is aided by the originators' own desires to forget the initial bitterness of rejection by substituting their negative memories and *inventing* the past in their own mental accounts. In her last interview, Margulis offers the following account (recorded by Teresi, 2011):

> *When evolutionary biologists use computer modeling to find out how many mutations you need to get from one species to another, it's not mathematics—it's numerology. They are limiting the field of study to something that's manageable and ignoring what's most important. [..] They are reductionists ad absurdum. Population geneticist Richard Lewontin gave a talk here at UMass Amherst about six years ago, and he mathematized all of it—changes in the population, random mutation, sexual selection, cost and benefit. At the end of his talk he said, "You know, we've tried to test these ideas in the field and the lab, and there are really no measurements that match the quantities I've told you about." This just appalled me. So I said: "Richard Lewontin, you are a great lecturer to have the courage to say it's gotten you nowhere. But then why do you continue to do this work?" And he looked around and said, "It's the only thing I know how to do, and if I don't do it I won't get my grant money." So he's an honest man, and that's an honest answer.*

Most people cannot sustain being a rebel and re-inventing themselves for all their lives. Margulis could. The few who move the needle early on in their careers are usually happy to become a majority later in life. That is, if they live long enough to see this happen during their lifetimes --- some innovators can be too ahead of their times.

Science Operates by Disconfirmation; We Don't

On p.117 Nozick (2001) notes that an individual scientist's bias toward his favorite theory can be useful at level of whole science enterprise if it motivates the named scientist to look for evidence against competing theories and does not allow him to block, through an exercise of power, others from doing the same. Wason (1977) reports on experiments on belief persistence, where subjects were failing to use the very powerful evidence that was

staring them in the face, persisting to their initial (wrong) ideas. Kahneman (2011) and Evans (2013) both reach disturbing conclusions about the operation of dual processes in our minds: one actually drawing conclusions ("System 1") and another one rationalizing them after their are drawn (our overrated, rational, effortful "System 2"). Wason and Evans (1974) demonstrate the tendency to look for evidence in favor of a prior commitment. But this process is not science. As discussed in my previous work (Teselkin, 2014), a theory is not scientific unless it is falsifiable --- capable of making predictions and disproving them in experiments. *If* it is impossible to do so, there is no difference between science and belief. And science had long suffered from the problem of demarcation between "scientific" and "non-scientific," an unsolved problem in philosophy. Evolution is neither a theory nor a fact; the evidence for it lies in fact; but any theory itself is an attempt to accommodate some (or, hopefully, most --- but never all) of the facts.

The dominant, essentialist, worldview shared in the modern society, if based on science at all, causes a large part of the population to reject 'GMOs' as 'unholy' and is grounded in a divergent view of evolution based on random, small, slow variations in individual organisms, guided at each step in the direction of adaptability by the almighty natural selection, but so slowly so as as to be negligible in practice. This view sits well with our desire for permanence and also comfortably takes our own species from the umbrella of universal natural selection. This standard view forms the mindset of that part of GMO consumers who accept evolution (though not necessarily including oneself into it). It implies that gene flow is possible only *within* species -- hence the biological definition of species through intercompatibility in their sexual process. Parents exchange their genetic material in the course of the sexual process and reproduction. This is something that we *can* see. What is it that we cannot?

Evolution is Not Slow and Gradual

Shapiro does do a great job ("Variation and Selection: What's the Difference? What Are the Issues?," 2012) in delineating the common confusion that only one of the following processes can be sufficient for evolution (while in reality, one needs both):

1. *Variation*, or the occurrence of heritable differences potentially leading to the formation of evolutionary innovations, and
2. *Selection*, or the real-world testing of the innovations for their contribution to survival and reproduction.

Molecular evidence for the inability of neo-Darwinism to explain evolutionary observations, specifically in the "variation" part of them, has been accumulating for the past 50 years; it is now overwhelming.

But disagreements and hereticism with respect to the "Teaching" that would declare genetic technology unnatural have a long history. Fossils were being studied long before the birth of molecular biology. Henri Bergson, in his diatribe of *L'évolution créatrice* (1907) was one of the first to propose, from paleontological considerations, for evolution to be

"creative" and unexplainable solely by Darwinian natural selection; Darwin himself pointed this out before, asking, with his characteristic modesty, not to canonize his work and treat it as a hypothesis. Sure enough, the work got canonized.

In 1923, C. Lloyd Morgan pointed out that many of the most prominent innovations in living things have been largely discontinuous, not *slow* and not *gradual*, in relation to the past evolution. Morgan proposed that entirely new properties appear rapidly because of the unpredictable rearrangement of the already existing entities. He was criticized for his inability to provide a concrete mechanism for this. Providing a mechanism was not possible, however, given the technical development of his time. It is always the case with anything new, that there are more questions than answers at first, so it is unclear how a new paradigm can take a root at all. This was first pointed out by Thomas Kuhn (1962).

Despite this, the fossil record kept providing the evidence that contradicted the neo-Darwinian consensus of British mathematicians since the 1940s and could not be fitted into any mental boxes. Unfortunately, there was more mathematics than biology in the emerging 'new synthesis' of the time. After the war, natural selection got elevated as *the* mechanism of evolution into a status of religion. Descriptions of natural selection as *the* mechanism of evolution keep being repeated in the titles of authoritative books till this day (e.g, Bell 2008; Futuyma, 2015), although the suppression of the second half of Darwin's insight finally started to get lifted in the very realm Darwin opened up for us (see Shapiro, 2011). I cannot mention often enough that our reality (really, a conditioned reality that we were *trained* to see) is socially constructed. The "always-busy" natural selection was fitting well with the Protestant work ethics, and both realities were dominating the same geographical space of Protestant cultures. This is the difference between the believable and the unbelievable: anything can suddenly become very believable if enough of people believe in it. *What else* could be constructed then?

The common view that evolution is the result of small cumulative errors rather than that of epidemic rearrangements by molecular tricksters is akin to imagining innovation as a result of a secretary's typos. Indeed, creationists had a point, in a sense, but their arguments were properly the arguments against an improbable Neo-Darwinian explanations of evolution, not against the evolutionary change itself. Such complicated and nuanced discussions inevitably get simplified and twisted when they become a kitchen matter. A more technical discussion on the probability of the evolutionary innovation according to the "small-error," neo-Darwinian view, is presented in Appendix A.

As seen there, there exists no impetus for complexity according to the standard view of neo-Darwinism. Environmental pressure alone cannot explain all the diversity of living forms on Earth, since there exists much more of this diversity compared to the available ecological niches. Progress in biology means, in fact, nothing other than replacing reliable designs with what often works less well, at least initially.

By any account, the most successful bulk of life on Earth had always consisted of the invisible prokaryotes, including bacteria. They remained essentially unchanged in their organization for all the billions of years of life on this planet. There is no biodiversity loss

happening now, as is often alarmingly claimed, with biodiversity defined non-exclusively (not in our image). Life on Earth is as antifragile as ever.

Why would any complexification of architecture and a corresponding loss of its robustness happen? All existing organisms of Earth are of the same age, which is the time they had uninterruptedly existed since the origination of life on Earth. Bacteria of today are no different, in principle, from the bacteria of the past. Besides, they change generations much more rapidly than 'higher' organisms, and, hence, should be providing much more opportunity for natural selection to 'direct' them all the way into becoming 'us.'

And yet, they exist just fine at the 'low' level they are, feel no need to evolve anywhere, and can even survive our nuclear and chemical catastrophes without much of an issue. Therefore, it seems, complexity is not adaptive, which is why natural selection prohibits it. The small is pretty.

Counterintuitively, the fastest evolving organisms are the slowest reproducing ones. How could this be possible? The evolutionary trajectory in all of its undeniable facts cannot be explained by natural selection, and humans have been very limited in their agricultural efforts having had to rely on artificial selection *of pre-existing variation only*.

The fossil record kept its own story. Both early (e.g, Berg in 1926) and modern researchers, such as the famous science popularizer Stephen Jay Gould (1989, 2009) kept adding to it. Gould worked on the Burgess Shale fossil bed in the Canadian Rockies and have done meticulous work documenting the sudden appearance of new phyla in the Cambrian fauna and the absence of transitional forms. There was little change in-between the rapid speciation explosions --- hence, the name of 'punctuated equilibrium' for his position. As well, there was no explanation for the complexifying force in evolution --- direct experiments, too, (Kuppers, 1979) have demonstrated long ago that pure selection is only a simplifying, conservative force.

The fact is that many traits appear without having a clear selective advantage (Dykhuizen, 1978). This is evolution "not by the rules." Innovation, too, is the very opposite of something "by the rules." It is not a box or a department or some other category; it is everything that is physically possible but did not happen because it had not been thought of and tried out.

"Neo-Darwinism" Substitutes The Only Thing It Knows For Everything It Cannot Explain

We all possess a powerful psychological defense mechanism --- the mighty ability of perceiving everything as *ordinary*. In terms of innovation, this ability is the mental barrier of taking things for granted. We all do; the question is where this is no longer adaptive. The taking of things for granted consists in subconsciously replacing the *mechanisms* by *phenomenology*. So are avoided the incessant "whys." This happened, too, in the post-war

history of evolutionary biology, where the gaping holes in our knowledge were conveniently ignored and overlooked. And although this might have been the way to move forward at the time, this situation had persisted for all-too-long to ensure the progress in science.

We live in a world where, over all the innumerable generations, in order to survive and retain mental sanity, one had to dial down one's thinking ability to the point of numbing it.[10]
Evolutionary innovation does not happen by natural selection --- conservation does. It is honestly surprising that so many could have been not noticing the contradiction for so long.

Selection can select only what is presented to it, and do so according to *human* criteria in case of *artificial* selection, and according to some currently incomprehensible criteria of internal and environmental "fit"/compatibility in case of natural selection. In order to select, one has to first *obtain* the variety which to select from. Beggars can't be choosers. Cultural and scientific innovation, too, does not happen in organizations that seek uniformity and monoculture and succeed at it, for they contain nothing to select from.

Lynn Margulis was one of the first to substantiate the work of her heretical predecessors by proposing, in the 1960s, concrete mechanisms for the source of creativity in evolution (Sagan, 1967). Her concept revolved around symbiogenesis --- merger of organelles, or of genomes. Molecular biologist James Shapiro had introduced and justified the term "natural genetic engineering" in peer-reviewed literature from the 1990s onwards, culminating in his monograph *Evolution: a view from the 21st century* in 2011, where the concept did make a stir, but remained a minority view, largely owing to its historical (and distracting) conflation with teleology (the invocation of purpose).[11] He seconded Margulis in her view of evolutionary innovation as originating from the rearrangement of basic genetic motifs and evidenced by the vast variability of DNA content among and within species, and even during different stages of individual development.

"Momentary" acquisition of antibiotic resistance is nothing but the very Lamarckian acquisition (and then inheritance) of acquired traits. And, the illusion may be that it happens "as needed."[12] Mutations of any kind, however, do not vary in the "fitting manner." The population just increases its uptake competence -- the lucky cells survive and

[10] The breakdown of these psychological defense mechanisms (by overdoing on the induction) often causes one to end up psychotic and dysfunctional. Hysteria, however, is a sure sign of a *questioning* mind.

[11] This was probably due to Shapiro's unfortunate insistence on terms such as 'cognition' and 'sentience' as applied to bacteria. His ascribing of knowledge and decision-making to cells in human terms looked too human and could have been taken as diminishing the role of selection (which plays its part, not an all-encompassing-one, but nevertheless an indispensable part). Shapiro also seems to confuse determinacy with predictability in his online discussions on the topic. E.g., Shapiro, 2012a.

[12] As a side note, there is some evidence for the unsolved question of 'adaptive mutagenesis,' at present most certainly not at the level of concrete genes thought to be under selection, but rather at the level of genomic mutagenic 'hotspots' that can be induced under environmental stress (Rosenberg, 2001). It is also unclear to what extent such phenomena can be self-directed as opposed to being motivated ("recombination-dependent stress-induced mutagenesis") or reinforced by external DNA.

reconstitute the population of the future. This can be limited to specific 'hotspots' and mediated by recombination (Harris, 1994; Ponder, 2005; Shee, 2011), including that by exogenous DNA.

Lamarck's 200-years old idea of "training" as an example of inheritance of acquired traits was unfortunate, as were Halton's experiments disproving such by cutting murine tails and failing to observe the inheritance of this. This was a human-made circus, not nature (and we all fall victims at times to mistaking one for the other).

Same with the 'GMOs': one uses complicated equipment and chemical reagents to generate them *in the lab.* Nature has none of such equipment --- so GMO generation should not happen there, the logic goes. It does happen, however, just via different, previously and largely still unimaginable to us mechanisms -- and much more efficiently, too.

It takes imagination in science, as everywhere, to move beyond the mental image of a specific way of doing something to thinking how else something can get done.

Sciamanna (2009, p. 1039) summarizes that their team's data *"strengthen the emerging view of a novel transgenerational genetics as the source of a continuous flow of [..] traits* [emphasis mine], *independent from those associated to chromosomes."*

The 'flow' of anything goes against our intuition, which views the world as static, against the visible and seemingly unshakable stability of nature. And yet, nothing has happened till now in the larger scientific community, its sanctioned textbooks, or in the society. We, by and large, subscribe to the ideas of permanent and perfect Earth that (bad) people are disrupting and destroying by simply trying to live. Ideas in science or culture often only stick decades or centuries or even millennia after they were first introduced. As pointed out by Taleb ("Opacity," 2019), irrespective of the factual truth of an idea, it takes self-serving agents who benefit from it in some form or another for the idea to spread.

Therefore, one cannot divorce the human factor of self-interest from the pursuit of abstract universals such as "truth" in science, or "knowledge." Ironically, as will be detailed in the coming sections, Taleb himself subscribes to the following incorrect statement by Darwin, a statement that was turned into a social construction by Darwin's many less-than-through followers:

> *"If it could be demonstrated that any complex organ existed, which could not possibly have been formed by* numerous, successive, slight modifications*, my theory would absolutely break down." (p.213, in Caroll, 2003)*

The theory would survive such very real inability to demonstrate. Admirably, Darwin himself changed his position in his later editions, as reported contemporaneously by Herbert Spencer:

> *"Variations [..] seem to us in our ignorance to arise spontaneously. [..] It appears that I formerly underrated the frequency and value of these latter forms of* variation*, as leading to permanent modifications of structure* independently of natural selection." (Spencer, 1887, p.363)

The prior view was easier to mathematize and publish on, after all! And the majority would always go for the easy, forming a "consensus" along the way as a measure of truth. There was consensus at one time that the Earth is flat, and rests on three whales…

I need to make an aside here and point out implied teleology of the above discussion. Selection implies *agency* and is a *teleological* metaphor. A *false* metaphor. It is ontologically correct to speak of variation and resultant differential outgrowth. But it is easier to speak in terms of a teleological narrative fallacy, for we as *agents* can know nothing but our *agency*, and so like (and not like) gets explained in the only way it can --- by the like, giving rise to unavoidable circularity.

Darwin developed his theory of Pangenesis (Liu, 2008) to account for the unknown source of evolutionary creativity. He suggested that all cells of a multicellular organism shed minute particles, or gemmules, which circulate throughout the body and are passed onto the next generation through the germ cells, thereby transmitting the characteristics of the 'parents' to their offspring. Unbelievably, Darwin also hypothesized that gemmules might be able to survive and multiply outside of the body (Darwin's Correspondence, 2002).

At the height of the Cold War, the scientific debate over "vegetative hybridization" (plant hybrids created by grafting) turned political (Liu, 2006). Darwin's "gemmules" were the purported mechanism behind "Michurinist genetics," accounting for the incorporation of graft plant's traits into the progeny of the receiving plant. This ignored phenomenon of hybridization had no place in the dominant evolutionary theory but had recently been revisited and molecularly substantiated --- of course, under a new name --- by Western scientists, despite having been known since the times of Darwin (Stegemann, 2009).

Darwin's "gemmules," pieces of DNA, can and do get transferred along as a source of variation both in plants (via plasmodesmata) and in animals (gap junctions), although the authors describing them almost invariably prefer not to draw any far-reaching conclusions beyond the existing theoretical box (e.g, Lucas, 1993, 2009). So strong is the power of convention.

The Stupefying Odds Against the Probability of Evolution

If the history of science teaches us anything, it is that hypotheses that explain everything briefly and clearly do not really explain anything. Separately, as particular, exceptional ones, etc., many facts are all "out there" and accessible to anyone. But putting them all together often creates a totally different picture, and people are rarely willing to get to this step and try to make a quantum, Gestalt-like perception leap (Popper, 2005).

We have seen in the Appendix A how math does not bear the "small-event gradualism" of the classical view. The independent probabilities are multiplicative, and intermediate stages are maladaptive or neutral under the natural selection. So, risking accusations of heresy, I would point out that there is no path for the observed patterns of evolution at all solely within the limited paradigm of neo-Darwinism.

And we are even more justified in thinking so if we consider that the spread of an already improbable new trait in the population would occur only with the speed of reproduction. Sex must mean something from what we imagine! Horizontal gene flow is able to accomplish the spread of a new trait much faster, through selective DNA amplification, essentially unlinking sex (recombination) and reproduction. Jiggins (2011) directly calls such cassette transfers as 'macromutations' and points out that symbiosis-associated adaptation will always be more rapid than adaptation based on mutations in existing genes. Indeed, the first thing that catches attention regarding non-bacterial genomes is their (genomes') inexplicable, almost mystical, *modularity*.

As a LEGO set, our genomes seem to be meant for rearranging, assembly, and disassembly. Most of the genome consists of repeats, flanked by other repeats, flanked by other repeats --- and the question that really arises is how all this can actually exist without breaking, and not for a short time, or even our ~70 years of life (100 if one is lucky), but for a third of the age of the Universe.

Even genes themselves (~1% of the human genome) are modular in anything beyond the simplest forms of life. Bacteria lack modularity and release their DNA with their death; eukaryotes do so by amplifying their DNA and stay alive in the process.

Now time for a shocking statement: we are not people --- we are retroviruses, judging by what makes the bulk of our genome (Smit, 1996; International Human Genome Sequencing Consortium, 2001). Retroviruses like HIV (Zwolińska, 2013), whose biological role goes far beyond causing disease and stigma in humans. Why is this knowledge never linked to the GMO debate?

Desire for Efficiency, Ignorance of Scale

As it stands, the textbook theory of evolution (and everyone went to school) excludes the very evolution it is meant to explain. It is based on an out-of-the-human desire for rationality and efficiency at all times, the desire that claims that every trait at every time should be adaptive. This tells us more about *our* nature, however, than about *nature.*

This is an example of the psycho-logical habit of not seeing the unwanted, also called the confirmation fallacy -- the greatest barrier for innovation. Of note, the human innovation process, too, is commonly described as rational and efficient, by those who have not partaken in this very innovation. "Nature in our image," -- even though there is no reason for anything that makes us human (logic, for example) to apply anywhere beyond humanity

itself. And not even the humanity --- we only think, in our ignorance, that we understand ourselves.

One sees with one's mind first. When the evolutionary role of the plasmodesmata/gap junction anatomy to explain vegetative hybridization was openly suggested, sometimes in relation to the GMO risk discussion, the authors were rarely cited (e.g, Keese 2008, Talianova, 2011). Countering the common criticism that human-created transgenes can escape and "ruin the [perfect] world," Keese concluded, for example, that [due to usually much larger background horizontal gene transfer level], "HGT from GM plants poses negligible risks to human health or the environment."

Interestingly, it was Australia and the EU that principally opposed embracing the risks of GMOs, despite the authors above coming from these regions, respectively.
Scientists busy with science are traditionally not good at communication, perception, and policy manipulation. Politics plays by different rules and requires a different mindset compared to the one proper science trains one in (unless science itself devolves into politics). Those who are good at politics for one reason or another, often --- unfortunately --- have also agenda other than science. As a result, what happens is what happens.

Dell'Anno et al. (2005) and Levy-Booth (2007) demonstrated the equilibrium mass of the extracellular DNA in the Biosphere to be as high as $4x10^{9}$ tons, with a residence time of 9.5 years, all heavily concentrated in thin layers of soil, shallow water, and surfaces of living organisms. This results in the natural concentration of DNA similar to the one used in the laboratory techniques for GMO creation (Lorenz, 1994). *What a coincidence!* Why would that be?

These authors also estimate the half-life for the environmental persistence of many DNA fractions to be in hours, demonstrating the high dynamic exchange level and sufficient time for biological effects to occur. In fact, these should be under-estimates since the very same authors, way back in 1994, have also demonstrated that the natural "freed heredity" transforms bacteria orders of magnitudes more efficiently than in the laboratory, massively creating *visible* (when the genetic change is expressed or can be detected) and many more *invisible* natural 'GMOs'. Too bad this knowledge never made it to the public discourse.

It is amazing how we teach ourselves not to see the reality and its contradictory signals that we receive once we get conditioned to see and recognize something as "obvious." Truly, the illiteracy of our time is not the inability to read and write, but that to learn, unlearn, and learn again, especially of people at the forefront of change. In laboratories, people measure results --- like the transformation of cells --- while not seeing and therefore failing to acknowledge the process leading to such results. We see horizontal gene transfer (of a particular gene of interest) as an *event*, not as a temporal slice of a process that led to the event. Genetic flows of exogenous DNA and non-target transformations (other than those of interest) are not counted at all due to our narrow frame and inability to imagine.

Jiang and Paul (1998) estimated that only in one tiny ecosystem of Tampa Bay there are 10^{14} transduction events occurring annually. That is a natural GMO laboratory, operating without FDA approvals. The phenomenon of horizontal gene transfer makes *everything* in our food web a GMO, including ourselves, and so the strong negative reaction from the public regarding GMOs stems from the public's essentialism regarding organisms and their genetic makeup.

What is known as 'viruses,' too, perform their infectious duty mostly as a heredity transport vehicle rather than a cause of diseases. Or, put another way, evolutionary innovation often takes the form of what we see as 'disease.' Not even 'infection,' but more so 'colonization.' The discovery of the world of plasmids and episomes in bacteria opened up a whole new world --- the world of genetic migration. These informational entities did not cause any detriment to their hosts, and, moreover, turned out to be interconvertible with 'viruses.' Many of these vehicles turned out to be nothing more than packaging material for shipment of bacterial DNA.

The discovery of the symplast architecture of multicellular organisms (the structure like that of the fictional 'living ocean' from Lem's science fiction novel *Solaris,* a unibody organism covering the whole of its planet as its only living entity) remained among the unimportant microscopical details. And yet, the discreteness of organisms is also far less absolute than it looks from the surface. The balance between the mixing and differential multiplication is why evolution (still!) happens, but children nevertheless resemble their grandparents. Fixation of novelty is a rare process; not as rare as neo-Darwinism would ask us to imagine, but rare compared to the span of human life. This is why we do not seem to have horns, tails, hooves, and other, more exotic features; this is why we do not yet photosynthesize.

The Emerging View: Living With A Fluid Genome That We Do Not Understand

A surprisingly modern view of the world **(see Fig. 2)** had been described by Empedocles, whose views have been summarized by Gordon Campbell ("Empedocles," 2018):

> *.....first of all, individual limbs and organs were produced from the earth. These wandered separately at first and then* under the combining power of Love *they came together in all sorts of wild and seemingly random hybrid combinations, producing double fronted creatures, hermaphrodites, ox-faced man creatures and man-faced ox-creatures. [..] The creatures assembled wrongly from parts of disparate animals will die out,* either immediately, or by being unable to breed, *and only the creatures by chance put together from homogeneous limbs will survive and so go on to found the species that we see today.*

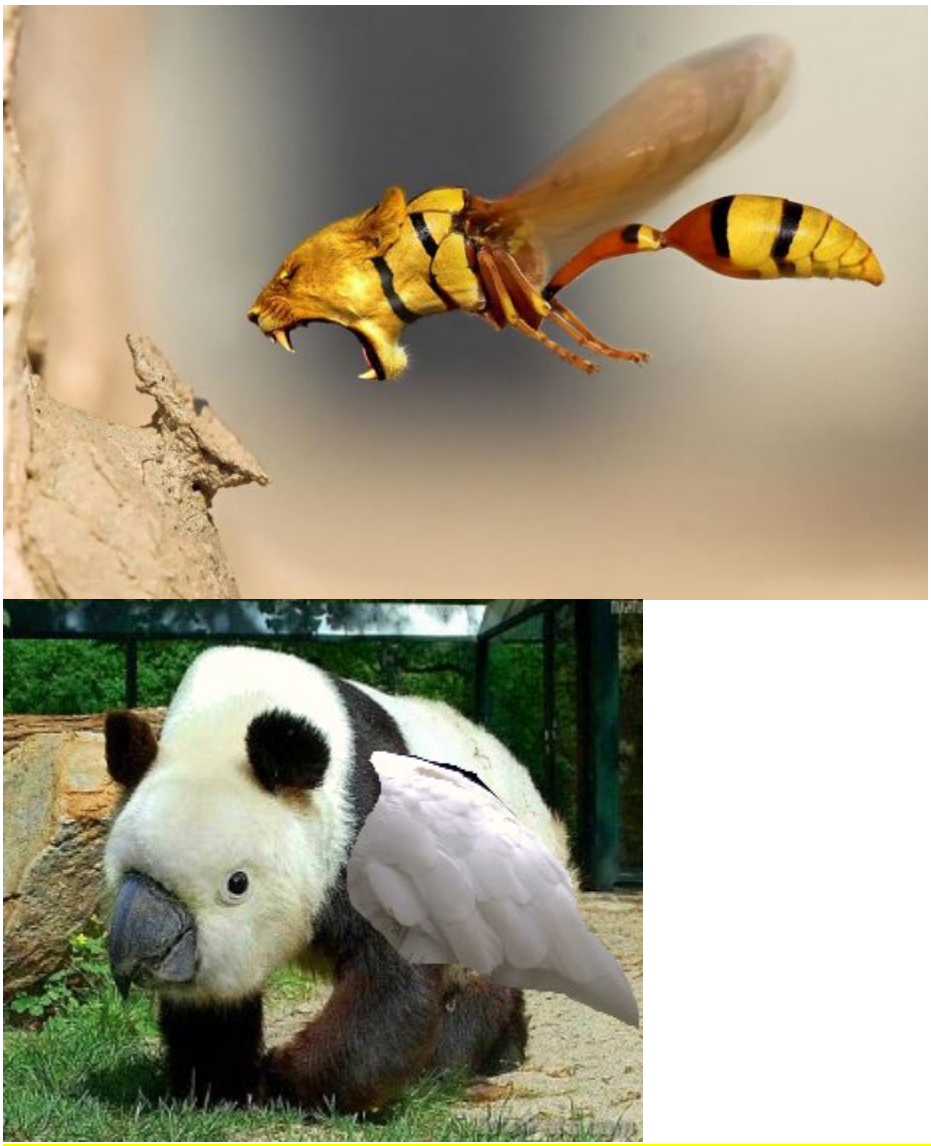

Fig 2. Combining different parts for evolutionary creativity. Anything is possible and is being continuously tried out by Mother Nature. Once gone through a sieve of natural selection, some of this unbounded creativity becomes innovation, only some, and in an exponential fashion --- but one would have an exactly zero chance of innovation at all without this input in the first place.
Image from https://www.reddit.com/r/HybridAnimals/comments/1aqab7/lion_wasp_liosp_xpost_from_rpics_by_uduschdecke

And this is exactly how evolution seems to happen, based on the experimental results accumulated since the 1930s, when the forefathers of the 'Modern Synthesis' were formulating the mathematical core of their theory --- elaborated, sophisticated, but not applicable to reality, as almost all of the mathematics.[13] When 'it' appears -- it is abrupt, rough, ugly, and very new. The "it" is the evolutionary *novelty*.

[13] Some neo-Darwinists went as far as to claim that evolution is mediated solely through changes in gene frequencies, whereas it seems that it is mostly degenerative change that is mediated through these

When its epidemic spread occurs, just as per Empedocles, the time starts tickling for the proto-species to perfect itself molecularly to a competitive level of both external and internal (self-) fitness, or else to die out. Failure to realize internal, or *endogenous*, functions will result in self-incompatibility (mechanically analogous to a part failing, or parts of a mechanism not properly fitting when working together and therefore wearing each other down). Failure to realize external, or *exogenous* functions, is the failure of the environmental, external, fit, that is, inability to exist ecologically.

If this two-pronged "polishing" happens fast enough --- all while the numbers of the carriers of the newness are declining --- the crisis is averted and the numbers of the new species start to rapidly increase, exceeding the ancestral level.

Such is the process of human innovation, as well. Innovation entails a crisis. It is a disease that makes one stronger if one recovers from it. It happens dynamically, and at all times during it, the organisms or the organizations have to be living and competing. The in-between is always dangerous --- without the protection that an established species or business model offers and with which one actually gets into competition.

The donor DNA in this interspecific hybridization behaves just like Darwin's gemmules (Davis, 2004) --- capable of dormancy, taken up as per the classic infectious process, sometimes kept, sometimes not, and sometimes expressed when time comes.

In her 2008 book *Symbiotic planet: a new look at evolution*, Lynn Margulis summarizes that:

> *"Although Charles Darwin's theory of evolution laid the foundations of modern biology, it did not tell the whole story. Most remarkably,* The Origin of Species *said very little about,* of all things, *the origins of species. Darwin and his modern successors have shown very convincingly how inherited variations are naturally selected, but they leave unanswered how variant organisms come to be* in the first place." (quoted as per "Symbiotic planet: a new look at evolution," publisher's summary, 2019).

Indeed, Darwin's book had been named wrongly: it should have been called *"On the preservation of the species…"* or *"On the maintenance…*[thereof]*"* because, as per Darwin's own admission, he could not propose the mechanism of the origin as such, and got the secondary mechanism of natural selection unsoundly substituted for the primary, the unknown one, in the minds of his learned readers. Darwin was essentially describing something more fundamental than the origin of species: he was describing the mechanism of Life as a phenomenon that makes it different from non-life.

Margulis expanded our idea of Symbiosis: as a merger of organisms, and as that of morphologically distinct organelles, and now as that of morphologically unexpressed

---

changes, since once lost, a well-adapted combination of genes cannot be recovered. The described evidence to the contrary seems to be exceptional and therefore noteworthy (Teselkin, 2014).

genetic information. This happened some 50 years ago; so why do we still stick to a 1930s framework?

This problem with scientific progress and the institutions meant to advance it (but often doing the opposite) has been on air ever since their establishment. Csiszar (2016) advances a characteristic and very troublesome insight describing the scholarly referee "as a defender of a society's *reputation*, working behind the scenes to exclude publications that *do not belong."* There is a big problem here since *reputation* usually implies a *fear to fail*. It was in the 1960s, fueled by the massive need to divide the newly available research funding, that refereeing activity emerged as a false symbol of objective judgement and consensus in science.

What makes every person is his or her individual virtual world. If, in "my" world there is no space for something or the something is in contradiction with "my world," the something then doesn't exist or does not make sense. Does not make sense *for my virtual world,* which is "me." This is the echo chamber effect. And it had always been in operation.

All of us, specializing in our narrow areas, rely on *faith* to act beyond those narrow areas of expertise. It is impossible to analyze everything on one's own. Many think even today that evolution is over. It did occur, millions of years ago -- and now got halted. Nobody sees it --- so it should not exist. As soon as there appeared "peoplekind"--- the evolution on the planet had stopped. Something, of course, died out, disappeared, was exterminated. We the bad humans are accelerating such tragic events. But the new - *no-no!* It took the emergence of HIV/AIDS to shatter the notion of the evolution as events belonging only in the dinosaur era. And maybe all the newly described species that are appearing right before our eyes point to something, the common explanation for them being unseen before given in reference to our 'insufficient study' of the natural world?

"GMOs" Are Natural. We are GMOs, too.

Contrary to the implicit assumption that trans-species gene transfer at the root of GMO creation does not occur in nature, transgenics do arise in the exact same, rapid way in nature, and this mechanism, albeit without human agency and at a much grander scale, lies, in fact, at the root of all evolutionary innovation.

Despite the enormous diversity of organisms on Earth, all the individual organisms are all unified at the molecular level. Their heredity exists only in the form of DNA. A universal system for decoding of the genetic information ("the genetic code") makes it possible to express -- with a few technicalities -- genes from very different organisms in any *other* organisms. All of the modern biotechnology is, in fact, based on just two principles: (1) this *unification* and *interconvertibility*, and (2) the principle of *self-multiplication*. These two principles are seen as defining life because they are deemed sufficient in the efforts to create artificial chemistry and artificial life (Buliga, 2014). Life has its information encoded in the geometrical structure of some molecules (DNA) and survives by multiplying their numbers.

In agriculture, first, there was selective breeding with a reliance on *nature* to generate the variety to select from; then came 'GMOs' where the *generation* step had been moved from the nature and into the lab, and now, in our sci-fi dreams, it is synthetic biology that is bound to supplant them all.

Before we are able to create self-replicating systems from scratch, however, it is transgenic technology using which human genetic material can be transferred into bacteria so as to produce therapeutic proteins. Or bacterial genes inserted into crops to make them resistant to insects. Canadian Blood Services routinely collects stem cells to transfer them to people other than the donor, where these cells can repair patients' dysfunctional organs. And human embryonic brain cells can be introduced into the brain area of a mouse embryo --- thus creating a human-mouse chimera. This is something of a routine today and is (technically, not ethically) perceived as a banality (Behringer, 2007; Greely, 2007). Something of this sort should be taking place all over the Biosphere, too --- so as for it to maintain its unity despite its endless structural and functional diversity.[14]

We don't see what we can't imagine. An antibiotic resistance gene is expressed in bacteria when we take the antibiotic. The gene, on a plasmid, had been there before --- but it was invisible to us. And will become invisible again once the antibiotic is gone. How do we get to see the invisible, *the potential?*

Manu (2017, p.26) writes that:

> *Strategic capital is the excess of an organization's future possibility over its current capability; it indicates the organization's ability to remain* relevant *in an evolving [..] ecology.*

While it is a *business* organization that is meant in the above, the same logic applies to biological organization: species survive or go extinct depending on their strategic capital allowance, the openness to horizontal transfer of genetic information and the allowance for its dynamic storage. As we will see in the **Fig. 3,** *most of the genome* in the eukaryotes is devoted to the invisible, the unexpressed. Interestingly, no relationship was found among the many attributes of species or genera and their longevity in the geological record. In my view, it is the balance between the actuality and future possibility allowance that determines the longevity of species. Some species were too *efficient*. It may be for this reason that the dinosaurs famously did not survive.

[14] This thinking led Margulis to the co-development of her Gaia hypothesis.

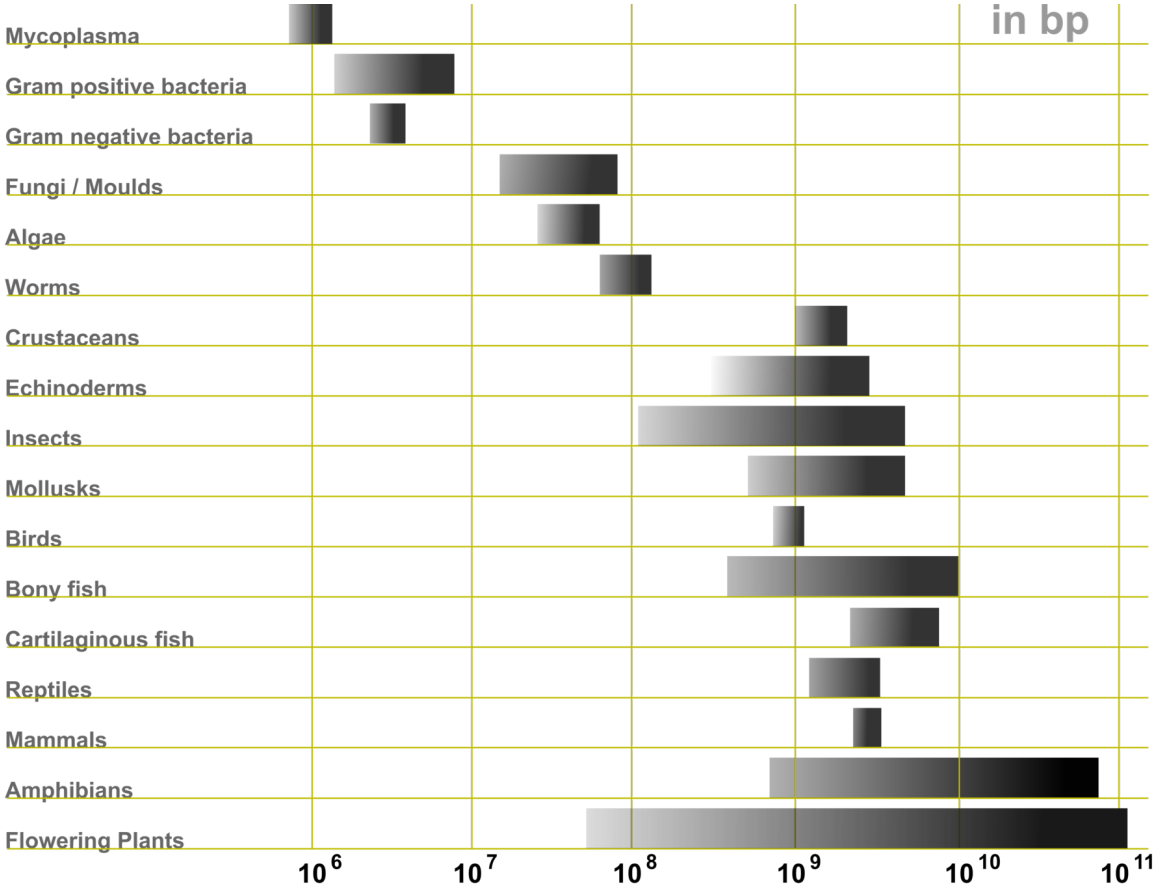

Fig. 3 Genome size enigma,
from https://en.wikipedia.org/wiki/Genome_size#/media/File:Genome_Sizes.png

In summary, the earthly form of life is universally convertible, exists on the basis of self-multiplication --- and this includes us, humans, too. Life's *convertible* information (nucleic acids) multiplies itself by means of the *nonconvertible* information of the proteins that it encodes. And this carrier of traits (DNA) is a unified, convertible "something" that can determine the expression of -- in principle -- any trait.

Genetic engineering, gradually developing and improving, combined artificial and natural processes of genetic interconversions. It became apparent that, on top of the already known "natural," everything that was carried out artificially (in the lab), also occurs in nature, that is, naturally --- only with its own direction and probability.

Bacteria and viruses were first considered as a special case (and by many still are considered as such). Everything begins with a special case. Then it turns out that the case was *not that special,* and the new concept is extended to an increasingly wide range of phenomena and events. This happened when Newtonian mechanics became a special case of the quantum one. Does this weird genetic transfer stuff hold also for animals and plants?

Not even that (such as the textbook example of *Agrobacterium* that naturally transfers its DNA into plant cells). Even human cells are not spared (Fernandez-Gonzalez, 2011; Schroder, 2011). And this takes place with an efficiency exceeding those of any laboratory technology --- 1% transformed human cells per 24h. And for each successful transformation, there are many more unseen *attempts* that did not result in success. There even exists a name for this widespread process --- *bactofection*. Until recently (Andersson, 2005, p.1182), the process of bactofection had been vigorously denied because it was turning the comfortable, traditional worldview (and careers) on their head.

> *"Transfer of genes from prokaryotes to animals with sequestered germ lines appear to be extremely rare, although it cannot be formally excluded."*

This transfer lies at the origin of new animals and plants, including those of agricultural significance, the 'GMOs'. Perhaps that is why us humans, flies, and worms have the same number of genes, despite having differing overall genome sizes (see Fig. 3). It turned out that 'junk DNA' was not junk at all, but rather a creativity reserve rivalling or exceeding the expressed, materialized portion of DNA.

There exists also this set of evidence, described, repeated, and not questioned, but psychologically absolutely unacceptable. This evidence is the evidence for human transformation after normal eating of normal, regular food. And even inheritable in generations! Forsman (2003, p.362), for example, puts it like this:

> *"One hour after a meal of rabbit meat containing 1014 copies of RERV-H DNA, a maximum concentration of 200 copies of RERV-H DNA per ml of peripheral blood was observed. [..] RERV-H DNA* [the marker they used] *was detected in both cellular and plasma compartments."*

Some DNA vaccines can be taken as food. For them to work, they need to be taken up, expressed into a protein, and then to start an immune response by means of this protein. This means that DNA is not broken up in the digestive tract and can retain its functions. In mice, inheritance of this digested DNA has not been ruled out in generations -- "foreign DNA, orally ingested by pregnant mice, discovered in [some] organs of fetuses and newborn animals" (Schubbert, 1998).

Global Channels, Global Ruin? Desire for Absolute Control and the Suggestion to Not Even Try

The global channels of the horizontal genetic flow were of particular concern to some critics, like the outspoken if controversial[15] Chinese-British geneticist and author Mae-Wan Ho and even more outspoken and controversial Lebanese-American probability philosopher Nassim Taleb. Taleb was also concerned about the internal stability of the GM-based modern agriculture system, and other potential pitfalls we may not be even aware of. The global channels of gene spread so much of concern to both of these thinkers can be

[15] -- a good thing!

mediated by insects, birds, wind, and human economic activity. The authors, in my view, commit each their own versions of a deductive fallacy in their arguments relating the global potential of ruin to the topic of GMOs.

In her scientific and publicity work, Mae-Wan Ho sturdily attacked the mainstream view that transgenes cannot be transferred via horizontal gene transfer and that any DNA in the environment exists solely in a degraded form, as food possibly, but not as information (Ho, 1998, 2003). I have been arguing for the same worldview above.

Ho is mistaken, however, in stopping half-way and not estimating the volume of the natural gene transfer on top of the fact of its mere existence. Horizontal gene transfer and recombination of travelling genetic material, Ho claims, is the main route for generating new pathogens and spreading antibiotic and drug resistance, and genetic engineering, in her view, is nothing but a greatly facilitated transfer and recombination channel and should thus be contributing towards emergence of new infections (Ho, 2008).

I would agree with Ho, *except on the scale she assumes*: the human attempts are a greatly *weakened*, not greatly facilitated mechanism for evolutionary generation. Having no intuitive perception for large numbers, we overestimate our impact in our ignorance of the scale.

As has been demonstrated with the literature calculations above, Ho greatly overestimated the role of humans in an enormous-scale natural combinatorial process. She is right in claiming that the emergence of new viral and bacterial diseases and antibiotic and drug resistance accelerated since genetic engineering began in the mid-1970s. *But correlation does not imply causation.* The two trends Ho is pointing out have a common third cause: the uneasy emergence of what could be vaguely described as the Noosphere, a new system by us to allow us to control phenomena to our own ends, the system that puts the human at its center by automating the process of control across the entire ecosystem.. all the way to a whole planet --- and that competes therefore with the Biosphere of the old by being more and more aligned with human optimization desires, at the expense of delayed risks.

The Noosphere can be described as an ideal of human wants that started to materialize in the middle of the past century, owing to a partial release from the dogma of categories, resulting in the possibility of Korzybski's *Ā (nonaristotelian)* worldview (1958, 1994). It started to gain traction much earlier, however, since the population explosion after the entrance into the demographic transition in the 19th century (which itself was consequent to a sustained and massive awakening of the human minds prior -- see Selkin, 2018). Vernadsky's (1945) geological definition of the Noosphere should at the bottom of it denote the sphere of human control of the matter flow. It is an abstract term for the new, modern biogeochemical reality that is enabled by Korzybski's "time-binding" of all the knowledge and beliefs that people have in their heads and that translate into environmental control, and which we exchange, modify, and transmit down the generations. Ideas finding expression and form in a material. How to make things. How to adapt to the environment. It is a growing but terrifically uneasy and contradictory cultural, memetic sphere that has become more and more of an alternative to the Biosphere of the

old and our Biospheric existence within it. And it is driven by the long-standing human motivation for Pleasure (that we derive from extracting our version of Order from the world):

> *The* condition of being human *involves the potential of manipulating the world around us, which is the reason the world needs to have plasticity. And because of this plasticity we are using our surroundings to leave traces, and to change natural objects to make them* pleasant *for us.* (Manu, 2017, p.52)

Gradually, as a result of the accumulation of this cultural capital (Korzybski's 1994 *time-binding,* embodied and accelerated by, for example, the emergence and growth of the Internet), we have been transitioning, as a civilization, from having a Biospheric perspective as one of its components (what can be called a 'selfish' yet totally biological perspective, like one that all other species have --- Nietzsche, 1874) to a perspective attempting to re-balance the system that included us in it, too, and do this according to our understanding of it and our human values projected onto it --- rather than having it balanced for us by life, "primitively," Biospherically, as before.

Technologies are our ways to achieve our goals, which consist in transforming nature, and the material implementation of the Noospheric desires had always had a technological embodiment to it. Genetic technology is an example of this.

Ho references how a soya transgene got transferred to human intestinal microbiota after eating a GM meal (Netherwood, 2004). Amazing! But not really, if one considers, for example, that Chagas disease (and many others) bomb human genome with genetic fragments through mosaic recombination and hitchhiking on retrotransposition events, in both somatic and germ cells (Hecht, 2010). Constant transient genetic flows through everything and anything are nothing new. They are new only to neo-Darwinians. The unbelievable transgenic technique for obtaining hybrid animals called sperm-mediated gene transfer was discovered to be very natural. In fact, even more unbelievably, this gene transfer channel, mediated by dedicated receptors on the surface of spermatozoa, proved more effective than direct injection of genetic material into a zygote (Lavitrano, 2005, p.21).

> *"This result contrasts with the reported efficiency [..] using [artificial] microinjection [..], offers a 25-fold improvement,"* -- the authors wrote.

We can conclude therefore that our very own germ line is primed for uptake of random DNA, and that ubiquitous transitory hybridization between us and bacteria is taking place. Why else would spermatozoa even possess the dedicated capacity to reverse-transcribe exogenous RNA "so as to generate transcriptionally competent sequences that are transmitted to offspring?" (Sciamanna, 2003).

And yet, children still resemble their parents, most of the time. The explanation for the seeming contradiction is that this 'invisible' gene flow dynamically exists in equilibrium --- environmental DNA is taken up, exists for some time, and is then eliminated. It would have

been a great clickbait title that "GMOs *infect* future generations," but not only GMOs --- everything does.

In her article *"Horizontal gene transfer happens. A practical exercise in applying the precautionary principle"* (2002), Ho claims that genetic engineering can lead to a "catastrophic breakdown" owing to the irreducibility of genomic interactions and the fact that information makes sense only in a feedback loop. The fact that there is no data to assure that such has not happened or cannot happen mirrors Nassim Taleb's 2014 argument to the same effect. I will discuss this much more real veridicality concern in the following chapter.

Both Ho (2013) and Taleb (2014a) also independently proposed food waste reduction in place of GMO reliance as a solution to the food production needs in the face of the always changing climate and the growing population and its also growing material, "quality-of-life" expectations. This seemingly innocuous approach has an important other side, however: just as in the case of "junk DNA," *we do not know what is waste,* and therefore arrive at the very same problem of induction.

This *real* problem with GMO strategies, therefore, transforms into the problem of *having* to design for what we do not know, no matter what the approach: genetic engineering for generation of more efficient food staples or efficiency improvement in the food distribution network. It comes down to the question of our optimization desire, which is based on the supposition of the future resembling the past, and therefore us *knowing* what it is that we can "optimize out."

> *Probable reasoning cannot establish* anything *about the future, because it is based on the relation of cause and effect. [..] We are determined to expect that the future would hold the same objects that we had been accustomed to, and we are determined from habit to transfer these objects into the future because we lack the* imagination *to create a new story, populated by new objects. (*Manu, 2017, p.79)

Summary

- Under incessant selective regime, no innovation can happen in the same way it is impossible to pull oneself up by one's own pants. The Neo-Darwinian view of evolution is nothing but an evolutionary embodiment of the Protestant work ethics and Aristotelian teleology of keeping oneself always busy. This role is attributed to natural selection, the process of elimination, and a conceptual friend to a mental process of deduction. These social constructions, unfortunately, tell us more about the constructioners and their culture than about anything "natural" they were meant to describe.

- Darwin did not describe the mechanism of origination of species, despite the title of his famous book. This in no way diminishes his contribution: he described something more profound --- *natural selection,* the mechanism of life itself.

- New species arise via *exaptation* --- radical and unpredictable co-opting (repurposing) of large chunks of the "flowing," *trans*- DNA. Some lucky DNA recombinants, those "information" monsters that give rise to evolutionary novelty, appear suddenly by large, step-wise and completely random genetic changes, and *only then* begin to adapt to the environment and look for a suitable ecological niche. This initial leap, like a leap of imagination, *cannot happen without* --- initially --- being sheltered from objective restraints that give rise to natural selection. Contrary to the dominant view of it, natural selection is *not* a creative force.

- The genomes of higher organisms are partitioned into the expressed, functional --- and the unexpressed, hidden parts (the majority of the DNA content). In evolution, the principal historical branches of organisms are those that do not sacrifice their future for their present by over-optimizing for efficiency and disposing of the energy-heavy silent DNA burden in their genomes, *regardless of their level of specialization.* We have seen in the Fig. 3 how much of an extra DNA all the higher organisms carry around. *It must be necessary for something.*

- It is this that is the ultimate reason, *fragility*, for which the dinosaurs died out, the commonly quoted 'reasons' at most being the proximal causes, triggers, etc. Most dinosaur species "made" a choice that aged them out, through environmental misfit. It can be imagined that the most resilient species of pests (against which often all the "means of civilization" prove useless) have the best ability to *adapt over and over* by keeping their DNA intake open to recombination, i.e. "wasteful," and expressing received information as needed in conditions of environmental change. The strategy for their control, therefore, should consist in tapping into instead of *denying* this mechanism, for example by utilizing the process of *gene drives* (Burt, 2003).

- Consideration of scale shall play down the concerns of unforeseen (and potentially negative) consequences of having a gene transfer from a GMO cultivar to other crops. Crop system stability is a whole different and less often raised concern (despite being much more valid). As pointed out by Taleb, it is conflated with agricultural and imagination monocultures. This concern will explored at length in Chapter 2.

- Efficiency in evolution can mean extinction. We ourselves have 98% of our genome not coding for who we are. *Might it be necessary for something, even though we may not understand for what?*

Chapter 2: Innovation starts with Variances

Innovation starts with foresight and is followed by strategic planning and reality testing. In this Chapter, I discuss GMO risk management and strategies to minimize harm from the limitations of knowledge all while in the alluring and socially encouraged pursuit of efficiency. I will also develop the question of where else this thinking could turn useful, extending my foresight to other systems, all nested between biological innovation and social processes influencing innovation in* Homo sapiens*.

As discussed, genetic technology is a platform technology, in the same way that the iPhone is a platform technology for its apps. The fear with letting it in is the fear to start down the path of accepting more and more forms of intervention, becoming dependent on it, and eventually extending the intervention to ourselves, as well.[16] As they say, when you see a door in, make sure you also notice the door out. But do we really enjoy the luxury of a choice?

[16] (We might be needing the latter in the current civilizational model, though).

2.1. Don't be afraid of Variances in Biological life

The Need to Function Without Going Insane

In his *Science and Sanity* (1958), Alfred Korzybski proposes that *sanity* is tied to the structural fit or lack of thereof, to what is actually going on in the world. *Insanity*, therefore, consists in mistaking a map for its territory. Doctors for centuries believed that their theories worked when they did not; peer group pressure often halts progress in its track. Groups are therefore not immune to insanity, either: in fact, consensual validation can exacerbate it (Fromm, 2013). Nietzsche wrote to the same effect in his *Beyond Good and Evil* (1885) prior, saying that "madness is rare in individuals - but in groups, [..], ages [and scientific guilds] it is the rule."

Mysticism and limit on questioning had always provided a defence against the Terrible Unknown, and a soothing emotional comfort to satisfy our gnawing need for Certainty (Brooks, 2002). This applies to theists and a-theists alike, in that a belief system that does not need to be questioned has to be supplied in order to live, be it a recognized religion, or a belief in rationality, the power of science, social democracy, technofuturism, wisdom of ancestors, the rule of law, and whatnot. Some sort of belief is a foundation that allows humans to function without going insane; it is how our ancestors survived the competition of the Savanna instead of freezing in the middle of it trying to figure out who they are and for what (Nietzsche, 1873; 1874).

Imagine a hare thinking in the middle of a forest about Philosophy, or Art, or Science, questioning everything, like Socrates or Robert Nozick (2001), sympathetic to neo-Darwinian premises, albeit *self-reflectively* so.[17] How long will it take for it to be eaten? Or for a lion with the same hobby to starve to death? Humans have been different to begin with, and have been increasingly becoming even more so in the course of their Noospheric Transition over the past two centuries and the explosion of science, culture, art, addiction, and mass action it brought about. We now seem to be updating our phone's software more often than our own, despite our best efforts to maintain a semblance of parity.

For a long time, without any science, the practical human use of nature have been demonstrating the mental reality of only what was known as 'sexual' and asexual (vegetative) reproduction of plants and animals. The emergent science detailed this, and molecular biology very recently did so even further, by mapping the source of 'heredity' to the molecules of DNA. Up to this point, this knowledge is, by and large, an element of public consciousness. What *had been not accounted for* for long is the concept of silent information --- the part of the genome that does not get expressed. We know now that this hidden part constitutes a major portion of the genome in organisms more complex than bacteria, including us.

Within the Western forms of democracy, relying at present largely on political marketing rather than on less picturesque decision-making by specialization and expertise, an out-of-tune public perception and some of the interest group activity can be a hindrance to

[17] See his Note 45 to page 102 (2001) for more details.

accomplishing anything innovative, or sometimes accomplishing anything at all. We need to bring together existing disparate pieces of information and instill a sense of perspective into the choices that the society makes in allocating its limited resources. In doing this, it is critically important to calibrate our sense of perspective --- to create and communicate a new mental space for innovation.

How does a belief or behavior that was once 'deviant' become the new normal? A usual reaction of having one's belief challenged is Anger. The emotional, automatic, ancestral psychological "System 1" kicks in (Kahneman, 2011) and fights what it perceives as danger. Our reason is driven by our emotions. It took substantial conflict and violence for many new belief challenges to reach enough tolerance with our brain chemistry and eventually get incorporated into general culture, sometimes as "universal truths." We have believed that the Earth is the center of the universe. While our place in the universe may not feel as special anymore, we still feel ourselves to be the lords of the dominion of Earth, and this belief is reflected in the discussions surrounding the merits of genomic engineering and the outputs of biotechnology industry.

The Limitations of Traditional Agriculture, Based on the Traditional Mindset

It is in the state of play -- the state of 'what IF?' -- that discoveries are made and understanding is advanced. This state of flow is a state of wizardry, when the imagination barriers are overcome and weightlessness ensues. It is also very fragile and prone to being disrupted.

So let us imagine. All the stuff that makes people, plants, and animals comes from transcription of DNA into proteins, which then interact with each other to produce biological structure and anchor all the other components that contribute towards it. Humans have been using artificial selection in agriculture for millennia, with some remarkable results -- and yet these approaches have their limitations. There is a ceiling to traditional selection methodology, and our human-directed endeavours fall short of what biological systems routinely do.

We might be missing something in our models of biology; there might be some "new stuff" that we need. The new stuff is probably (as always) something that is already staring us in the nose, and we just have not seen it yet, seen *with our minds.* This is because in order to see with the eyes, one first needs to see the possibility with one's mind (Manu, 2007).

My guess is that what we may not be seeing is not some mystic quality but rather a fundamental *dynamic description* of what is going on in living systems. It definitely seems right that the mathematics underpinning our understanding of evolution is fundamentally flawed.

Is adaptation governed by extreme values and rare events, when average properties of the current population are of no importance? Do averaging assumptions suffice? Or maybe bacteria overwhelmingly don't grow in isolated culture because they are missing

something --- such as the genomic flow of their native communities supported by their spatial architecture?

Lab-isolated isolated culture is purported to model the evolutionary process (Teselkin, 2014) --- and yet beyond a few exceptions, not much growth, and even less innovation was ever observed to come out of these artificial constructs; rather, the commonly underreported laboratory degeneration after limited passages. Consequently to not seeing something, we are leaving out the necessary generative components life uses to produce the processes that give rise to its diversity --- as we attempt to modify the living part of our environment to fit our human desires and needs.

As pointed out by Kiss (2009), the network-building property of horizontally transferred genes can be viewed as an effort to stabilize as large a segment of their environment as possible. The preservation of these creative, disruptive elements in a system is necessary to ensure the system's evolvability, innovation within it, plasticity. We don't see these elements; what we do see is only the limit, the fixated parts of genetic flows and transitory genomes. The powerful idea that Brooks (2002) compares to von Neumann's and Turing's computation and that "will give us great explanatory and engineering power for biological systems" is *horizontal gene transfer* -- "a gentle, nondisruptive idea, but one that [is] immensely powerful."

We need to *update our driving metaphor* for what biological systems are -- and with this update, with the undoing of current, in-the-way knowledge, a new understanding will come and new possibilities will be noticed.

Design is a field of inquiry that operates to deliver results where theories are absent. Design operates where there are no references. References help with standard situations and are essential for within-paradigm finessing, but no single situation is 100% standard, is it? So there are lots of judgement calls, including with GMOs. Design is not about avoiding failure, but about the ways to best coexist with failures. Just like life is not about avoiding loss at all levels (protein, cellular, individual, species turnover) but rather about how to coexist with it best.

Prototyping is a supposed antidote against the limitations of our mind and its unbelievably limited knowledge and experience at any given time. While any life-form in the universe may not be smart enough to understand itself well enough to build a replica of itself through engineering a different technology (as per the Gödel's incompleteness theorems), we may not, in fact, *need* this; what we need, however, is not to keep our hands voluntarily tied owing to a fear to address and challenge our feeling of specialness.

Our gap is similar to what Brooks describes as a gap of a patient who, after a stroke, could see the colors and use color words, but could not make *associations* between the two. What newfound capabilities of environmental manipulation can 'normal' brains gain with a few changes in wiring? These changes are what we call self-driven education, learning, discovery. Don't get me wrong: the ability to *see* stuff does border on insanity (Korzybski, 1958), and may be enabled by the same brain architecture. Things in evolution come as a package: the "good" and the "bad," never a perfection. It's take it or leave it. The same way

we sometimes look at our ancestors who did not see 'the obvious,' will our descendants (or perhaps a more intelligent extraterrestrial species) look down on us.

We Cannot Control the Fate of "Travelling DNA" by Not Introducing Any of Our Own Creation

We can enable but *not* control Possibility, such as the emergence of new biological species. Nassim Taleb, an otherwise extremely germane thinker (and needed especially in our times), seems to apply his own view that trial and error (i.e, prototyping, design) beat academic knowledge in reverse in his position on the GM technology (Taleb, 2014a). This position may be logical within the currently domineering narrative of Anglo-Saxon neo-Darwinism but becomes not so after us learning to un-see it. Taleb overestimates the potential costs of human-directed GMOs in terms of their unwanted propagation ability. The mechanism of GMOs at a planet-wide scale is simply the mechanism of life's diversity generation, and our own genomes are a testament of every single living thing on the planet being a 'GMO' (Leger, 2018). It is yet another assault on our cherished feeling of specialness, this time the specialness of our technology. The *scale* of the natural evolution dwarfs any human attempts to emulate or control it.

Taleb (and Ho) vastly underestimate the creative potential of the Mother Nature --- anything, for which there was an ecological need, would have been created and selected regardless of our actions. It is like suggesting not having children so as to avoid them becoming criminals or getting afflicted with something. Or not smoking to improve air quality while there is a forest fire next door. The scale and the structure (connectivity) in a system matter. Having children can be propagating events, as well, and some of the people born in the past have been known to cause quite a bit of global ruin.

Concerns about, for example, an accidental creation of a new pathogen in the laboratory or as a result of the operation of our genetically modified food supply systems, or such other undesirable, or even catastrophic changes, are not limited to laboratory premises or creations of our own making --- these processes happen in nature. One cannot 'ban' them.

Venn wrote in 2008 that he was taught animals do not photosynthesize (and so was the author). The "Green Molluscs," *Elysia chlorotica*, do (Rumpho, 2008). In an amazing example of "symbiosis," the mollusc eats algae while retaining and temporarily using their chloroplasts in its own cells for photosynthesis. Apparently, it is also using the algal genetic information from its own nucleus to control and orchestrate the process, since one cannot just plug a new organelle and get it to work. So the algal information must be migrating into the genome of the mollusc. While genes themselves take time to hybridize, despite the incessant flow, the flow should be temporarily enabling the operation of the (also temporary) chloroplasts. We may be witnessing the creation of the first photosynthesizing animal. With time, the temporary imposition may well get adjusted, fine-tuned its parts to each other --- and become the new permanent. We need to remember that in nature,

fixation of the dynamic, travelling part of the genome is not limited by *supply* --- it is limited by the ecology.

For the sake of consistency, the Noospheric vector that the humanity had chosen in its development (increasing environmental modification to avoid selective pressures) makes it necessary to follow along the path chosen, although we do not know, indeed, where it will lead.

History had proven that resistance to new technologies is ultimately futile (Juma, 2016). While it is the balance of winners and losers that shapes technological controversies, new ways of relating can only be *delayed*, not thwarted. The singling out of the GMO domain among all the potential risks is, in my view, an example of a documented psycho-logical overthinking phenomenon, whereby, in an effort to control something, a loss of control only is achieved (Einhorn, 1986). The biggest tail risk that we face from a biological viewpoint resides within our own minds. Evolution in the natural world does not "benefit one error at a time." 'Errors' can only destroy. A different mechanism is at work here, and the appreciation of this mechanism and its scale totally changes the risk outlook for agricultural security. Thus, a proper recognition of advances in biology should reverse Taleb's probabilistic argument --- and what should also be reversed is the social opinion, too, that --- it seems in this application only --- aims for an absolutist, metricized safety ideal and aligns with Taleb's inflexible stance on it.[18]

In the medical application, Taleb advises us in his blog to take more risks than we would normally do in a dire situation:

> *"the Second Principle of* Iatrogenics*: it is not linear. I do not believe that we should take risks with near-healthy people and treat them at all; I also believe that we should take a lot, a lot more risks with those deemed in danger."* ("Opacity," 2019)

The explosion of human civilization (and population) since 1800 is such a dire situation. We *are* in danger. The Biospheric existence is no more, the Noospheric one is not yet.

> *It is* irresponsible *to talk about small probabilities and make people* rely *on them,* indeed*, except for natural systems that have been standing for 4 billion years* (--- and this *is* the domain of 'GMOs"). *(Ibid.)*

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Taleb would claim the risks of the old technologies or products have been tested by Lindy, by time (the Lindy effect). In case of transgenic crops, the analysis entails the relative advantages and disadvantages of the genetic and chemical technologies. It is no coincidence that transgenic companies and chemical companies are usually one --- the two are the alternatives to satisfy the same need of *domestication*.

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[18] Taleb views the GMO category as 'clear-cut,' and fails to recognize the *sameness* of the GMO problem to the problem of antibiotic resistance. Moreover, he explicitly reverses the 'irreversible ruin' risk assessment of antibiotics, whereas, if anything, antibiotic resistance is that propagating, systemic danger that can significantly reduce human numbers. Source: "Nassim Nicholas Taleb on the Precautionary Principle and Genetically Modified Organisms - Econlib," 2019.

The chemical application can be deadly but its effects remain local; genetically modified organisms, like all organisms, have the ability to propagate. Now, granted, a cost-benefit analysis is inapplicable to the domains with a small but propagating possibility of ruin. Similar to Taleb's stance on climate policy ("Climate models and precautionary measures," 2019), the following asymmetry applies to decision-making: the scale of the effect must be demonstrated to be large enough to have impact. As per Taleb's paper, the good news is that some classes of risk can be deemed to be practically of probability zero: the Earth survived trillions of natural variations daily over 3 billion years, he says; otherwise we would not be here. By recognizing that normal risks are not in the category of ruin problems, Taleb rightly recognizes also that it is not necessary or even normal to take risks that involve a possibility of ruin.

The Scale of Human GMO Intervention Not Large Enough to Be of Concern

Once this is shown -- and it had *not* been done so in case of the 'GMOs' -- the burden of proof of absence of harm is on those who would deny it (i.e, on the scientists making claims). Harm is therefore the default state, in Taleb's view. Introducing too much carbon into the atmosphere is potential harm, and so is introducing transgenic proto-species. The problem with this reasoning, as we have seen in Chapter 1, is that claims in the scientific enterprise cannot in principle be *proven*. They can only be not disproved (Popper, 2005).

And this shifts the burden to those opposing claims. We seem to be reaching a practical dead end here. Taleb's argument also fails to consider systems dynamically, assuming that doing nothing ("exercising precaution") entails no risks of its own.

It is a described cognitive bias (Stanovich, 2010) when all the focus is on the potential risks of a new technology, without paying sufficient attention to the benefits of that new technology over existing products and the status quo -- and their respective *existing* risks. The point here is that doing nothing is a choice, maintaining the *status quo* (risk suppression) is a choice, and these choices come with their own risks. Again, the problem is in focusing on one thing only while ignoring the others. Doing nothing may well have risks, and the risks would again be impossible to estimate.

The formal arguments do not work well with complex scientific problems stemming from "science" because we soon reach the limitations of deduction. In the legal system, the burden of proof is customarily left to the accuser. In case of the climate change, the accusers are scientists who propose a causation between human economy and climate trends; and in the case of the GMO debate, the accusers are those questioning the safety of the products. Should the burden of proof be left to them?

Taleb would reverse the burden in both cases, and put it on those proposing anything that goes against the old, time-tested practice (such as the economy prior to the fossil fuel age, and traditional agriculture, or the hunter-gatherer lifestyle, if we dig deeper).

We are commonly assuming guilt for both the human impact on the climate and the effect of genetic modification. Cause-seeking is the very fabric of our species that had enabled our prior survival. It is dangerous, however, to be looking for causes no matter what, and the cost to the society in the form of witch-hunting can be large.

In his *Black Swan* (Taleb, 2010, p. 384), Taleb translates Algazel advancing the following criticism of reductionism:

> *...their determining, from the sole observation, of the nature of the necessary relationship between the cause and the effect, as if it one could not witness the effect without the attributed cause or the cause without the same effect.*

We know that scientists cannot 'prove' any claim, but also that coming up with evidence of harm takes time (as with X-rays, for example, or many modern toxic chemicals that are still presumed innocent until proven guilty). Taleb's interpretation of the Precautionary Principle states that if an action has a potential to cause a non-local harm, the action should not be taken in the absence of scientific near-certainty about its safety. This imposes an impossible logical burden on scientists -- to prove the negative, and therefore paralyzes any action.

Taleb, being a proponent of the Popperian principle of Falsification, denies himself the possibility of science to 'prove' anything, ever. Recognizing the contradiction, Taleb advocates confining precaution to specific domains and problems, and views 'GMOs' as an example of such a domain where precaution is warranted.

"Total failure" is the risk, we are told -- why did then Life had not suffered such a failure in its 4 billion years on Earth? Taleb does not criticize genetic technology solely on the ground of artificiality, but this assumption nevertheless constraints his view. Just as one newly uncovered fact can exonerate an accused person, one scientific fact can throw away all of the previously constructed edifice.

Transgenics by themselves, in practice, are a domain with a small but propagating possibility of ruin. But the risk of the technology itself is not systemic, given the natural supply of transgenes, and this puts GM technology in the *same* category, not in the opposition to the nuclear plant risk that is compared to the GMO risk in the 2014 paper.

Both can spread; in fact, the effect is less in case of transgenics as compared to nuclear reactors (e.g, as evidenced by the very global atmospheric effects of volcano eruptions, such as that of Mount Tambora in 1816). Here, considering the scale of what humans can do and what natural GMO-generating processes do, the absence of evidence can be deemed equivalent in effect to the evidence of absence because of the extreme rarity of systemic effects and their inevitability otherwise.

GMOs can carry risk, in the same way that new drugs can, or nuclear plants, new cars, or other human technologies. When things went wrong with the drug Thalidomide, the ruin was local, not global, too. The GMO propagation potential is a feature of all living forms. It is *not only* 'GMOs' that are scalable (by means of replication and/or recombination, further horizontal gene transfer to wild populations), but so are all the other organisms on Earth.

The concern here is about the unavoidable incompleteness of information (the potential for Black Swans -- we can test *only* for what we know in advance) and the human desire for Certainty, when a psychological cost of attempting an action, the fear of failure, outweighs the cost of losing on opportunities through inaction (the fear of missing out).

It is worthy to clear one common confusion here: there is no such thing as sexual reproduction (Bell, 2008). *Sex* (including gene transfer that gives rise to 'GMOs') and *reproduction* are, indeed, opposed: the former changes the nature, and the latter the number of individuals. The wild competitors can be expected to be more fit for survival without human involvement, and thus keep any volatility from the human crops in check.

The factor of resistance to innovation, along with the human bias of taking disproportionate risks in order to avoid small losses (Kahneman, 2011) explains why the FDA adopted, in practice, the European Precautionary Principle in its dealings with the first transgenic *animal* -- the salmon.

A Dystopian Scenario

The rapid growth of the population in the last hundred years will lead, with further retention of such a tempo, to an even more rapid exhaustion of all the resources of the planet. So it may be the time to look inward for sustainability worries as we are running ever faster from physical trial-and-error and into our virtual inner spaces. What could happen if the maintenance system of the GMO-based agriculture, specifically its societal component, proves unable to keep up? (We can combine current maintenance and future potentiality of a system into a notion of *"serviceability"*).

First, the living conditions of the affected population will sharply worsen, habits will disappear and convenience, too --- with the same result. The failure of one system can cascade, due to interconnectedness, into the failure of others: health care, for instance, will suffer, which will restore the postnatal part of natural selection, applied, yes, to *us*.

In a short time (one to two decades) the population of the planet will be reduced by at least three times --- to something on the order of 2 billion people. What will we get as a result? Genetic information that has been lost cannot be recovered, so it is quite possible that rolling effects of civilizational breakdown will continue. As a result, a further reduction is possible in the population --- even after the primary wave of mortality associated with the crisis --- in the post-crisis decades.

Transgenic technology is inevitable. All the experience of the human civilization so far

demonstrates that nothing can stop the new in science, as long as somebody can find a way to profit from this new; until that happens, the new will be delayed, sometimes by a lot. Genetically modified agricultural forms are economically more profitable: less labor, many advantages. So they will keep their advance.

But one needs to monitor them closely. Because as soon as the transgenic plants get access to the market, all local varieties will be phased out and lost due to unprofitability. The problem will be the absence of even inferior (but stable) substitute crops and the resulting corporate monopoly on food production --- losing the good in a pursuit of the better.

The problem with the complete reliance on new forms is that due to the lack of time for refinement and proper integration of new genomic material, as well as other constraints of trait inheritance, transgenics need a constant supply of new seeds. This is not new, but rather a further development of a long-term trend; F1 hybrids that rely on 3rd-party seed supply had been in use in agriculture since the 1930s. But we are taking the system to a *new level* of efficiency/fragility. Some transgenics are engineered to be sterile with a purported benefit of no transgene escape to their environment (Daniell, 2002) but a real consequence, again, is linked to the reliance on third-party seed supply for food security. This maintains a point that can break. But there are others, too.

Genome instability is more of a secondary GMO concern among the activists, the first one being the environmental escape of transgenes. These priorities should be reversed. Indeed, genomic instability has been known to be a possibility (e.g, Choi 2000) and should be assessed on a case-by-case basis, as well as at system management levels. Planes are so safe today not because the circuits they rely on cannot break, but because these circuits are doubled down for redundancy and the inspection is regular and careful.

There is never something for nothing in life: the greater *efficiency* of GM crops with regard to human-desirable traits comes along with greater *maintenance load* and the *work* that has to be put into such crops.

In combination with the agricultural, corporate, and regulatory monocultures and other forms of 'efficiency-optimization' this could lead to the widespread propagating failures in the food production system. That's one too many monocultures to bear, all at different levels and all monocultures!

In the development of space equipment, people have tried to create biological life-sustenance systems, which were also closed ecological systems. Such systems, just as our laboratory models, are fundamentally just extricated pieces of the Biosphere, with the scale of creativity available to them accordingly diminished.

Engineering is a very human activity, responsible for our survival; it is therefore expected that we exhibit desire to understand and create self-sustaining systems --- and try to control the direction of their adaptation. With such, it could be possible to built first inhabitable bases away from Earth. That is, unless we overlook something --- the pitfall of the early systems had been their stability. The same applies to the agriculture on Earth. The

Biosphere on our planet is what it is because of its scale --- the scale matters. Everything that had been created to this day consists of dependent systems that continuously require an influx of people, materials, food, equipment. Stability requires certain minimum size.

Therefore, the danger is not in the GM technology as such; it is in short-termism and in the monoculture/monopoly that accompanies it. In the long run, it is systemic design of technology-based systems, not the technology itself, that will make the difference. This is where Taleb is *right*; one can understand why Europe largely keeps a moratorium on the import of transgenic plants from America to protect its own (chemical) expertise and thus remain strategically protected (Tagliabue, 2017). This risk of breakdown of human networks that service GMOs is substantially more real than the fear of the theoretically possible purely biological harm from the use of them.

At the same time, the well-documented positive Black Swan potential from the application of transgenic crops (NRC 2010, Hutchison 2010, Wu 2012, Bohnenblust 2014) can turn the environmental application of the Precautionary Principle on its head. Taleb's very own barbell strategy advocates not for the elimination of risk, but for a combination of an *extreme risk-taking* and *extreme cautiousness,* to maximize one's exposure to the positive unintended occurrences.

Teleology Denied: Genetic Prototyping, Not Engineering

Complex systems are usually impossible to predict before essentially *running* them (Wolfram, 2002), thus defying the purpose of prediction, Buckminster Fuller's *Ephemeralization*. The world is so full of ambiguity and uncertainty that the only way to survive in it is to embrace and encourage volatility oneself, thus switching one's orientation from a decision/precaution mindset to an exploring and prototyping attitude.

"Genetic engineering" is a misnomer; biologists do not engineer. They *prototype*, with natural selection testing for them the viability of their creations at each step. In this way, biologists are different from financial engineers, for example, whose top-down approaches to a completely artificial system of finance remain unchecked by reality until the next financial crisis --- and then the one after it. Today, we are doing sporadically with our genetic prototyping what nature is doing massively -- and call it our Biotechnology. Unlike in financial engineering, however, there is an element of reality in nature. It is called selection. Therefore, genetic engineering combined with selection should better be called as 'genetic prototyping.' With plants and animals, this is something one *can* do societally.

Taleb's concern should be about the *scale*. Scale introduces the structure that now makes the system fail well (in a compartmentalized manner) as opposed to failing badly (catastrophically). A few acts of undesirable transfers from GMO crops to the wild will not make a difference --- for a new species to emerge, this stream should outcompete the natural horizontal streams in its magnitude, as it takes many individuals in a given geographical area who need to be infected to give rise to a new, unrefined species --- so

that this new entity --- contingent on its refinement and survival --- would now admit and protect them.

A species is a semi-stable group characterized by a functionally similar expressed phenotype resulting in a similar response to similar challenges. A species is also a phenomenon of scale: its members need to have an ecological perception of each other as 'own.' Most species even reaching that stage are so short-lived that we can never register them (or their fossils). We are completely oblivious (without recognizing it) to what we do not see and look for.

While Taleb's application of the precautionary principle makes sense in areas for which it was originally developed -- in such man-made dependencies as the global financial system, for example, it is inapplicable to the generative process of the horizontal genetic transfer. Instances of it had indeed led to dramatic evolutionary changes, with ruin to some systems and the antifragile strengthening of others, and of the Biosphere as a whole.

Biotechnology is strongly associated with genetically modified plants. At the same time, it is not taken into account that GMOs have already created a number of medicines and valuable products. Now in plants they are trying to get vaccines, and in animal organisms --- medicinal proteins necessary for humans. Based on the gene modification of insects, a vaccine against the H1N1 flu virus with a faster production and better safety profile had been obtained. It sounds like a fantasy, but the huge potential of GMOs is far from being used.

What else can an artificial testing grounds of evolution generate? Why not to eat bacterial protein? How about genetically modifying foods to contain higher levels of cancer-fighting compounds? Or include Selenium that is rare in foods and is a key component of the glutathione-dependent anticancer/anti-aging protection system? Or fresh fruits and vegetables with improved shelf lives? Edible vaccines? Crops that will flourish under hotter climate? All are realistic possibilities. If we could learn to see and manage the massive horizontal gene flows in natural ecosystems, then biotechnology would turn into an ecotechnology.

Bacteria are the producers of new genetic information, while higher organisms -- animals and plants --- are the consumers, so why is everybody uneasy with GMOs while nobody is surprised at the production of human proteins in bacteria? Evolutionarily, prokaryotes such as bacteria, despite their greater genome lability than higher organisms, are locked at the level they are at, since they are not able to make use of much of the information they themselves create. This is because their architecture (such as the absence of the nucleus) limits the size of their genome.

Bacteria are like agile serial startup founders who specialize in the creation of the new but need to transfer their products down the chain for scaling up. So it is more natural, in this evolutionary sense, to express a bacterial gene in a plant than a human gene in bacteria.

In bacteria, a high rate of change prevents an even higher rate from taking place, just as sometimes accepting small risks helps to eliminate large ones. This is why bacteria do not all jump into becoming humans. Prokaryotes are more promiscuous that higher organisms: while in the higher ones the sexual process occurs within species, in bacteria it happens among species, and the capacity for the sexual process can be transferred via the sexual process itself. In evolution, too, there are two big camps: the camp of bacteria, that "froze" in time in terms of their architecture, and the camp of eukaryotes, including us the animals, that have no choice but to keep complexifying, once on the path, whether they like it or not.

Biocoenosis, an association of different organisms in a closely genetically integrated community, can be viewed as a platform evolutionary model for experiments on their information component, both its transitory expressed (ecological) and the silent (evolutionary) parts. For GMO sustainability, we need to start prototyping full biocoenoses, and do so in a localized fashion that leaves us room for error.

The new can be experimentally created in two stages: first by transfer and expression of a block of genetic information (like an extra Lego toolkit); then via refinement of what had been transferred by fine-tuning it, e.g. "turning off" most of the hazardous and upregulating/developing most of the useful. So, life *is* a Lego set, and one does not have to wait millions of years for the evolution to occur. The fine-tuning is a significantly longer process compared to the initial *infection* (sic) and happens to assure a close fit with the environment. One may imagine the creation of evolutionary testing grounds aiming to semi-naturally achieve the traits we may want to impart. We will not be able to calculate everything we need; perhaps the term 'genetic prototyping' is more apt than 'genetic engineering' to capture the fact that engineers are not mathematicians -- only financial engineers are.

Absence of Evidence is Not Evidence of Absence

The key distinction Taleb makes in his risk evaluation is the difference between non-recursive (top down) approaches, versus incremental/recursive (bottom up) approaches, which he considers 'evolutionary.' This 'evolutionary' designation makes sense only within the neo-Darwinian framework. Using Taleb's own metaphor (but reversing it), being concerned about a transgene escaping out of human-made transgenics is like being concerned about the wine being served on the Titanic. *Other issues* such as agricultural and institutional monoculture and *other risks* far outweigh the essentialist 'GMO' framing and instead deserve their proportionate share of focus.

Designing genetically in a small way, as we do, does not warrant a precautionary principle because it is essentially less risky in terms of human-unfriendly ecosystem disruption than running an earth-wide, large quantity laboratory, as Mother Nature does. Absent humanity, the Biosphere also engages in natural experiments due to random variations,

and sometimes does so with global impacts -- and all of our biogenic Oxygen in the atmosphere is a testament to that. We are afraid of the wrong thing.

Here, we are worrying about the pennies, not the dollars, and this can be dangerous to society that chose a certain path and must follow. Taleb means well but his focus here is on the insignificant. Our resources (both cognitive and scientific) are limited, perhaps too limited, as Taleb himself points out ("Opacity," 2019). Our Black Swan risks are increased by failing to keep our minds available to focus on the big fish on the horizon, especially something we may not even think of as important --- until it happens. The horizon gets further away when one stands up.The GMO question is linked to the changing climate. An adaptation to the changing climate, whatever its cause and contributions, requires an orders of magnitude more effective innovation, including in agriculture. Suppression of our advanced technologies could leave us defenseless in the face of newly hostile nature (Galam, 2008). We need to be open to new technologies as long as they are introduced and managed strategically: with limited downside.

…..but People Still Have a Way to Spoil It

One doesn't need to bet all of one's life on risk-prone endeavors. One can take Taleb's caution and use his *barbell strategy* for risky bets instead -- in case of GMO foods, this would mean above all avoidance of institutional monoculture, while putting most of our security in the trusted, stable species and *some* of it into the risky, high-risk-high-return, potentially unstable ones. This could buy us our existence into the future.

Biologically, monoculture means profit maximization by planting one brand of one crop all over the earth for profit maximization and an efficiency of scale. Such an arrangement makes the whole system vulnerable to any perturbation that we could not have known in advance. Food waste reduction can fall on these lines as well. For example, a trade or a hot war will quickly disrupt an optimized global supply system. And we understand society even less than we do biology.

Finally, individual safety/stability assessments of GM products depend of the imagination and the agenda of experts assessing them. As seen in the neo-Darwinism or the human blame in the climate change saga (and many others), the objectivity of such assessments is usually compromised due to learned conformism and lobbying processes.

And it is *here* that there is a major, social, problem, affecting the GMO system. The problem resides in the aging, fragilizing, corruption in our institutions as a result of suppression of degrees of freedom in their constituent parts. In his recent *Skin in the Game* (2018), Nassim Taleb discusses how an organizer of any event is tempted to buy only non-GMO, or gluten-free food, or whatever else a minority may need, because the minority is inflexible in

their preference, while the rest of the patrons are. Everything at a party will be non-GMO, provided the price differential between GM and non-GM food is not overly consequential.

People, both generally, as "public," and within institutions of expertise, need a simple metaphor to believe in. As a biologist, dealing with changing the *nature* of my objects, I could be tempted to think that modifying people's worldviews is as easy as getting their genomes changed; I am afraid, however, that is not the case with the worldviews, which tend *not* to evolve on a group basis (but rather on an individual and generational one) and are subject to the limitations of being human. Epidemics of newness are easier to engineer in the world of biology; in culture, this seems to occur at the level of individuals and not in groups.

The GMO debate may stand as a moniker for something, a metaphor for anything *but* a particular technology. Probably it stands for two things:

- Our continued erosion of the feeling of specialness and the psychological security it brings;
- A justified concern and distrust for official narratives because of corruption/aging/fragility in the societal institutions.

Technology itself is the least of a problem here, and is unstoppable anyway. It is important to have other crops to ensure distinct-architecture redundancy in case of crop failure. As a health benefit, this will also diversify diets.

Everybody who studies variation in microorganisms knows how hard it is to obtain a new trait (not a loss of a trait) in a pure culture in the laboratory conditions, using the classical 'non-GMO'-dependent methods, and how easily this happens in nature. The same applies to plants and animals. We need to create a mindspace for understanding the information that develops within and around a replicating system, whether in biology or in society.

The discovery of the program of DNA in the 1940s *as opposed to the previously known chemical compound of DNA* almost a century earlier was a particular case of something more general. We made great advances in understanding the properties of things, their descriptions. We have not made much progress in understanding of programs behind these properties, but despite this lack of understanding we have to operate and try to expose ourselves to mostly positive surprises in doing so. The eventual goal is action: describe, predict, and ultimately manipulate the elements of the world for desired outcomes, with or without a sufficiently complete understanding of their meaning. We want to avoid being paralyzed by analysis.

Enhancing heresy in science-related decision making as well as avoiding agricultural monoculture will help ensure survival of these systems. This will be subject of the next section.

Summary

- Direct genetic modification increases our options by making possible domestication of new crops more suitable for new types of climate (Lemmon, 2018). Despite a few elements, such as transgenic constructs, adequately organized, being capable of disproportionately affecting a whole system via invasion and infection, our own GMO creations are very unlikely to become those disproportionate elements. In order for the novelty to penetrate through the protective immunity of the genome, organisms that have undergone a genetic infection must be weakened, and their vitality must be undermined by a change in living conditions.
- Biological innovation is, therefore, not limited by supply; it is limited by the ecological demand. Same as innovation: it is always resisted. But in times of stress, it can be picked up.
- We have to take some risks in order to reduce the risk of a much larger failure. Absolute safety does not exist: what we have is to manage risks by picking a lesser evil. Creativity, whether evolutionary, or human, *cannot be controlled:* it can only be enabled, or not.
- Optimization of our crops to only the tried-and-true methods ages us out and will result in an environmental misfit with the changing climate and unavoidable population needs.
- GMO-enhanced agriculture represents a step *up* in the complexity of the system, with correspondingly more points to break or go wrong. To counteract this, short of abandoning the technology, as suggested by Taleb, we must try to minimize the risks by avoiding the agricultural and institutional monocultures that somehow associate to GMOs.
- Depriving ourselves of *opportunities* anywhere does not seem like a good option, especially that the trajectory of human civilization over the past 200 years makes it inevitable to have to say "B" once the "A" was said (that is, to continue on the Noospheric path). What is misleading and dangerous is having illusions of understanding and taking misguided actions based on them, such as in improving 'efficiencies' by cutting food waste and many other things that we may dubb "waste" in our ignorance. We understand the operation of the society even less than we do that of evolution, hence can expect larger risks in reliance on human rather than biological networks and arrangements.
- In conclusion, the public policy "precautionary principle" in the present form should *not* apply to the domain of 'GMOs' because the probability of systemic ruin from the technology *itself* in this domain is dwarfed by other systemic risks of the Noosphere transition.
- Taleb's own anti-Aristotelian "barbell" strategy of *distributing* risk among the stable and the new, efficient, GMO crops may be applied. But monoculture avoidance is a must and should start with a much harder feat: avoiding any monoculture in the decision-makers' heads, through asking and exploring questions derived from an outsider perspective, the questions that would otherwise not be asked.

2.2. The Human Factor: Suppression of Variances in Social life

Letting Go, In Order to Let New Things Into Life

Getting rid of maladaptive opinions is difficult as it is often perceived as admitting defeat. This is where the world of science must better differ from the world of nonscience, but in practice it often does not.

Since the agricultural revolution, the mankind had been -- unevenly and with much resistance -- undergoing profound changes in its worldview. It proved extremely difficult to bypass our anthropocentric feeling of being superior and more complexly elaborated than everything else (Galam, 2012). Especially hard is recognizing that we don't think about something not represented in our analysis, that the map is not the territory.

As presciently observed by Mae-Wan Ho ("The Corruption of Science," 2014) apparently one can say pretty much anything as long as very few understand what one is saying. The great crime committed by Galileo Galilei, Ho goes on, consisted not so much in *what* he said, but in that he insisted on saying it *in Italian,* the language of common people, rather than in Latin, the language of the scholars and priests. Kepler and Copernicus had already published much of what Galileo espoused. But they did it in Latin and therefore did not incur the wrath of the Church. I would disagree with Carl Sagan, Margulis' husband, who said that it is far better to grasp the universe as it really is than to persist in delusion, however satisfying and reassuring.

For true scientists, it is indeed the case. But not always and not for everybody. Delusions can be massively adaptive and serve the functions we are not aware of. This point parallels our indexical discussion of truth in the introduction to this work, and the possibility of multiple-level conflicts between serviceability of truth in different systems.

"Knowledge kills action; action requires the veils of illusion." (in Nietzsche, 1999, p.40)

In the Declaration of Human Rights, it seems, the great idea of individual rights became absolute and was turned into a contradiction --- the assertion that the interests of the individual are above the interests of society. But a society is made up of individuals. And whatever one may say, beyond the fog of the general discussions, the inescapable conclusion logically turns out to imply that the interests of one person are above the interests of another. The only question is --- which one. Therefore, not in a declaration, but in reality, everything will depend on the individual's ability to exercise one's right.

And the same goes for scholarly publishing, and opinion spread not only in the general society, but also in the institutions and *societies* of expertise. The materialization of a right depends on the means and energy of those who want to realize it, since energy and

resources are summed up by combining personalities with similar desires. As psychologists Lieberman and Patrick (2018, p.130) note:

> *Human coalitional psychology reveals an appetite for identifying smaller groups, evaluating whether their existence yields a net positive or net negative on one's own fitness interests, and, if negative, recruiting allies to strategically marginalize them.*

The best fulfillment is when a desire becomes legalized, i.e. becomes an article of law, in a concrete form, guaranteed by the state machine and binding on everybody. In science, the laws are more subtle but still binding, in a similar way.

There is a difference between organisms in the laboratory conditions and in the nature. The overwhelming majority of soil microorganisms, for example, do not grow on any laboratory media, and those that do often quickly degenerate instead of exhibiting adaptation (Teselkin, 2013, unpublished data). The laboratory-stable additions of DNA, both chromosomal and extrachromosomal, become very labile in natural conditions, ready to be dynamically replaced by more ecologically relevant information. Such data have no place in the orthodoxy, hence the prevailing system, as any paradigm in science (by necessity, closed) would classify them as “experimental error,” or ignore altogether.

Regardless of our ability to accomodate this reality, this means that GMO cultivation, despite being a natural extension of human desire to conquer and modify nature to our needs, adds layers of upkeep and maintenance to the food supply system (such as the need to re-create seeds in a centralized, non-natural setting), which, absent proportional antifragility in design solutions, can make food production systems more productive but also more fragile.

The Need For Specialized Bodies of Expertise, And On Aging of These Bodies

Complex systems cannot suddenly become simple. All they can do is to keep increasing in complexity, under competitive pressure, finding new uses for their newfound abilities -- until becoming extinct. The human society, too, as enormously complex as it had become, cannot exist without specialization and narrow expertise. The problem with this is that specialization and cooperation bring about aging (Kiss 2009).

Evolution and continued existence do not happen under closed channels for horizontal information --- and neither does human cultural evolution happen under the conditions of closed minds or closed cultures; fossilization does.

All things break eventually. Some are made expensive and last longer on average, but that just means a low probability of breaking early. There is always this probability nevertheless, the risk is never zero. There's no such a thing as "guaranteed safety," ever, in

the history of the world. Thus, the goal is not to make something that lasts forever but to make something that is unlikely to break before it gets replaced. This applies to all designs and all systems.

Any control system requires a feedback mechanism. The system must be able to adjust itself based on the feedback. This significantly increases the chance that a system can last longer, because essentially it is "replacing itself" in small increments. But the feedback can also fail. So one will need to have a feedback for the feedback. And feedback on that. There is no end. Which means, at one point one has to say "I'm willing to take this risk, let's stop here before I spend the entire earth's resources on this one design."

We expect there to be errors, attempt to catch some and use them. To take what is "harmful" and treat it as a signal for change. Instead of thinking that the system should work perfectly, to think that it will never work perfectly, hence the need for constantly updating it. Misfits and errors are not harmful in the long run unless ignored. This is also true for human "misfits" (Aminoff, 2017).

Contrary to Karl Popper's (2005) idealistic view of how science should be done, people with stakes in something will almost always do anything to combat 'heresy,' so it is, unfortunately, mostly generational change that is driving innovation in science. At the same time, we shouldn't discount the dangers of access to knowledge by those who it can harm or who can harm others by misinterpreting and misusing it. In science-based issues, commodification in the name of the social construct of 'democracy' universally resulted in the simplifying of the debate, its perversion -- and the personal, emotional, aggressive character that the debates took. Back in the scholarly world, the former rebels, once accepted back by the institutions, do not speak about their rebellious and marginalized path, and once no longer alive, are no longer available to testify even theoretically.

Lynn Margulis was an exception and kept looking for Platonic folds in science until her very passing. Utilizing her foresight, she was looking for aged social constructs in need of replacement, the intersubjective agreements lacking in objective facts. It does not matter, whether "justifiably" looking or not --- what matters is the mindset, the resolve to look for disconfirmation and not to rest on one's laurels. Margulis was aiming for failure, not for success. And while there exists an undeniable need for within-paradigm work, science, or any other human endeavor, quickly ages itself out without fresh thought that intellectual rebels inject.

Science is the leading, marginal edge --- inhabiting *not* the area of 'consensus' but rather the fringes of the "scientific community." Innovation, in biology and in business alike, does not happen because of consensus --- but rather, *in spite* of it. This is a universal process, universally resisted. And no form of social organization is immune to it. I have described an example from biology, and Galam (2012) provides his similar but first-hand experience from physics when his advance (as will be determined many decades later) was being resisted by not even allowed the light of the day by his Tel Aviv University in Israel.

> *"It was not a dictatorial country…. It was not an underdeveloped country…. It was not… It was a high-level academic university. It could have been such an opportunity. It was a pity."* --- Galam writes (2012, p.50).

In the above, we find ourselves in a situation similar to the one that Dr. Ignaz Semmelweis found himself in the middle of the 19th century, when nobody would believe his simple recommendation for doctors to thoroughly wash their hands, despite the strongest humanly possible evidence he generated to support his claim. And if it sounds ridiculous today, we need to remember that people of those times were no stupider than us. They were just people, embedded in their time. They followed the convention, and semi-violently defended it --- just as *we* do today. It took the arrival of Pasteur's germ theory for Semmelweis' work suddenly to start "making sense." No universally accepted backdrop --- no sense. And also the primacy of theory/reason/explanations over reality and practical results.

The *germ theory* itself was unbelievable back then in the same way that *fluid genomes* are today --- it postulated the existence of an invisible potential, present probabilistically "everywhere." The *heredity* behind the "GMOs" and behind our own lifespans. What's not to like? It seemed like a proper stuff for the madhouse --- the claims of invisible things, and such --- and that is exactly where Dr. Semmelweis was put before, not without assistance of his colleagues (Wykticky, 1983).

The great contribution of Lynn Margulis and part of the reason for the dedication of this work to her memory has been in her creative ability not to start fearing the newness she once contributed to herself --- to age in body but *not* in mind. It takes a continuous battle with the status-seeking human nature to strive for such an ideal. The metaphor of the Semmelweis reflex had been proposed to describe society's reflex-like, xenophobic tendency to aggressively reject an idea radically differing from the prevailing constructions of the time ("Semmelweis reflex," 2019). While social constructions, as a form of common knowledge, enable simultaneous and coordinated mass action, they also have a downside as they invariably ossify over time, become maladaptive, and start causing the ruination of the very systems they helped create in the first place but prove unable to maintain. Successful foresight requires practitioners compelled to say silly things without feeling shame, embracing the foolish role of a *trickster* --- and not worrying too much about being wrong. It requires a replacement of the fear of reputation loss by a fear to miss out on conceptualizing and communicating the latest worldview insight.

The *scandal* happens when ideas initially not recognized as "scientific" enter the science through a transgression of science's rather narrow, inert and vigilantly protected orthodox borders. Concepts and hypotheses that are illegitimate today can become legitimate tomorrow if they succeed through provocation, trickery and such means to shake the foundations of obsolete paradigms and legitimately join the ranks of traditional science. It is thanks to such "scandals" that the latter gets the opportunity to develop further. An opportunity to not *age*.

If one is not prepared to be wrong, one will never come up with anything original. Innovation consists in remaining a child while having an adult capability and ethic for work.
One cannot move much in a science and technology area with the standard of a show. In this domain, progress is only possible when pushing the limits of specialized uncommon expertise. And yet any technological advancement depends on the willingness of technology's customers (and one's specialized peers) to understand and accept these very advances.

When there was little technology, everything was in balance. Things have changed with the explosion of knowledge and population from the 1800s onward. The social understanding of life and biology lags behind the biotechnology advances by at least half a century. Narrow specialists themselves no longer have a humane ability to digest these advances and desperately cling onto what worked for them in the past, and what thus constitutes their identity.

In the history of neo-Darwinism, for example, the fear of failure within this frame results from our desire to conserve our status --- if such a status depends on *what* we think rather than on who we are and *how* we think. The consequences of this are disastrous, just as the consequences of short-termism and corruption in general. Instead of looking for ways to reinvent ourselves, we all naturally strive to look for and interpret information so that it may conform to our *existing* beliefs. And it is not bad --- most of the time, and in times of slow change. Our confirmation bias, whereby we would take the facts and fit them to reinforce our existing emotional beliefs, ensures our sanity. The problem is when this is doing us a disservice.

In the Noosphere, we may be afraid to lose our identity, our continuity with who we are --- if we let our worldview be shaken. We start wanting personal immortality. The good news is, we lose our identity all the time. If anyone were to remember oneself at 10, 20, 30, 40, 50, 60 years of age, those different-aged people (their virtual "*I's*") would be composed of a succession of completely different personalities, having more in common with other people of the same age and culture rather than with each other, as a continuous personality. Our memory continuously modifies our past to bring it in accord with our present self (Shaw, 2015; Akhtar, 2018).

In evolution, the very fact of receiving and expressing a block of new information causes complexification and the need to search for a new way of applying it to the conditions of existence; the way back is impossible due to competition from better adapted 'lower' species and societies. It is *evolvability* as an ability that ensures one's success; not anti-competitive practices. The new forms have no competition --- up to a time.

Monoculture is negatively associated with evolvability, due to a limited set of possibilities that the reality can select from. This is why some branches of the evolutionary "tree" terminate, and others continue. I mentioned already how the disappearance of dinosaurs may have little to do with the reasons commonly quoted, but rather everything with an 'efficient' choice for information management at the genomic level.

We need to remember that any selection proceeds not according to our understanding of it, but rather according to an entirety of the factors of which the reality is composed of.

The Improbability of Innovation in Closed Virtual Systems

Why innovation? Even *maintenance* requires innovation, since systems exist dynamically, either on their way up, or on their way down. How does one convince, influence, or even train other people, whether general public or fellow narrow professionals, to accept new revolutionary scientific ideas, dissenting views on safety, and the psychological discomfort that lack of agreement brings? One doesn't. Can't. All behavior change comes from the inside of the brain. Useful ideas may stay confined to only a few minds before gaining traction and starting to have impact. What potential is hidden in us? An unexpected reversal to the old, gradual increase of the new, or an emergence of something that had never happened before? What is the potential behavior that is prevented by the conditioning of a system's response on its prior state, the state when our "aha" powers are being numbed by habit and repetition? The simple sequence of trigger-routine-reward reinforces the cycle of operant conditioning (as suggested in the laboratory by, for example, Schwartz in 1982). We form habits of thought, and no innovation happens without us breaking them.

And information without its recognition systems simply "does not exist." Without its recognition systems a piece of DNA is as 'alive' as a piece of nylon. So what we have on Earth is information on building the multiplication systems, for itself. This information is encoded by DNA. Heritability is a feature of this information that is expressed into an organism capable of existing in given conditions. The rest of the information is the creative reserve that we do not see, perceived by us as a chemical compound only, as a polymer, or maybe food, without the extra information content that can spring up into existence. Information is materialized within a compatible servicing system capable of recognizing it as such. For a computer --- it may be a USB stick, for a newborn such information consists of adult human faces, for DNA it is the cellular machinery capable of expressing and multiplying it. And for the opinion systems it is something one can recognize as valuable.

Since information is perceived as such only within its servicing systems, outside of them there are no non-permissible combinations, no selection. This is how life solves its innovation problem: creating new without destroying all of the existing and the running. Just like with the genes of the artificially created GMOs, this silent DNA, in its outside existence, holds memory for the remnants of different spaces and times. We do not see all this wealth just as we do not see the radio waves from cell phones, TVs, and WiFi's, even though we are literally swimming in them.

A DVD, for example, can be used as a mirror, or as a throwable, flying object, purely based upon its material *properties* -- with all of its possible information, and the very possibility

for such information unbeknownst to us. A molecule of DNA in the environment can both serve as a source of information and --- a source of food, or as a structural glue for something. *What else* are we missing? For we surely do.

If one were to take a DNA powder from a shelf of other chemical reagents and cause an existing cell to take it up, this[19] would create that self-sustaining system that we call life. Once this happens, the foreign information becomes 'self' and starts to be treated as such --- the *unthinkable* magically becoming the *obvious*, just like in the case of human innovation. We never become aware of the underlying process, since both the unthinkable and the obvious are perceived as givens.

A DNA sequence stored in a computer makes sense as *information* encoding "life" only within a system that can read and service such information (which the computer is not). A computer sequence is not "life," anymore than a schematic of a car is the car; rather, it is information about life --- information that can be read and serviced by a different, higher-order system of our minds. An information and its servicing system comprise a closed loop, where only the *same kind* of information can gain entry. In the application of 'GMOs,' this loop is horizontal gene flow.

In terms of our conceptions of the world, it is new design visions that manage to get through our psychological defenses. The Optimization Desire is pervasive but anti-innovative by its nature. It is a desire for Order, while innovation, at least initially, and primarily, is a desire for Chaos, disruption. The Noosphere, *if it is to succeed, rather than to turn out another painful delusion,* will have to include *both* of the desires, as both of them are parts of us --- and thus must *balance* each other.
As Manu (2016, p.29) points out:

> *A retrieved behavior is a latent behavior, a behavior that did not have a* media *to make it* manifest *(you did not know you wanted to send texts of 47 characters in length, until the medium allowing you to do so became manifest, which made your latent behavior manifest.) Latent behavior is an action you might be engaged in if given the right tools.*

The Fear of Failure

There is one universal psychological barrier and it consists in the fear of failure, whether in the biological or in the imagination realm. The fear of failure leads to *not even trying* and a corresponding mis-assessment of the "possible" and the "impossible." If everything possible were to be tried, or thought of, somewhere, by somebody, would it be adopted by the society? With rare exceptions, no. We seem to try to make a decision that will make us feel good about it in retrospect, a sort of mental accounting that depends on the history. The fear of failure manifests as a desire to avoid cognitive inconsistency and self-esteem doubts arising from reconsidering decisions already made and beliefs already formed

[19] (subject to the probabilistic overcoming of cellular defenses against the non-self)

(Abelson, 1968). It can be effectively counteracted only in people who feel thinking itself is fun.

The prospect theory (Kahneman, 2011) states that --- when faced with choices linked to unknown risks --- people make decisions based on the potential value of losses and gains rather than the final outcome. That way, the fear of failure can be avoided for them, since one cannot be properly said to have failed if one had never even tried. If *some* minds were different, however, with respect to the ways in which we are being influenced by "wrong" conceptions, what limitations could then be overcome, what new limitations would take their place, and what could become possible?

We share the fundamental need for three things: security, connection and certainty. We fear losing control over our life or loss of any kind, whether real or just potential. In the GM food debate, this means we fear scarcity and breakdown, as per the dystopian scenario from the previous chapter. We fear even more the loss of our habitat. This fear of loss is a very powerful emotion. We feel happy when our sense of control increases.

Connection is a consequence of us being a social species, since there is almost nothing we can achieve alone. Self-actualization also takes the form of being connected to the world around us. We spot threats to our security and connections by looking for inconsistent patterns. Pattern detection makes us human and is a hallmark of artificial intelligence, as well. We constantly scan our surroundings for breaks in the consistencies we know about. If we have no explanation for something, we will invent one, just to fill the gap, and the appetite for doing this is insatiable.

Looking for consistency is a function of the psychological "System 1", that of automatic processing (Kahneman, 2011). Its operation frees up our at-will mind to pay attention to *in*consistencies, which signal either threats to our security and connections or opportunities to improve on them. Design, which challenges and breaks down existing control systems before re-building them, can be an antidote here. Good design reworks the patterns of connection. Good design --- and *strategic foresight* as part of it --- plays an essential constructive role by creating fresh meaning.

The needs for security, connectedness, and consistency combine together to form our *Optimization Desire.* This is our desire to control, guide, and manage systems, a desire reinforced by the pursuit of Pleasure --- oftentimes, overly so.

Gaming the System: Neither Consensus Nor Expertise

The dangers of monoculture, this time embodied as an all-too-serious reliance on current understanding, manifest themselves in focusing on looking up for causes (but really *inventing* them, and subsequently dogmatically, categorically sticking to them) and all-too-eagerly pursuing "corrective" actions for them. Then wondering why it didn't work because of "unintended consequences." It was easier at a point to believe in the continued creation of life, just as it is easier today to believe in the slow and gradual creation of an impossible

sequence of beneficial mutations for the emergence of a new trait in an organism that has to continue living at all times during this process. When its time comes --- the old 'obvious' goes away, to be replaced by the new 'obvious.'
So one cannot separate culture and biology if culture depends on biology. There are restrictions on the process of the formation and propagation of cultural representations.

In democratic societies, this is very well implemented via a special, recognized and respected social technology, which was named "Lobbying." If the individuals who are elected to adopt laws want keep being elected (and they really want it), then groups that seek their own interest to gain a backing of the law, communicate (more or less openly) their the support of that legislator who, after her election, will become an active medium for the adoption of such the law. And if she does not, then she will not be supported. And, of course, every effort will be made to prevent the election of those who oppose the interest. Such interest groups are generally not numerous. But they have the money, the energy, and time achieve the goal, and their voice is strong. The bulk of voters may not think like these groups. This bulk is busy with their affairs, however, and is not noticeable. Lobbying works, the law is adopted. Now the media are creating a new (information) reality, and the process of social engineering steams ahead at full speed.

This scenario had played many times and for different reasons. The complementary methods included destruction of experimental crops, other uses of force, threats, blackmail under the banner of "human rights," etc. Of course, such actions are carefully blamed in words, even condemned, but with a warning, so as not to offend the "movement," because elections are held regularly.

So an actionable strategy to educate the market and engineer the acceptance of a new technology does *not* involve winning over the majority. The emergence of a value orientation in a society does *not* come from a consensus. Rather, the most intolerant faction imposes their values on others, just as it is only people who are most determined to vote who *actually* vote. The rest submit to the outcome. This is true for the evolution of both the scientific and social opinions.

This is how consensus is often produced (Galam, 2012, p.51):

> *Amazingly, in the early twenty-first century I again went through a very similar experience of near ostracism from colleagues who feared for their reputation. In February 2007, I wrote a paper in a major French daily newspaper,* Le Monde, *in which I questioned the claimed human culpability with respect to the assessed global warming. I stated that there existed no scientific proof of the Intergovernmental Panel on Climate Change (IPCC) climatologists' claims. Taking such a position at the time resulted in quite an outcry against me and the newspaper,* Le Monde, *which had never experienced such a shaking from both outside and inside.*

Exclusion of those disagree (by open and hidden aggression and fund cuts) is the path to unanimity. The world of science is subject to the same issues as any other social sphere. Dynamics of science as a social enterprise are not politically correct, and, as has been

pointed by critics since Nietzsche, the scientific enterprise remained quasi-religious in nature since its founding.

We Do Not Have the Right to Know What We Are Eating

What about the demands for "transparency" in GMO labelling? Do we have a right to know what we are eating? And why to single out GMOs? What other things must we be tracing?

We don't have the right to know what we are eating. First, for the sake of our own psychological health. Knowing too much has a mental price. Secondly, because rights for some mean extra *burden on others* and on the whole food distribution system.
The ethicist Chris MacDonald offers the following explanation on the subject of rights ("The Right to Know What I am Eating," 2019):

> *It's worth remembering that when someone has a* right *to something, this imposes* obligations *on other people. In some cases (as in the right to free speech) it means an obligation* not to interfere. *In other cases it means an obligation actually to* provide *something (for example, if I've performed my job as promised, I have a right to be paid and my employer has a positive obligation to provide me with my wages). It's also important to note that, given that rights impose obligations on other people, we need at least to consider just how burdensome those obligations are, before we assert the correlative right with any certainty. (For example: even if you desperately need a kidney, you don't have a right to mine while I'm still using it.)*

The point of GMO labeling is in the same vein as the point of unnecessary medical tests. The information thus provided can do more harm than good. It is nothing more than a cure for anxiety. It also provides a false sense of security and diverts our attention away from the real challenges. We as a society have grown to trust experts with handling complex affairs on our behalf --- although these experts, as we shall see further, can suffer from problems that increasingly compromise their function.

Inevitable Distortions During Commodification of Expertise and The Need for Dismissal of Public Opinion

Older psychology experiments seem to suggest that scientific rules are useless in settling social issues, as people will find flaws only in what they do not like, via subsequent rationalization of fundamentally emotional decisions --- and without noticing this reversal, of course (Lord, 1979). The successful separation of the unconscious, deciding "it" and the rational self was also demonstrated by Quattrone (1984). Serge Galam's 2010 paper presents a disturbing conclusion that public opinion cannot be won with scientific honesty. He uses the climate change saga as an example. The issue of climate *per se* has very unfortunately displaced from public consciousness the issue of genotoxicity of all the other substances *but* the CO_2. Everything *other* than CO_2 (and water vapor) is toxic in car exhaust. Many European countries fell victim to combating climate change with diesel promotion while increasing all the pollutants, with or without a monoculture-based collusion between

the automakers and regulators. This is what happens when one dogmatically chases metrics and an *idée fixe*.

Under the bottom-up democratic systems, that focus on appearances, it seems, per Galam's research, one has to develop a politically oriented machinery that will produce *false statements* in order to reach ideological goals. This is how people get to believe and act.

As Galam (2010, p.27) writes,

> *...on this basis one could conclude that to adopt a cynical behavior is the obliged path to win a public debate against unfair and rigid opponents. However, an alternative conclusion could be to dismiss the increasing weight given to the public opinion in the process of policy making by decision makers.... [..]*
> *We desperately need to create new tools and new paradigms so as to apprehend collective phenomena as part of our basic resources for the future.*

Good luck changing the culture!

The *Food Evolution* documentary (Adamchak, 2016) assumes that human behavior is driven by reason. I am in disagreement with Neil DeGrasse Tyson, who narrates the movie, --- and am afraid that all the history proves that people rather choose based on faith and values, not on reason. Also based on fear. Dostoevsky (re-published in 1999, 2019) was one of the first to write about this, in the 19th century. Today we know that our emotional system is much older and much more powerful than its recent and lazy rational sibling, the rational System 2 (Kahneman, 2011). Taleb would say this mistake is a typically modern rationalistic disregard for the basic irrational mechanisms that govern man's orientation toward his world. We need to be more willing to look into how people's emotions inform their opinions. Emotions and stories, not facts and numbers, resonate so deeply with us in a public debate. That is why pro-GMO movies talk about reason (and do not succeed), while anti-GMO ones talk about stories. People are not equipped to handle the naked reality (myself no exception).

As pointed out before, simplification and exaggeration are unavoidable --- and it is very important to understand that distortion is necessary to win a pubic debate. This means that public debates cannot be engaged under the logic of science. The alternative is to decide by different means and not to engage in such debates for the sake of imagination and integrity. The documentary *Food Evolution* simplifies and distorts things for common digestion, making use of the narrative fallacy. For example, it pushes the idea of 'scientific consensus,' which, just as 'design consensus' or any other kind of consensus, exists only within corrupt mono-cultures or in the books on history.

I support the idea put forward by Galam (2010) that the common and 'reasonable' approach of adopting a cautious balanced attitude based on clear but inconclusive data appears to be a lose-out strategy. In contrast, overstating arguments with irrefutable claims are necessary to form the public opinion, and it takes a dedicated, stubborn minority for this to happen. Galam (2012) gained notoriety for investigating and communicating the

paradoxical effects of using majority rule voting in bottom-up democratic hierarchies, coming to a conclusion that a dedicated minority is all it takes to impose this minority's preferences on the majority --- all with a naive observer being under the illusion that the choices and preferences are those of the majority.

It is probably not unexpected by now that I will not recommend a general access communication strategy to 'educate' the public on "GMOs" --- it will not work. It is too much to bear. The naked reality is too much too handle for any human psyche, and the understanding will be distorted along the way. The closer one moves from one's simple virtual ideas to the real and infinite reality, the hotter the fire. So a maladaptive social construct must instead be replaced by another construct, also a "wrong" one, but hopefully now in an *adaptive* manner.

Taleb (2018, p.88) also advocates for a layered approach by writing that:

> *"Society does not evolve by consensus, voting, majority, committees, verbose meeting, academic conferences, and polling; only a few people suffice to disproportionately move the needle."*

This makes it critical to ensure *who* those people are.

Decision-making by Imaginative Expertise

Imaginative expertise is not only capable of foresight. Foresight is its primary mode of existence. As is the mastery of the link between foresight and logic (see Fig.1).

Galam points out that in the bottom-up, uniscale democratic decision-making process policy making relies on a distorted perception of public opinion. Public opinion is not formed, as one may assume, by overall majority of individual opinions. There is an emergent internal structure to this process. The absence of structure in the governance system is compensated by the emergence of an informal structure within the society itself, where a minority is (unofficially) propelled to dominate. Galam also points out, by way of a practical example, that scientists were right in *(wrongly)* asserting the social construct of Darwin's theory as *proved* --- since otherwise they would have lost the debate against the Intelligent Design proponents. What this surprising result means is that decision-making on complex issues, such as those stemming from "science" should be left to *imaginative* experts only, since fairness (based on merit) cannot be achieved in decision-making by marketing but only as a result of that by imaginative expertise.

The Anti-Corruption Mechanism of Imagination

Our teleological behavior results in corruption. The reliance on extrinsic rewards that we learn as we grow up has a hidden cost of compromising our integrity and inherent satisfaction from the intellectual process. The psychological research has been demonstrating this corrupting effect of goal-directed behavior for some time (Festinger, 1962; Lepper, 1978; Amabile, 1986). The consequences of the deductive social constructionism on creativity are very real-world.

There is a saying that science is the belief in the incompetence of experts, as is attributed to Feynman --- *by other experts,* we need to qualify. As mentioned, science doesn't evolve by consensus any more than taking one of each type of pill at a pharmacy will make one very healthy. And science (just like design) quickly degenerates without imagination. The chief mental barrier is our Platonic desire for crisp categories, where even uncertainty or innovation itself would be treated as a well-defined category that can be put away. That is why people think about something very concrete, defined and contained, like quantum mechanics, for example, when uncertainty is mentioned -- the well-defined uncertainty of *measurement*. This is *not* the uncertainty that matters. This is the difference between a tamed uncertainty, for which there *is a theory,* and a totally unexpected uncertainty, for which there is no clue at all, much less theory.

Are we in danger of a systematic neglect of reality in case of the 'GMOs'? Are we in danger of neglecting the wisdom inherited down the generations? Is Nassim Taleb right in saying that 'progress' consists in substituting what works *reliably* for what doesn't work as well *(but is more efficient)* and that too fast a rate of evolution cancels out past gains? The concern here is that our understanding of anything is always digital, and low-resolution at that. We also tend to mistake this blurry picture for different patterns (none of which are "really" there) --- depending on the time we live in, mood, and prior training.

The danger here consists of being human, and some mental barriers unconsciously prevent us from straying away. Reality is infinite in its manifestations, but we -- because of habit, inclination, profession, specialization, and our limited experience -- almost always get locked into our own constructs and start mistaking them for "the" reality. The danger of genetic engineering is not in doing it --- it is in overdoing it by getting locked in rigid mental models and losing touch with reality.

We sometimes instinctively oppose this tendency by exercising caution at things that have not been long in existence. What has not been long in existence is not the genetic transfer in any form of it (which is as old as life itself), but rather the *human design* of these systems.

GMO Reliance "Safe" Only Under Addressed Groupthink

Groupthink trains one to suppress *even that remaining little bit* of original thinking, of *foresight*, of creativity that we did not lose after childhood. It turns humans into zombies

(Festinger, 1959). And it's not like there was much of foresight to begin with --- our Platonic culture is traditionally bad at induction, especially of the *imaginative* kind. Charles Darwin himself wrote that ignorance more frequently begets confidence than does knowledge (a point re-described by Kruger, 1999). This was seconded by Nietzsche, who said that convictions are more dangerous enemies of truth than lies (Nietzsche, 1878). And finally, what's known as Putt's Law (Putt, 2006) states that any technology gets dominated by two types of people: those who understand what they do not manage and those who manage what they do not understand.

This is, of course, enabled and modulated by the socially constructed reality (whatever it may happen to be), since beliefs and assumptions are transmitted to us by our social environment and shape how we see the world, on top of our genetics. In modern terms, we can say that the greatest threat to the operation of any human enterprise, be it the aviation or nuclear or genetic industry, for example, had time and time again been proven to be the *insider threat* (Vicente, 2013). Once the limitations of *groupthink*, like in the Challenger disaster or the Takata airbag affair, have been discovered, we can, at least in principle, shake up the framework and reduce these very limits (Monk, 2015). Science needs the likes of Lynn Margulis' --- unruly, imaginative, self-doubtful network elements that will prevent it from degeneration.

This means embracing the (rather-natural) genetic technologies while avoiding monoculture/corruption. Avoidance of monoculture is best accomplished by redundancy via distinct architectures. In social terms, it means maximizing the socially awkward events of shame and feeling silly that people are trained to avoid since childhood. Embracing frequent failure of ideas in the virtual world before they make it to the food supply (an external maintenance) system.

A proper sample of signals (including safety signals) is always contradictory. Contradictoriness of signals is a good way to ensure that our confirmation bias is minimized. It is also hard to see these signals --- looking for them directly makes them seem only part of the landscape. But signals are always there, some growing, some diminishing --- and some of them, in plain view yet unrecognizable as such, will determine the future of the system in question.

These ones are like mammals in an era of dinosaurs --- who would have predicted the small, furry, and otherwise nondescript animals to take over? And yet this is how real insight happens --- it is always something other than most of us would logically or habitually expect. As we become aware of a signal, following sensation and recognition, it emerges from the background. But to recognize, we need to be able to see things with the mind, as well.

The most important principle in systems engineering is that no matter what, a complex system will break down. Water will evaporate. Rocks will be eroded. There is no physical identity that doesn't change, it is just a matter of "time scale." If one considers mountains as solids, with a change of the frame that speeds up the time, these mountains start flowing like water. The unit of change is millions of years instead of milliseconds. There can never

be a "perfect system" or opinion *consensus*, and realizing this is the number one step towards making a "*good enough," working* system. Scientific 'consensus' is a manifestation of the desire to find *perfection* where there could properly be none. And public resistance to the social construct of "GMO" stems from an idea of the possibility of *perfection*, as well.

The GM technology as such and the social processes in place for managing it need not be conflated, although in practice they usually are. We need to assure volatility at the idea/imagination level of the respective scientific and decision-making institutions to compensate for increased fragility that the demanding maintenance of GM crops and animals can produce.

It is a separate question whether this can be done, but we now can focus on this real issue among the GMO concerns --- the lack of generation at the idea level. This will result in further fragility in the GMO-enhanced agriculture system, and this part of Taleb's et al. 2014 argument is well justified.

So, it seems, much of humanity came to know too much for existing social structures to be able to handle that. Society's response to its own mind-boggling complexity requires either a qualitatively different transition or a rollback to the manageable and very sustainable old ways, so as not to collapse under its own weight. Either/or. Return to being a component of the Biosphere or complete a transition of us from the exp*e*ndable component we used to be into an exp*a*ndable system in its own right --- the proper Noosphere. To help along the latter path, I propose the strategic direction of not trying to turn people into machines, but rather doing the opposite, using technology to *empower* people:

- Decision-making by expertise, when everybody doesn't get to vote on everything and protest everything without even understanding what the topic is about --- not "understanding" at the commoditized social construct level, but *really* understanding, reaching a degree of self-doubt.
- At the same time, the previous point is worthless unless (and this is very hard to do) there exist effective means to prevent monoculture among the 'experts.' Scientists, for example, cannot be trusted to see the limitations of their science --- this is a job of philosophers, the modern versions of who are no longer scientists themselves and don't understand, unfortunately, how science is done (and suffer from own mono-culture if employed and judged by other philosophers). They also have no decision-making power.

A mechanistic push for increased accountability may only create a conflict of interest, where metrics can be pursued at the expense of essence. "Do no harm" should be as much of a designer's motto, as it is a doctor's; I want my directions to have the minimum possible adverse effects. People do not change faulty behaviour despite *awareness*, as humans are not rational beings. In the proposed decision-making system, therefore, I am to appeal to the Intrinsic Value proposition (Zimmerman, 2015) as a strategic ground for a system of GM management. The Intrinsic Value is what something is inherently worth to the staff, and its meaning. Intrinsic motivation, doing things for yourself, keeps us in our healthiest and most productive (not resentful) state, regardless of physical age (Deci, 2010). Extrinsic

Value is the ultimate output of the work, the deliverable: public policy for example, or an appropriate path forward. But one runs into a big trouble if focuses on the result instead of on the process, by taking shortcuts in Generation. In other words, I wish to make the experience of doing one's job an attractive (not onerous) thing, by and in itself. And Generation is attractive --- as those of us who remember ourselves being children can attest. Only by doing this can we ensure the incentives will "stick" --- instead of falling into disregard.

I propose extending the concept of 'game' and 'play behavior' to serious settings. Adults are children, too, and by tapping into that reserve of imagination, we can accomplish things doomed to fail otherwise. During the 1990s, children frequently took Tamagotchi digital pets to school because in the first two releases (Generation 1 and Generation 2) a character could die in less than half a day if it did not receive adequate care. This created compulsory caring behavior impetus.

How do we make sure that the compulsory self-doubt spirit does not die out in science and science-based decision making? Concerns over class disruption as well as general distraction from schoolwork eventually prompted many schools to ban the Tamagotchi. This could have been a grave mistake --- instead of banning, the product and the human factor it exemplifies could have been turned around and used to reinforce desired behaviors.

I endorse decision-making by imaginative expertise as an anti-corruption mechanism to move forward (imaginative people are more likely to get bored of rent-seeking, internally, based on the feeling of excitement they chase after). But there are few of them. This means aiming for equity rather than equality. This also means agreeing with Galam in the need to dismiss the increasing weight given to the public opinion in the process of policy making by decision makers for a 'fair' outcome --- in the societies capable of supporting this. My recommendation goes contrary to the populist view reflected in Parthasarathy (2018), a view that asks to "incorporate the perspectives of citizens at every step." We end up with a mess, at the current level of development, if we try to accomplish that. The citizens should learn to be comfortable delegating. An alternative is always possible, too: a rollback to the pre-Industrial state.

Science is not about unanimity nor is it about number of voters. It is not about putting up a show and should not be about manipulation. It is about the rare power of *turning imagination rigorous.* But one gotta start with imagination, not with rigor! Seeing past the metrics and into the people is the first step down this road. Initiatives such as pre-registration of hypotheses, in GMO evaluation, when a scientific journal provisionally commits to publishing a study regardless of the results, are laudable, but, as pointed out in Warren (2018) are still gameable. The human factor approach tells us that any attempt at developing a universal system of rules, or a test, or some other formal metric, is bound to fail. There is no alternative to having only the people who internally feel good about doing what the ethos of their position requires them to do.

The dangers of politicizing science lie in the damage that the crystallization of collective

fears of damage can make before or even instead of the actual damage taking place, be it from climate or from the 'GMOs.' As mentioned, this will also contribute to overlooking other, salient, hidden dangers that could prove far more impactful than the ones being talked about. The fears of the 2009 H1N1 swine flu, for instance, turned out to be baseless, and the mortality level of H1N1 did not exceed that of comparable years (Liu, 2017; Pereira, 2016). The dangers of succumbing to the convictions of an inflexible minority in today's world consist in the loss of flexibility and evolvability of the society.

The Community Research by the European Commission (2005) proposes to apply precaution *without slowing-down or impeding the implementation of scientific inventions* via a "Noocratic" system of governance, with a main administration body by way of a "consensus" in place of Plato's philosopher-king and "everything equitable for everybody" (although the devil here hides in the consequences of setting up and staffing a central monitoring body, since in practice, *nothing will be done "by all"*). *Precaution* here applies, in my view, to avoiding reliance on agricultural and especially scientific monoculture --- much less so to the fears of transgene escape. For regulation, a similar case is being made in Bronk (2016). As an alternative, we should aim for the *multi-structural function realisation* principle, where multiple and qualitatively different means would be available to perform a task. This will seem 'inefficient' at first, but will pay off over time.

A *tactical mindset* mistakes precariousness for safety; fragility for stability; and threatens the long-term survival of any organization. A *strategic mindse*t, in contrast, does not fear occasional, or even overwhelming, failures as a result of experimentation with "uncomfortable" ideas, and chases the potential for opportunity generation at the expense of the feeling of 'well-oiliness.' A seemingly "safer" option may turn out inferior. In light of this discussion, the EU policy statement quoted above gets a new and deeper meaning. One has to accept and service some smaller costs or risks in order to avoid incurring the larger, and delayed, ones. GM technology has the potential to produce more food with less pollution, as pointed out by Wang (2015). False efficiencies are not a solution for long-term antifragility and will backfire. And it is pollution that matters, not climate change (to which GMOs will, incidentally, help us adapt, whatever its "cause"). "Talking to public" is unfortunately impossible without overstatements, however. The public cannot handle it.

One last thing remains: the Noospheric transition demands not only the reinvention of our brain software but also of the biological us. In our discussion about how monoculture causes fragility and aging of any system it touches, whether on a farming field or in a bureaucrat's office, we need not shy ourselves away from applying these principles to our own, biological aging. The time is ripe for this.

The grand ambition of the humanity for the 21st century, way more profound and impactful but also way more risky than the 1969 human landing on the Moon, is reimagining *senescence,* at the germ-line and bodily levels. Our understanding of the evolutionary mechanisms, common to our crops and to ourselves as a biological species, is a foundational step towards that.

The *misunderstanding* of the evolutionary process as a gradual accumulation of point mutations finds its place as a proper *understanding* of the aging mechanism. Similarly, the mechanisms that are commonly thought to lie at the heart of innovation lie, rather, at the heart of degeneration.

The risks of GMO-based agriculture turn out to be relatively minor in proportion to other risks we face as an out-of-balance, rebelled biological species, and can be minimized (but never eliminated) with *monoculture-avoidance* system designs in mind, in agriculture proper and in the minds generally. In business generally, success is marked by "extreme contentiousness that regards dissent as an obligation and treats no subject as undiscussable" (Sonnenfeld, 2002).

Summary

- Our brain distorts the world to reinforce our emotional ties to the views we already hold. Starting with answers instead of with questions represents a corruption of imagination in research culture by privileging the result over the process. The invasion of simplified, inflexible public opinion into scientific debates, just as the invasion of agriculture into the hunter-gatherer world, represents the unavoidable victory of inflexible replicators (Galam, 2010). This should not be allowed, and science-based decision making should not occur by social manipulation.

- Within professional communities themselves, however, a vulnerability exists to the Expert Problem: suppression of diversity, imagination, dissent by overconfident experts who are not aware of their limitations. Low opinion turnover seductively optimizes the mental comfort of these specialized communities (their "safe spaces") but results in their unbelievably fast aging. Someone has to define the future as its business, by disrupting the nature of their own comfort zone from the inside out.

- This comfort looping manages to avoid both belief adjustment against the world via Retroduction *and* generation of new beliefs, via Induction, both by avoiding the touch points with a reality that is not socially constructed and socially reinforced.

- GMO reliance is dangerous not because of biology but because of the way humans end up handling this system within their socially constructed structures. This is a clear negative boundary. Taleb's principal conclusion holds up, *in practice (i.e., in the way it matters),* despite his own reliance on a culturally constructed view of evolution that has little to do with the evolution itself. Just as per the Protestant view of evolution by "busy" natural selection, and the older Aristotelian teleology it is derived from, the inability to remain not purposely busy hinders pursuit of scientific imagination, such as the ability to imagine oneself being wrong --- and compromises incredibly complex existing sociotechnical systems that cannot be maintained, less developed, without this ability. There is a survival value in remaining a child despite growing up.

- We need to prevent degeneration of our scientific decision-making into a version of *Solaristics* that got so low on imagination so as to regress into nothing more than a busy *nomenclature* science of compiling phenomena for a pursuit of metrics and no longer trying to understand what these phenomena really mean. Deduction is dry. Since perceptions are integrated into a socially constructed worldview "to make sense," that is, usually to confirm a preexisting worldview, only genuine passion and idea generation can potentially ensure the safety[20] of GMOs --- and many other systems, too. Imagination and its possible outcome, foresight, must challenge beliefs. Imagination must remain free so as not to cease being imagination. Although difficult to share, precisely due to its uniqueness and subjectivity --- the very attributes that make it so valuable --- imagination *can* be shared and put to use collectively. For this, its social disruptiveness must start being celebrated instead of suppressed. At present, the institutionalized incentive structure largely is aimed at proving oneself *right*, not *wrong,* which constitutes its ultimate corruption, *inversion*; worse than no science at all (the aim to prove oneself wrong is the counterintuitive good practice, corresponding to guarantees of academic, opinion, expression freedoms, etc). This, understably, results in societal distrust towards the "outputs" of such "science" and consequent (preventable) political rift.

- The biggest GMO agriculture risk is *not* in the GM technology itself; it's in having fake experts/fake scholars in charge, who chase appearances to "get by" instead of the essence/new worldviews and find themselves in positions they should have never been in. There could be more in people than they are manifesting. More of a person in a body. The efficiency focus and metrics short-circuit human behavior to focus on the metric, rather than on the outcome the metric is trying to measure. *Tip: to avoid premature aging, limit the planners. Save the Idiot. And hire the freaks.*

[20] insofar as it is possible to be safe from *oneself*, while being a particular realization of a species

Life as Art:
Positioning oneself to make best use of Variances

Underscoring the Need for Increased Generation, Not Avoidance of It

A true recognition of potentiality forces one to completely reimagine one's approach to the world, to the point of becoming a different person. In our human economy we need both cognitive differences (primary) and similarities (secondary, *not* primary matter). A deeply entrenched Aristotelian teleology prevents us from making sense of ourselves and the world. It focused on similarities, disregarding differences all along. Life starts with *generation*, not selection. Innovation, too, starts with *foresight, as generation,* and is followed by strategic planning and reality testing. Logic aims at invariance, but it is what is *variant* that is illuminating for aesthetic and practical purposes. And it is Art that is traditionally characterized by a *variance* bent. We somehow manage to overlook the generation part, in both biology and business, and that's why I focused on *generation* in this work, to help us realize that these parts of the picture even exist. Embracing a proper role of Foresight unleashes the hidden cognitive diversity. People vary in their neurological wiring, and we might want to ask how to *harness* this potential instead of excluding things we do not understand. As pointed out by Nozick (2001, p.297), there is a value in….

> *….. subjective psychological states not intersubjectively available to others [..], because these kinds of states are* shielded *from the knowledge and predictive ability of others [and even of self-].*

In evolution and innovation alike, the generation of biological/cognitive variances has to be shielded to some extent, at first; otherwise, it will simply not happen. We see this theme over and over. There is a challenge and an opportunity here. Induction that underlies the foresighting capacity comes from the same Latin prefix as in "inclusion." Combined, the return to reality (retroduction) and foresight amount to "creative destruction." And *Madness, Chaos* suddenly become useful in preventing failures of imagination. And since there's only one way to be "normal," but an infinity to be *not*, Foresight disrupts the danger of groupthink, disrupts the very social constructions, according to which it (Foresight) has no right to exist. Different people will be extracting different patterns if freed from the social expectation and its Aristotelian abuse. This means that any particular foresight itself is not immune to disruption, either, and should be welcoming of it. Our technological safety, whether in case of the GMO reliance, or numerous other civilizational systems, would benefit immensely from taking a part of the idealistic deductive zeal ("rule of logic/law," "the Apollonian or nothing") the present situation is vividly characterized by --- and putting it instead into a healthy amount of inductive and imaginative opportunism in trying to think of ways to *enable the opportunity* for the cognitive variances we already have access

to but choose to suppress and contaminate with convention instead, despite the (idealistic but empty) proclamations of "diversity."

Paradoxically, one usually ends up most useful when not trying to be so. The objectivity of a map-territory relationship in representational problems and the avoidance of technosocial Black Swans can be achieved through genuine intersubjectivity, i.e., resulting perceptual similarity, *despite aiming at the maximization of inherent subjectivity of foresight.* But this cannot be *forced* via the fear of failure and other social pressures. Objectivity is invariance under transformations, not avoidance of them. I will repeat the point from the Introduction, that *something becomes an objective fact, in part, because it is intersubjectively agreed to, but this holds only if the agreement was reached* in good faith, *independently of societal pressures,* i.e. while aiming at *disagreement* and being *unable to achieve it.* We have seen, from first-hand historical accounts, such as Galam's, that this is the criterion only to be desired, and real-world agreement ("the consensus") is increasingly often produced by much murkier means (and with much less bounded consequences for technological safety; *stuff just doesn't maintain or invent itself without somebody doing it.*). We can thus join Nozick in concluding that intersubjective agreement is epistemically prior to objectiveness but objectiveness is ontologically prior to it (Nozick, 2001, p.91).

One can't directly aim at innovation, just as one cannot have fun *on purpose*. The need for being or appearing "busy" is (historically) a social construct, and is a consequence of the Protestant work culture of the Industrial age, just as inapplicable to biological evolution (with its purported never-sleeping natural selection) as it is to genuine innovation. Accepting one's own fallibility paves the way for antifragile designs in agriculture and innovation management --- but only if experts are left free to connect the dots and explore a lead when they see it because they have no script to *follow* and no role to *act out.* It is no wonder that only an *independent* gentleman-scholar like Darwin could have come up with his *uncommon* idea, as he did. The side effect of being capable of Foresight, in all times, had been being treated by the society like an idiot, and Lynn Margulis, who ended up fitting the missing piece into Darwin's conception, too, had experienced this in the process of modern peer review a century later. We are herd animals, and there's most definite advantage to going along with the crowd by being noncreative --- but this approach can fail big in times of change.

The same neo-Darwinian misconception (taking root in the Protestant work ethics) that every step in evolution has to be selective is also used as an assumption for human innovation: that we absolutely must have goals, metrics, and accountant-style accountability at every step of the process.

It may therefore be initially uncomfortable to think that even our own life spans (us being a "GMO," too) do not have to be taken as givens. The incorporation of genetic technology into our lives raises a host of psychological issues to worry about, some of them real, some of them not. As I have pointed out in this work, we should be afraid of the *lack* of Generation (of new genomes/crops and of new ideas), not of the Generation going wrong, because failure is part of succeeding, and no success is possible without embracing it.

Calling reduced generation an *improvement* or an *optimization* is a big mistake. This does not bring us closer to a paradise. This only results in the loss of vitality/compatibility/aging.

Our attention is often focused on those who might be hurt by an action, but it totally ignores those who would be hurt if the action was not undertaken. The avoidance of small risks can create much bigger ones.

First Things First

A few limited changes to some of our crops are cautioned by Taleb to lead to the possibility of a "ruination of the world." *Such changes constitute our attempts to mimic biological evolution and create new proto-species,* but are limited by our monstrously incomplete understanding of what we are doing and the dangers of relying on incomplete knowledge. Our desires and abilities to influence complex biological systems (one had never erred by *over*estimating their complexity) depend on our abilities to structure our socially constructed decision-making systems and infuse them with imagination. Those social systems we understand even less than all of biology, but it is *them* that efficiently reinforce our existing beliefs via social pressure, the easiest solution for most people consisting in maintenance of both the beliefs and the social circle associated with them. Does this make thus maintained truths *serviceable?* The bodies of expertise are anything but an exception to this process, and it is in this mental feedback looping that the primary danger of GMO reliance is --- and not only them, of course, but *any* system with the increased number of points to fail. While *all* systems have these points, since *everything* ages*,* they will differ in complexity and in their serviceability demands (sometimes to the point of *contradiction*, through incompatible requirements, such as between technological and social opinion serviceability, *but not only*). It is not about particular technology; it is about the very complicated social psychology of the GMO that is *us*.

A common unstated assumption when discussing precaution for GMOs is based on the idea that the organic world is perfect in some fundamental sense, and people are 'spoiling' it. The major focus should instead be properly on famine avoidance and the agricultural system stability from unforeseeable failures and side effects, as by-products of biased representations and Nietzschean wills to power.

The two systems discussed -- that of GMO management and that of professional culture --- are parts of the modern optimization push to shift from being controlled to becoming a controller. The systems can be said to constitute parts of an emergent ideal of the Noosphere. Since we have been on this path for some time already, we may want to animate with as much of *generation* as possible our social (the science enterprise) and technical (GMO-enhanced agriculture) systems. Generation is what breathes *life* into all kinds of systems, biological and whatnot.

We want to procure cycles of generation and selection among ideas and levels of biological organization *other than* our own population (e.g, "GMOs," that is, other species, or

populations of our own *cells* for that matter --- anything but our own level of individuation). Replication and selection of systems may well be the fundamental nature of our universe, with nearly *everything* being such a system. These shifts in the agricultural and expertise systems described form the essence of the Noospheric ambition (because in the prior version of human existence, the Biospheric one, everything was being just the opposite, **Fig.4**).

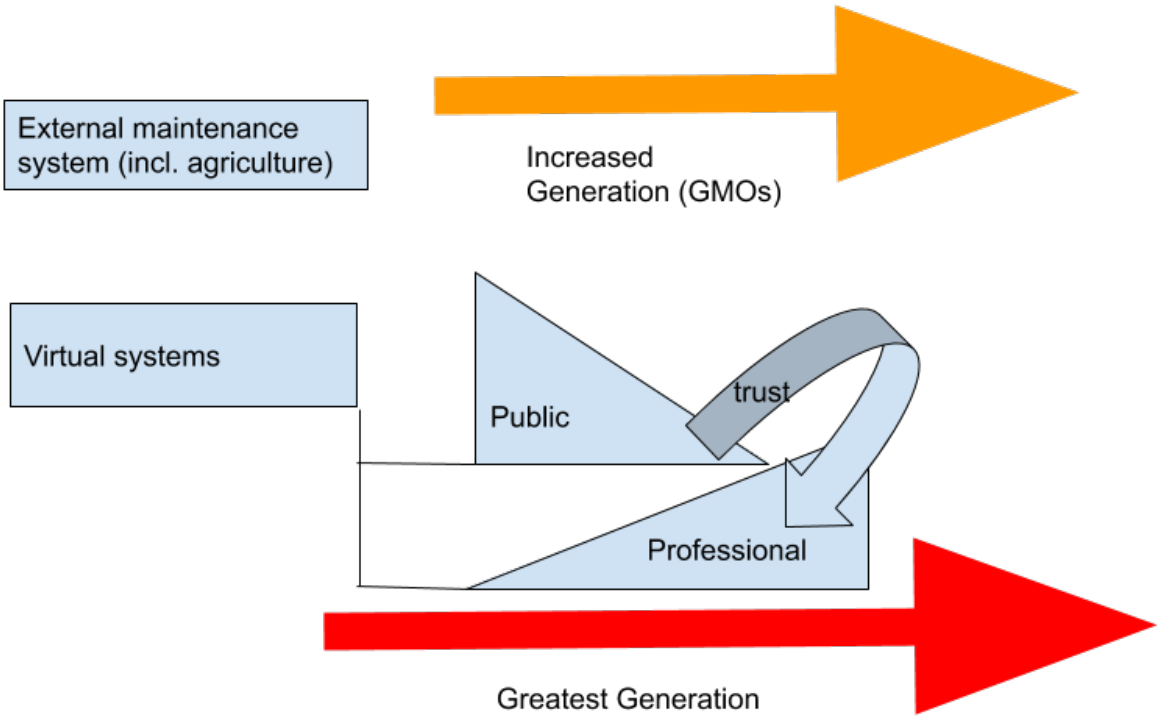

Fig. 4. Teleology prevents us from making sense of ourselves and the world. A key part of the Noospheric transition: replacing the fear of "safe space" loss by a fear of missing out on the newest great idea, first and foremost in our institutions of expertise. Neither people nor nature efficiently fit anything to a purpose: both just generate, randomly and a lot. *All we can do is to generate more.* As your complexity challenges get bigger, so should your imagination. We might be able to outrun the Time and the aging it causes to systems, including in our maintenance system, through making a full use of talent nested within human cognitive diversity[21] and avoidance of hierarchical, deductive, teleological aging. The way to achieve this increase in options is by putting a prime importance on exuberant generation of Foresight, its dynamic superabundance in our virtual system of knowledge and

[21] Accommodating the variances to the limit of possibility they *can* be accommodated to.

expertise. The potential of Foresight, just as the hidden portion of our genomes, might prove exponentially *necessary for something.*

Without realizing it, we used to aim at monoculture in resource development (it's just that our technical means of the past never allowed us to be as impactful as we are today), including in *agriculture*, monoculture and persecution is *social institutions,* and, most importantly, unconscious selection for health among our *own kind.* The conscious one is impossible. We can only do *the reverse* consciously, intentionally. Some of this had changed but has not achieved a new equilibrium state.

As a designer, one should aim to be not a complex systems *theorist* but rather a complex systems *practitioner*. This means no longer hiding behind Aristotelian categories, including its derivative social constructs (such as in "placing inventions into distinct categories," per Parthasarathy, 2018) by saying that one's model was right, "in principle." Only some out-of-the-field Black Swan derailed it. Such "expertise" does more harm than benefit, by causing us to lower our guard, based on false confidence.

But this applies to *any* representations, whether Aristotelian or those than could be replacing them. *They all* would have their blind spots. The human mind and its logic should be *distrusted*, and that is why the creed of design must rely on both foresight and prototyping (Retroduction). We distribute our minds through imagination (subjective Induction). Such states of belief suspencion are extremely rare and fleeting, and that is why they should be recognized for the value they can bring and cherished --- and why I advocate for decision-making by imaginative expertise. *The expertise that can imagine itself being wrong.*

There are limits to prototyping, however. And the bulk of our actions therefore depend on faith. And this presents a challenge for innovation, where pure and new faith is required, based on nothing but itself, and not even remotely time-tested.

What to Fear And What to Fear Not

It is not the connectivity of the biological world that is to be feared; rather, it is the connectivity in the social world, the groupthink, the uncritical and unreflective social constructionism. Social constructionism holds deep, invincible power over us. Social pressures tend to promote risk-hiding out of the fear of reputation loss. They thwart supposed behavioral independence of decision-makers, reducing degrees of freedom, which gives rise to emergent Black Swans at the system level as a result of corrupted perception and decision-making. In case of GMO-complexified agriculture, this can lead to a breakdown of the food supply system for a reason that we cannot, *in principle,* predict.

There is no need to fear "GMOs," especially those in agriculture. What *is* to be feared is allowing fragile systems to be "improved" by people who *think* they understand them. The

less one knows, the more is one sure of one's adequacy. Such a top-down approach is very arrogant. And not only in agriculture. The singular GMO focus of Nassim Taleb, however important, somewhat betrays his own prescription of not focusing on a singular issue. *Many other systems* are affected by the weaknesses of human mind, alone and (especially) in social settings. All the genes that could get transferred had been transferred, or will be --- naturally, and independently of us. This had happened repeatedly, continuously, and massively at all stages of evolution for all of its endless four billion years. Therefore, having been incorporated, the horizontal genetic material had either stuck and became "one's own" --- and therefore is unlikely to be dangerous --- or it didn't, which removes the concern altogether. It is, of course, necessary to research each individual case. And adequate precautions to be taken as necessary. But let us look for far bigger issues on our newly found Noospheric path forward that we better be wary of. The Black Swans nobody talks about.

Some stuff is physically impossible. Some stuff is ethically impossible. The CRISPR technology, for example, is not as precise as Platonists would love it, and this matters for some applications more than for others. But, in the present political impasse, I want to remove the impossibilities that *can* be removed, all stemming from lack of imagination and inability to connect different representational and epistemic modalities -- and it is an ethical thing to remove deductive staleness and capture the parts of reality inaccessible to Reason alone, *with Foresight.*

Monoculture and insularity constitute the first block towards both antifragile technology management and towards unleashing our imagination. Across all of the food waste reduction, agricultural and scientific monoculture, locally integrated networks will suffer from aging if left to their own devices. We can call this *deductive aging,* and it is schematized in the **Fig. 5.**

Fig 5. In the First Circle: *the pathological order of evaluation* and consequent aging from deductive looping without Foresight. I call this semantic disturbance the "loop of corruption," borrowing from the original corruption charge (correctly) brought up against Socrates. This short circuit represents a socially constructed "safe space" that will, over time, result in a self-accelerating ossification of the hierarchy it develops, resulting in Korzybski's "un-sanity." It is easier to go through that short circuit, compared to the full one, but there is a (delayed) cost. The small circle is a metaphorical bureaucratic Procrustean bed that can't stand what it doesn't understand and is motivated by the fear of loss of cognitive comfort. **Modified from von Baeyer, 2004.**

The "circular" terminology I use owes to both the management guru Tom Peters with his *The Circle of Innovation: You Can't Shrink Your Way to Greatness* (2010) --- for the full circle, and to Solzhenitsyn's *In the First Circle* (2011), as a metaphor for the corrupt deduction-only shortcut. Solzhenitsyn, among other things, describes the oxymoron of creativity-on-demand. It doesn't work that way. Foresight is not unlike quantum mechanics. The world can *simultaneously* be red and green. It is a famous riddle that is so hard to get. The moment you sample it, it becomes just one color. So the practitioner matters. And we need to sample often! Because if we think "it" is wave, it will one day surprise us as a particle; and vice versa. The sooner we adopt a world picture embracing this subjective view of

science, the more quickly we will be able to reap the technological payoffs it is capable of returning. The payoffs of the exuberant generation of Foresight.

Socrates has pointed out the allure of social constructionism in Plato's *Republic*: that is better to be just (to one's representation of facts, in our case) while appearing to others not so, than to be unjust yet appear to others as just. So, one may find useful things even in Socrates[22]! Because all societies treat those who disagree with whatever is the dominant narrative less-than-well, perceptual dissent can be said to play an ethical function. Nozick points a similar thought in his Note 63 to p.282.

Who Can Use All This and How

A.S Eddington was said to remark it does not seem a reasonable picture to be making odd noises on the off-chance that posterity will find them useful. Indeed, "odd noises" of foresight are to be made non-teleologically, out of passion. The off-chances are so low, in fact, that it is best to never think about them at all. This is true for both evolutionary innovation and that done by humans, in design. Exercising humility and restraint is never easy. In this exploration, I was simply trying to get my own head in the right place. I see my contribution in having had consolidated a new and unexpected framework on the relations of the 'GMO' concept to the biological reality and having had generalized the misconceptions about it into a more universal awareness of social constructionism that can have detrimental consequences. *All this was nested within a re-conceptualization of "foresight" outside of Aristotelian frameworks.* And *that*, in turn, within a recognition of pervasive and unavoidable teleology that messes our heads through an illusion (or inversion) of causal relationships. The teleological fallacy confuses the future and the past. Neither the human nor evolution can predict *anything, ever.* They just *generate*: randomly, and a lot.

Meaning is really only to be found by not caring about it. The GMO problem lies deeper than GMOs. It lies in the Aristotelian reliance (the technological explosion of the past 200 years consequent to it) and its own consequences in increasing opportunities for propagating failure owing to lack of imagination and socially pressured groupthink among designated experts in charge of complex systems, *along the lines of Chernobyl or Fukushima nuclear disasters.* Freedoms of imagination, of thought and of speech perform an extremely important (I would say, *necessary*) function in scientific collectives. A celebration (not just tolerance) of foresight variance coordinates to mutual benefit, thus serving an *ethical* function for a civilization. Nozick points out in his Note 63 to p.282 that disagreement suits well for people performing different tasks in society's division of labor, and such inclusive societies may outgrow the less coordinating ones. From the Black Swan view, this also helps coping with *new kinds of representational emergencies.* Short of freezing in time, there is *not much else* we have against the limit of our woefully incomplete and *incompletable* knowledge. "Science explaining everything" is beyond naive.

[22] He goes on to extol *rationality*, however, something actually *irrational* in its arrogance.

Inclusion of foresight goes against our animalistic will to power (including self-sacrificing behavior towards biological relatives --- see Nozick, 2001, p.240). The difference to the outcome it can make is nontrivial. Sometimes the experts can cease to be such, resulting in an Expert Problem, when whole bodies trusted with our well-being can get compromised by replacing *diversity* of perception with *conformity* of thought. For example, the Protestant work ethics construct, itself deriving from this Apollonian Greek tradition, however useful for other purposes, remains a serious block towards understanding of both the evolutionary and human-associated innovation, and I hope to have done my share in creating a space for its critical assessment throughout this work.

Anyone involved in the design of systems:

1. First, in any system, do not try to gain something by optimizing *on everything*. In some places, one cannot do that. Variation, dissent, generation can more often than not be absolutely essential for prevention of system fragility/aging. It should not be "optimized away" as waste. Blind "optimization," taken in the usual sense of "smoothing things out," or in a sense of "waste reduction," can be the single greatest way to *destroy* the system one intended to improve. And it is not intentions that matter, but rather --- results. As they say, the road to hell is paved with good intentions.

2. Secondly, assemble a team that would do things *for themselves,* yes, selfishly, and out of passion, not for the metric/appearance/public. By focusing on the product fake experts will skip the process and game the system. Today, it is not only *possible,* but, rather, quite common to have a PhD (Doctor of Philosophy) in _____, while not having a philosophical mindset *(what does that mean?).* Such epistemic arrogance is more dangerous than *lack* of any education. And this is an *ethical* imperative *("what to do?"),* explored at length in Taleb's 2018 *Skin in the Game,* where the reader is referred to for further ethical discussion. "Experts" do not know what they do not know. Knowledge is insanely dangerous without metacognition. Imaginative people enjoy the *process*; they enjoy thinking/making. It gives meaning to their life. They go into battle with their semantic reactions,[23] and actively *seek* those battles. This is the only way that things can last. Because it is important to have fun yourself, in the subjective generation of Foresight, and not try to imagine oneself as an audience. Analyzing the interests and preferences of the public, trying to please it as a prime priority is a sure path to clickbait, populism, and degradation. In contrast, celebration of dissent results in a piecemeal renewal of the opinion system and will delay its collapse. It all starts with a value orientation and the internal feelings of the professionals: what makes *scientism* different from science is the use of something that appears scientific but was, consciously or unconsciously, conceived initially as a backup of *pre-existing* beliefs, instead of as an imperfect tool for the pursuit of the unpredictable truth. It is all-too-often all-too-easy to be deceived by appearances, and this applies far beyond the particular case of GMO safety.

[23] See work of Korzybski

3. A system where everybody has their unique bias can still be reasonably veridical provided that rules of science are not being replaced by the rules of power. Individual biases, which are unavoidable in practice, despite the above, can be embraced within a larger system of seeking truth --- to *arrive* at that truth as a dimensional matter, notwithstanding the own direction of those biases. Emotions, too, may have implicit knowledge built into them, and, in addition, be motivating directly if aimed at the love of process rather than the outcome. Psychologically subjective things perform a function vastly exceeding that of reason. It is up to the adepts of Socrates to demonstrate conclusively, instead of hiding behind circular referencing within a social construction, how something evolutionary *recent* could have more veridicality for any purposes over something evolutionarily older and vaster, or why the information within those few millimeters of gray matter that they hold so dear necessarily needs to exceed the information contained within the world's dependency relations (such as that in the program of DNA, but not only).

The maximum stabilization of one's environment causes one to feel less alive. We need to counter the Semmelweis reflex. "Less alive" is the definition of Aging. One does not need any science to *feel* that way, although science, too, supports this conclusion. And science itself, just like our biological life, *needs* "fires," because truth should not burn.

What is borne out of fire is not afraid of fire. It *needs* it. Species are not afraid of genetic modification. Life is not afraid of metabolism. Theories are not afraid of being tested. And truth does not burn!

The biological life exists only dynamically: either on its way *up*, or on its way *down*. Reduced Generation is …. Aging, misfit --- not Foresight.

Zooming out:

Fixing Social Variance vs getting fixed Biospherically

There is always more to our blind spots. Nozick points out, along Taleb himself, and many others, how highly fallible are our explicit calculations/predictions (2001, p.271). Beliefs regarding the world's dependency relations coordinate our actions in this world. They incorporate past perceptions and inferences from them, and the belief apparatus itself has evolutionary origins, thus profiting from bound geological time. The world contains a wealth of information (such as our own intuitions, the program of DNA, other such "programs") that are reflective of past differential growth/"inclusive fitness" (teleologically: *partially* reflective of past selection). This information, at any time, partially exists as manifest one but mostly in a latent form, waiting to surprise us as a Black Swan. *(I am being guilty of a teleological explanation here -- this is where the "common sense" needs to be reformulated; but how do you do it faced with it being* shared*? Korzybski did not succeed at such a monumental task).*

The evolutionarily instilled patterns of information processing save us much of the genius burden in having to figure out the computational wisdom of the world (all of its dependency relations) during our lifetimes. Foresight, as an (imperfect) tool against Black Swans, should be aimed at possibility and potentiality, *not* at forms of prediction. H.G. Wells was following his cultural traditions, as we all unconsciously do, in his (teleological) conception of foresight as prediction (1932). These same traditions gave rise to British Neo-Darwinism: and both, despite their merit, dogmatically missed *the first step* of innovation and evolution, respectively. That step is actual *generation of variation* (and its subsequent differential propagation as step 2).

A question of what paradigm to use is different from the questions of truth and necessity of statements and properties formulated within the limits of those paradigms and in their respective terms. *My* foresight is individual perception, not a collective delusion. Collectively shared logic will follow after. Foresight is the *opposite* of long-term planning, in the same sense that deduction is the opposite of induction, or convergence the opposite of divergence. There, in fact, need not be a contradiction among the two: the problem results when one component of a system or a cycle is not kept in check under pressure by other components, all trying to outgrow each other. Imagination that inspires foresight can loop onto itself, too, resulting in its own kind of corruption, aging, fragility, maladaptiveness. But we as a society are in no danger of disrupting the whole system by it: foresight is rare, for better or for worse, as the capabilities that underlie it are associated with psychosis (Carson, 2003) and its unappreciated carriers get selected against within their respective groups, to an unrecognized detriment of the societies that do it.

Foresight consists in the removal of some of our sensory filters. Done right, it can become innovation. Done wrong --- end in schizophrenia. So, the Art is in trying to do it *more right.* As in our standard theory of evolution, *we may be overemphasizing on the "selection" part.* So, the ultimate problem is in failure to connect the dots and realize the necessity of opposites. Sure enough, one's paradigms may be so different so as to completely disable communication among different theorists, operating within nonintersecting paradigms (and this is why sending messages to extraterrestrials is beyond naive), but, thanks to the pervasive Aristotelian influence, we are in *deficit* of generation, not in excess. *And generation is where it begins.* Before aliens, it must be nice if people supposedly speaking the same language could *hear* each other. We are far from that. A fear of imagination is like a fear of transgenes: both are unpredictable, but necessary for long-term survival. Realizing this requires a serious Gestalt, a conversion. Anything can be a cure or a poison, depending on the dose, and the explosive technosocial vector of the human civilization since the Industrial revolution will not be possible further without infusing Foresight back into the society. There is an option of return, or maybe not, and if yes, then at a cost --- but the deductive self-looping of bureaucracy alone will surely not make it. *We don't know what will work; but we can be more certain what won't.*

The agreement or disagreement with the conclusion of the Taleb's paper requires, in the spirit of Margulis, an abstraction of the grandest scale. **Fig. 6** remakes the Figure 1 again, now mapping the three distinguishable human systems onto their major mode of existence: the Noosphere onto induction, the Biospheric existence onto retroduction, and the cumbersome *Bureaucrosphere (embodied via Nomenklatura)* onto the uncontrolled growth of deduction it is derived from.

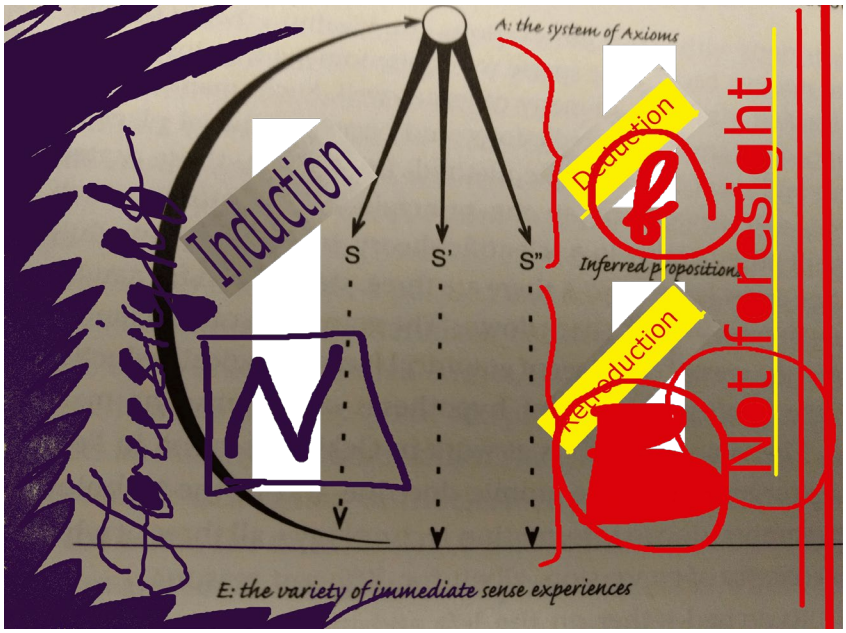

Fig. 6. The Bio- (B), the Noo- (N), and the Bureaucrosphere (b). The Noosphere seeks diversity, the Biosphere seeks sameness (from its components' perspective). The Bureaucrosphere also seeks sameness, despite claiming otherwise, but does so in a self-serving, pathological way. Inductive overgrowth results in *psychosis*[24], deductive overgrowth in *fragility*, and the retroductive one in *nonadaptive belief*. We are in an unrecognized deficit of induction at the moment (2019), and this applies to the GMO issue, as well.

Both our Biospheric and Bureacrospheric existence are children of *social constructionism,* and both are intersubjective *group* activities: it had been more adaptive in the past for humans to believe anything that is ultimately *wrong,* but do so in groups, together --- and survive that way --- than to individually believe their subjective truths. The Bureacrosphere hovers in the air, far above the ground, with no touch to reality: it is the world of sensemaking, where only what "makes sense" *(for impression of others)* and "looks good" has a right to exist. The Biosphere, in contrast, is reality-tested. It is what had survived in the past, what is real and proven, and what Taleb suggests us in his advocacy of the traditional agriculture over the modern one. Our Biospheric existence (as a component of the Biosphere) works well in stable conditions. And that existence had always been hard.

Unstable conditions or competition open the need for Foresight --- the dominant Noospheric component, the world of strangemaking. Foresight creates new worlds, by simply *sampling* the real one in a unique and subjective and individual way. Absent monoculture and social constructionist pressure, different brains will represent the world in different ways. And there is an infinity of ways to do it, as had been discovered, for example, by AI engineers and quantum physicists, given the vast inconsistencies between individual subjectivities. And the infinity of *potential* resulting from that, too. Most of which

[24] As in overimagining the same thing without being able to pull out

will remain virtual --- there are costs to *any* of the choices we make, and Foresight is not without its own. The problem is that there is never something for nothing; we do not know what "progress" or "waste" are, for example. The Noosphere-enabled shrinking of necessity can expand veridicality of our representations. But it might shrink something else, some other, non-cognitive veridicality, such as that of those unbelievably illogical modules that are our own genomes, the GMOs that we are.

I believe that our conditions *are* unstable, not only environmentally, but also *made* unstable due to intra-human competition (with better cooperating societies, able to coordinate to greater mutual benefit, better growing). Extension of cooperative coordination is now feasible towards previously neglected generators of variance, and power subgroups within societies may even realize (or believe) that doing so is in *their own* best interest. It is today's technological conditions, such as GMO agriculture reliance, that enable this more so than any vaguely-worded accounts of "moral progress." The fragile extended cooperation is always under assault by identity politicians of all kinds, willing to power --- in much the same way, as identity philosophy and identity politics have been misused for millennia. The humans themselves have not changed.

And humans themselves are even more unstable.[25] Strange times call for weird people. So there is a need to move forward, somewhere, while still keeping oneself in one piece along the way. But there it is, *foresight*: as President Kennedy with his Moon ambition, I propose my own *impossible possible*. To put imagination, dreams, Foresight back into the cycle of adaptation, while not dispensing with both the imaginary deductive world and the critical step of reality testing. As Nozick (2001, p.7) notes,

> *The [Biospheric, abductive] concepts must have got something right. Yet [their] selection does not guarantee their complete accuracy.*

Nor does it guarantee their future applicability. The choice over the use of GMOs and other such more productive, but also more fragile systems is the choice between what worked in the past and what may hold a promise of a new future. It is a debatable choice, and GMOs are only one part of it. In this particular case, Taleb's very own Barbell strategy of risk allocation may suffice as a way to harness the best of both the proven and speculative worlds. The point I'd like to make, though, is that between the Biospheric existence of the old and the proposed new sweep of the Noosphere, the movement towards which had been accelerating in the past centuries, there is no future *at all* if we let the legalistic, planning Bureacrosphere of modern times to take over. As a true corruption of adaptability, it exists only for the sake of itself, with no touch to reality. Reduced Generation the Bureacrosphere is defined by is *not* Foresight, although bureaucrats will re-define and misuse this word. In combination with its lack of touch with reality, their "foresight" is nothing but .. simply Aging, one that leads to unpleasant, massive surprises owing to the fragility it creates. Not only will this not *create* any innovation, but rather will it *destroy* the existing systems (created by others) through *iatrogenics*. Humans, indeed, even in their "best" desires, such as that for rationality (?), are the biggest danger to themselves.

[25] In more ways than my Foresight manages to incorporate.

Why not to deny the Putt's law? Perhaps we somehow will be able, in a pursuit of the Better, to mitigate the Inductive Fallacy via inclusion of Foresight and learn how to maintain our complexifying civilization. Then there will be a problem of internal complexity maintenance of us as a biological species (for natural selection, though not a creative cause of evolution, is not unreal). If even this is resolved (via the inclusion of Foresight, again), people will attain the next level of the danger of self-destruction. Let us remember that in the Biosphere, our existence is bounded (for us, that is). In the Noosphere, it is not, and we do not quite understand what this means for the future.

One thing is sure: what we *cannot* be doing. We can't be abusing reason and ignoring the world (and all of its a-rational wisdom, accumulated through endless selection of even more endless variation). Thinking is much more than logic; it must include Foresight. And many so-called "errors of thinking" are not really errors at all (Henle, 1962), but natural and adaptive refusal to answer questions on the basis of their form alone, in an analytic fashion (Rey, 2003), that is, without Foresight. Either try to accept reality using Foresight or let the world do its job for us. No stripping the world of all of its complexity and multiscale structure to make it *comprehensible* to the Socrates of today.

Nietzsche wrote that today's human species is a rope over an abyss. Foresight inclusion might let us explore the limits of humanity (as opposed to the limits of animality of the human animal). Korzybski, who personally fought in the WW1, developed a similar idea with his *Manhood of Humanity (see 1994)*.

Foresight relies on metacognition; it starts in wonder. It never ends. I don't know what it means (intentionally), or how to measure it, but less of all how to plan it; I know very well, however, (extensionally) what *not* to do so as to avoid getting caught into a (Socratic) game of bureaucratic non-foresight, a game that can turn toxic. Too bad it is well underway, and perhaps unstoppable.

Appendix A

Less Abstracted Abstract

Unbeknownst to us, the culturally maintained teleological beliefs shape what we physically see. While apparently critical of the mis-application of the (Protestant) work ethics to making sense of human innovation processes, Nassim Taleb at the same time *uncritically* relies on the entrenched neo-Darwinian view of the world --- derived from the same ethics *(and its underlying teleology)* --- and this skews his perception of the scale of serious unpredictable risks we face with the genetic technology proper.

- **Risk Classification:** The principal problem, as I agree with Taleb's main point, resides in the increasing (and faux) deductive optimization through agricultural and institutional *monoculture,* that is, at a level more systemic than the GM technology itself. Adding perspective to the issue at hand, I argue, however, that the public policy "precautionary principle" should not apply to the domain of 'GMOs' any more than to other monopolizing economic domains because the probability of systemic ruin stemming *from the GM technology itself* is dwarfed by other systemic risks of the Deductive-Optimization Economy, the emergence of which I regard here as a defining feature of modernity.

- **Decision-making** should be carried out exclusively by imaginative expertise as an anti-corruption mechanism to handle everything that we do not know. Imagination here means an internal drive to imagine oneself being wrong, and finding a seemingly perverse pleasure in doing so. I support Taleb in warning us about the hidden, skewed dynamics of opinion formation --- in the society and in professional *societies* alike. Imaginative people are more likely to get bored of rent-seeking at the expense of growth, *internally*, based on the feeling of excitement they chase after. I advance the Strategic Ambition *of reinventing our imagination within specialized bodies of expertise* by replacing the socially constructed fear to lose one's face with a fear to miss out on an intellectual contribution. This may result in strengthening of public trust in the institutions and delay their demise.

More generally, I locate the primary problem with GMO risks inside our heads and the type of thinking they have been collectively trained to do rather than inside the GMO themselves. The lack of Inductive Foresight is a generalized consequence of the Deductive Groupthink Culture we find ourselves in. The very possibility of the Neo-Darwinist mistake and coming Black Swans from GMO Decision-Planning are manifestations of that. I distinguish between the Noospheric alternative, relying on induction and inclusion of dissent, and the old Biospheric one, which consists in the abandonment of recent technology, whether voluntarily or not. Increased generation at the agricultural level (with the GM technology) absolutely must be accompanied by an *even greater* idea and dissent generation among professionals charged with developing and sustaining this complex system. Life starts with generation, not precaution; limiting the options is a path to competitive extinction. We must limit the fear of loss instead. We will be *less unsafe, insofar*

as it is possible to be safe from oneself, as long as the pace of idea generation within professional bodies outstrips the pace of complexity introduction into our life support systems, such as in agriculture.

Appendix B

The View of Evolution That Excludes The Very Evolution It Was Meant to Describe, and a More Adaptive Paradigm

The rates of spontaneous mutation (stemming from errors in the cellular processes) have been broadly estimated as 1/300 per genome per replication (Drake, 1998). This is the rate of general mutation --- and overwhelmingly that of slightly or moderately detrimental mutations at this. One needs some very certain changes to happen in order to create something new, not change in general. General change results in nothing but chaos.

The rate of mutation of a certain DNA nucleotide into another, also certain nucleotide, is lower than from any nucleotide to any, commonly quoted in literature as 10^{-5} to 10^{-7}, and can, therefore, be taken instead as 10^{-10} to $10.^{-12}$ Because independent probabilities are multiplicative, and because it takes several amino acid changes (also specific ones) to alter a protein, this would give a probability of 10^{-30} for 3 nucleotides and 10^{-40} for 4. And these changes will have to appear all at the same time to make sense for selection. Half-protein is of no use, as is half-eye. This is equivalent, in principle to turning the word 'DAY' into 'DOG,' with only two changes. The intermediate forms (DOY, DAG) make no sense and will most likely be harmful, by virtue of having lost their original function and not having gained a novel one. And what if an early organism had an opportunity to evolve a new trait (such as an ability to utilize a new substrate or break down a harmful chemical) that would have required not 1, but a whopping 5 enzymes to evolve? The odds become even more impossible if one considers the need to evolve whole genetic sets, not just one gene. We would have to multiply the individual probabilities again, and with that, the whole Universe might not be enough to provide the time to arrive at the emergence of novelty --- capacity to utilize a new substrate.

The probability of such a happenstance is the probability of a miracle.

On his webpage ("Evo21 References," 2019) and in his book (2011), molecular biologist James Shapiro had documented a selection of ways that inter-cellular, inter-kingdom and inter-everything DNA transfer occurs.[26]
In summary, the natural channels of GMO creation number many:

- Free DNA;

[26] As mentioned before, I would divorce myself for now from Shapiro's use of some concepts, however. While cells indeed possess ways to modulate their defences against foreign DNA (increasing uptake, for example, in times of stress such freezing-thawing cycles in bacteria), I believe Shapiro is going astray here overreacting to an illusion of agency. Nassim Taleb described this powerful cognitive illusion in his 2005 book *Fooled by Randomness*: *The hidden role of chance in life and in the markets.* Specifically, Shapiro seems to fall victim to the survivorship bias, where one selectively sees the winners and the success, while forgetting the huge number of losers that paid the cost for the winners to become winners. His term "natural genetic engineering" should not be interpreted to mean the presence of an "engineer," therefore. It may even be that his supermutability processes may be occurring as an emergent property at the level of the population only --- in some cells for benefit of the others, with the original cell dying from its load of deleterious mutations but producing also the new material for nearby cells.

- DNA packed into microvesicles of bacterial and nonbacterial origin;
- DNA included with regular, defective or 'pseudo'-viruses;
- Specialized 'gene transfer agents' (GTAs);
- Special pumping mechanisms (e.g, 'IV');
- RNA-mediated transfers (with recognition by our very own domesticated bacteria -- mitochondria);
- Mitochondria-mediated replication of exogenous bacterial DNA;
- Cellular reverse synthesis of DNA from RNA by cellular systems and by retroviruses;
- Some of the DNA we eat as components of foods and that gets absorbed into the bloodstream rather than degraded --- yes, this has been an anti-GMO concern, but it happens with any consumed food;
- Sperm-mediated gene transfer, including reverse-synthesis there;
- Contact cell-to-cell transfer (including gap junctions, plasmodesmata, nanotubes, temporary membrane merging);
- Cellular merging;
- Symbiosis (of organisms, organelles, genomic fragments like in the flu virus, which consists of 7 or 8 separate fragments of DNA);
- Insect-mediated transmission.

These processes overwhelmingly do not result in any visible outcome, because in order for a gene transfer to occur and be visible to us, the nature of the transferred traits matters (e.g, a new color that can be detected), and, even more importantly, many barriers have to be overcome, including the developed immunity of mammals and higher plants and their intracellular defenses against the "non-self." The now overhyped Crispr-Cas9 system, used for gene editing, in 'GMOs' and beyond, is an example of such an immune process at an ancient level. We can see here that the very same system is used both for invasion and for defence, much like police and their opponents may very well be using the same model of gun. So it comes down to mutual dynamics. Some of these channels are constant, some fluctuating; some active, with the use of dedicated structures and processes, some passive; overwhelmingly transitory/ecological, but some delayed/evolutionary, and some fossilized (surviving yet silent DNA of organisms that no longer exist themselves); some closed/local, some open and more global in nature.

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