

Anthropogenic relation to other biota:

Connections to Disorders and Crises of our Time

**Interpretation of 21st Century Punctuated Equilibria and
Predictive Perturbations**

Implications for sustainable and affordable survival

By Russell Jaffe

Preface and Introduction

Local human choices have delivered unforeseen consequences often extending far beyond their source. The consequences from acting locally and affecting globally are compared and contrasted. Mechanistic and integrative views about the meaning and implications of human interaction with the larger world are examined. The work focuses on sustainability, species viability, and solutions that allow one to live well through these challenging times.

Insights into causes rather than symptomatic consequences yield innovative understandings and solutions to address the accelerating epidemic of epidemics burdening life on earth. Understandings and solutions based on this approach can be evaluated. Full life cycle returns on human capital, environmental impact, and financial return on investment are discussed here. Effective, safer solutions for individuals, societies and planetary biota show promise in health care and systems biology just as they have been fruitful in energy security over the last several decades.

Interdependence with all life is acknowledged.

A practical, practicable synthesis of the following academically distinct yet operationally inter-related fields is provided. These include:

- Biochemistry and Physiology,
- Molecular Biology and General Medical Sciences,
- Paleobiology and Sociobiology,
- Psychology and Psychoneuroimmunology,
- Pharmacognosy and Pharmacology,
- Ecology and Nanotechnology
- Quantum Mechanics and Electrodynamics.

Cross training in a variety of healing arts grew out of curiosity about philosophies of care and their evidence base. Training in Allopathic, Osteopathic, Naturopathic, Ayurvedic, Homeopathic, Anthroposophic and Traditional Chinese Medicine (TCM) has been integrated with acupuncture, biochemistry, sociobiology, and quantum biophysics, Functional Integration such as Feldenkrais Technique, Milton Trager's Mentastics, and mindfulness practices from many traditions.

The past forty years of curiosity, skepticism and investigation have been a privilege. The next forty years will assess how well lessons have been learned and applied. With gratitude to my teachers and humility toward this task, this work is undertaken with head, heart, and hands in harmony.

Being cross trained helps clarify certain assumptions that have consequences for both the larger environment and the individual quality of life. Questions that impact health, society and science illustrate this. Decisions that affect the social contract are explored.

Motivations and goals for this work include a desire to:

1. Explain how human healing responses are evoked or quenched. Emphasis is on understanding fundamental causes of both good and ill health more than the symptomatic consequences or consensus explanations mostly supported by assumptions than evidence verified,
2. Provide a context for why *this* 'epidemic of epidemics' and why *now*,
3. Suggest actions prudent people would take to protect themselves, their loved ones and their community's health in light of these insights,
4. Help others make sense of what is happening and compassion for unnecessary suffering while appreciating suffering as a part of this world and a profound 'teacher', at times,
5. State clearly a current understanding of contemporary scientific frames and observational evidence,

6. Provide support upon which others may build a deeper, more personal understanding of reality, appreciated through a more comprehensive approach to successful living and sustainable survival.
7. Appreciate that physiology, psychology and pharmacognosy before pharmacology make sense in theory and in practice. This can be shortened to: Psychophysiology and nature's remedies before novel pharmaceuticals.
8. Connect action to context however much people may ignore or deny such interconnections or interdependences.

This is a work in progress rather than a “definitive” synthesis.

Human understanding links us with those who have gone before and those to come. The insights and syntheses here are the sum of gleanings from the above diverse fields of scientific inquiry, cross cultural perspectives, and traditional practices. There are common confusions about how the body functions.

At small or nano or quantum scale biology is in operation much more elegant and unpredictable, adaptive and vulnerable than macro mechanical models of reality predict or permit due to their different levels of assumption and analysis.

Breakthroughs in bench and clinical sciences profoundly revise previously held largely mechanistic views that have dominated for the last few centuries. A disruptive set of transitions is emerging. Deeper insights into functional and submolecular quantum and nanoscale insights into the remarkable, sometimes counter intuitive, awesome yet limited adaptive capacities of life forms (Biota).

Anticipatory awareness helps us function better. Learning history's lessons rather than repeating mistakes becomes more possible. Asbestos, formaldehyde, dioxins, PCB/PBBS, phthalates, biocides, neurotoxins, toxic metals and solvent residues are presented as examples from which to learn.

Options for healthful living based on self-assessments are highlighted. Finding and living in harmony with our individual nature and the life work that is for us to do as a citizen of this wondrous, fragile planet makes for a better examined, more meaningful life.

Dedication:

This work is dedicated to all those who seek better health, better function and the maintenance of affordable, youthful vitality throughout the full life span. To all who seek healthful vitality for life during these challenging times, this work says, “Salud, l’chaim, en shaala, and namasté”.

Ennobled in the ‘self evident’ truth that the ‘pursuit of happiness’ is a citizen’s right, we suggest this constitutional guarantee includes being and feeling well enough to *pursue* happiness. It is more than challenging for most people to ‘pursue happiness’ when they are not functioning or feeling well.

May all those who are suffering find peace in mind and satisfaction in body.

With thanks and gratitude to all teachers, mentors and sages including:

Roy Anderson, Father John Berry, SJ, Ven B V Dharmawara Mahathera, Professor Carl Franzblau, HH Tenzin Gyatso, the 14th Dalai Lama, Anna, Adam, Mitchel, Marcy, Marlene, and Samuel Jaffe, Rev. Robert Leichtman, Amory Lovins, Dr. Ramamurti Mishra, Daniel Owusu, Bill Phelps, Imam Abdul Aziz Said, Dr. Norman Schwartz, Rabbi Joseph Soleveitchek, Rebecca Sylvan, Rev. Olga Worrall, and Reb Zalman Shachter-Shalomi.

Anthropogenic influence on biota: Connections to Disorders and Imbalances of our Time

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Overview: Human relations to nature and vice versa

“The feeling of unity is not simply an observation. With it comes a strong sense of compassion and concern for the state of our planet and the effect humans are having on it. It isn't important in which sea or lake you observe a slick of pollution or in the forests of which country a fire breaks out, or on which continent a hurricane arises. You are standing guard over the whole of our Earth.”

Yuri Artyukhin, Soyuz 14 cosmonaut

A modern Charles Dickens might well describe *these* as the best of times *and* the worst of times¹.

An unprecedented experiment is underway.

Reciprocal influences between humans and the natural world are the subject, object and conscience² of this experiment. Replete with largely unforeseen consequences, the current transition from the second to the third generation of this experiment is underway. Accelerating exposures and synergies of influence, challenging the best of science and policy to understand and successfully manage the consequences of these rapidly escalating consequences in restructured living within limited resources in the biosphere³.

Neither a controlled nor a blind experiment, the end results include challenges to quality of life or sustainability of life on earth. This experiment's outcome will determine the types of life that thrive and those that dive. Large amounts of data

are being generated. Observers are finally able, as in the case of climate change and energy-security, to make *pre*-dictions as opposed to mere *post*-dictions. Application of the same modeling and systematic approaches shows promise of finding a window of opportunity for planetary survival linked intimately to individual well being.

Lacking “informed consents”, this study in anthropogenic interaction with other biota includes and unfolds before each of us. Biota includes all life. Biota expresses species-specific priorities; survival and satiation usually high on the list. By the 1970’s, when global searches for sites free of anthropogenic influence were sought as controls for experiments, none could be found⁴.

Anthropogenic influences appear to have irrevocably changed the planetary ecosystems with consequences for social and financial economy. Extractive approaches concentrate assets largely without regard for the collateral consequences. Society at large and the public purse become burdened by an unsustainable burden of financial, environmental and human costs. In addition, impaired adaptive capacities are becoming all too frequent as habitats compress and resources are increasingly constrained.

Results of assuming the human body to be a machine that wears out, the mechanistic view is compared with an integrative, biological, self renewing, self-sustaining view, used throughout to illustrate both how we got here and what we might do from here.

Highlights of the topics explored include:

Human influences on the environment and reciprocal effects of ecosystems on people.

Reproductive, neurodevelopmental and learning disabilities have rapidly increased over the past century. They have become disruptive influences on the families involved as well as on the social contract that governs civil society, fraying the social norms on which civil society rests. Consumption can be less conspicuous and more mindful.

Nature provides abundance and modesty by design. Emulating rather than dominating nature is increasingly found to be sustainable. The limits to 'extract and move on' are increasingly clear now that there no longer is any place to which to 'move on'. This is a fundamental transition now underway.

How **different views of the world take in the same information and reach orthogonal, seemingly incompatible conclusions.** Stewardship and possessiveness are compared with regard to planetary sustainability, analyzed from mechanistic and integrative perspectives.

Associations and observations on causes of infertility, birth complications and developmental challenges serve as early warnings of emerging challenges.

The ability to digest, assimilate and eliminate what we consume is central to being well. Impaired digestion prevents needed nutrients from coming into the body in sufficient amounts to meet all elective as well as protective needs. Toxic metabolites often build up as a consequence. This is explored both in terms of causes and of what to do.

Autoimmune or self-attacking conditions that occur when the immune defense and repair systems shifts from tolerant resilience to indiscriminant attack. The result is inability to repair 'self' from usual wear and tear leads to cumulative repair deficits understood as self-attack in need of suppression. Repair deficits lead to increased tissue permeability, loss of functional specialization, reactive swelling and pain

known as inflammation. Cumulative repair deficits link to largely avoidable, preventable and reversible scourges associated with older age. Physiologic and biologic breakthroughs of the last decades are applied by the emerging ranks of integrative, comprehensive, and holistic physicians. Understood as cumulative repair deficits and/or loss of healthy resilience factors reveals therapeutic options that too often still are largely unappreciated.

Repair deficits, then, are opportunities to bring the needed conditions to promote repair and concurrently remove toxic matter more effectively.

Stimulating repair competences that promote structural renewal of the collagen, elastin, and basement membrane structural elements is essential to functional vitality and resilience, as well as to cells and biotic systems information processing and orientation.

In the conventional, mechanistic understanding of inflammation consequence was confused with cause. A more evidence based approach is to correct essential deficits, reduce distress and exposures to specific immune-reactive foods or chemicals. Tolerance, resilience and functional integrity at cellular and whole system levels can thus be restored.

Autism Spectrum Disorders and other progressive developmental delays (PDD), metabolic syndromes and diabetic cardiovascular diseases, autoimmune syndromes and senilities are used as *examples* of chronic conditions that are the root cause of too much suffering even as more effective, safer solutions are available.

Integrative and functional perspectives developed here provide insight into both cause and consequence, both source and implications of this now global experiment in anthropocentric convenience and resource concentration.

The biological taxes of high-tech living provide a health deficit that barrow now to

be repaid by future generations through the costs to repay the ‘mortgage’ on healthful resilience or environments in need of restoration.

An example is reducing topsoil through mono-crop commercial farming. While this gives the quickest short-term return on farm investment, growing one crop repeatedly quickly depletes essential trace elements in the soil. This produces weaker plants more susceptible to pests and with lower nutritional content.

The average topsoil in North America’s agricultural land has, over the last two centuries, reduced from over ten feet to less than six inches on average on commercial farms⁵. This has turned ‘black gold’ or topsoil into ‘gold’ for a farming model based on moving on when soil is depleted.

Appreciation that soil is a principle capital asset to be valued, conserved, held in trust and renewed is the integrative view. Crop rotation or companion planting methods, as developed in permaculture and in biodynamic agriculture⁶, holds renewal of topsoil as essential to pest resistant, nutritious food. Topsoil quality is a reflection of that community’s social contract, and is held as high value within such communities. Leave the land better than you found it is a guiding principle of sustainable farming.

Paul and Betty Keene, founders of Walnut Acres, provide an example. Neighbors who used organic farming practices surrounded their biodynamic farm.

Biodynamically grown plants were resistant to pests even as organic and commercial farms surrounding Walnut Acres had their crops eaten to the ground by weevils, locusts or other pests⁷. In this sense, ‘pests’ are indicators of weaknesses in the plants. Highly healthy plants are observed to be resistant to pests. This provides opportunity to enrich the environment, improve community nutrition, improve soil quality and reduce hospitality to pests and predators.

The assumptions upon which both mechanistic and integrative views rest are reviewed below along with their major social and biological implications⁸.

“Life forms or ‘biota’ become the result of what they choose to eat, drink, ‘think’, and do. Consumption, mobility and mindful awareness determine the quality of each life.”

Russell Jaffe & Sam Dech Preah Ven Bhanthé V. B. Dharmawara

Each biota transforms what it has available and selects to ingest, digest, assimilate, utilize, and eliminate.

Biota either symbiose beneficially or parasitize harmfully other life forms⁹. Neutrality is not observed in biology. Symbiotic biota benefit mutually. Parasitic biota reflects impairment or imbalance in the hospitable host environment. The interdependence of human biota and the rest of biology are increasingly clear. This interdependence remains largely unappreciated in medical practice, finance and healthcare policy¹⁰.

With regard to the ‘symbiants thrive’ premise developed here, the following observations may be helpful in regard to human, anthropogenic interactions.

Differing value systems have different implications for quality of life, wealth and health disparities that develop as well as social cohesiveness and the resilience of civil society based on social and economic values discussed later.

Mechanistic and reductionist approaches assume independence from the consequences of actions toward other biota being modest or, at least, mitigate-able¹¹. Advances from the Renaissance through the Industrial periods are largely

examples of this extractive approach that yielded net benefit in comfort and security¹². Advances in this Post-Industrial period are largely examples of approaches that yielded net *negative* benefit in comfort and security¹³. Waiting for disability or disease to emerge and be treated is too limited to deliver sustainable good health¹⁴.

This integrative or systems orientation is based on the observation of interdependence and that consequences of actions toward other biota may have profoundly significant or potentially catastrophic unforeseen consequences¹⁵. “Comprehensive”, “Molecular”, “Holistic”, “Wholistic” and “Oriental” are included in the term “Integrative”¹⁶.

(See Table 1. Comparison of Disparate Views: Mechanistic and reductionist are compared to Integrative and Biomolecular)

Table 1. Comparison of Disparate Views: Mechanistic and reductionist are compared to Integrative and Biomolecular

Category or Weltanschauung¹⁷	Mechanistic and Reductionist or ‘Western’ View	Integrative and Biomolecular or ‘Eastern’ View
Assumption	Mankind dominates nature	Mankind participates within nature
Consequences (best case)	Comfort and greater security with reduction in fear	Practice participation in awesome nature of life and greater security with enhancement of compassion
Consequences (worst case)	Extraction of wealth that leaves expensive to repair distortion in its wake	Re-do because impacts are local and only sustainable successes spread
Application in commerce	Nature to be tamed and controlled	Nature to be appreciated and emulated
Marketplace premise	Labor verses management; Boom and bust cycles	Labor and management; Sustainable prosperity
Dominant period: Renaissance to Industrial Revolution	Use of gears, levers, steam and stream power,	Arts and sciences flourish
Dominant period: Post-Industrial Revolution	Discovery of novel chemical and electromagnetic solutions that assume safety until harm largely proven and leave biota largely worse for the interaction	Rediscovery of biochemical and vibratory solutions that assume risk until safety proven and leave biota largely better for the interaction
Preferences and values	Mankind dominant, Geo-centric, Isolated within Universe, Theocratic kingdom, Acquisitive capitalism, and Isolationism	Biomimicry preferred, Cosmo-centric, Enfolded within Universe, Anthroposophic realm, Natural capitalism, and Holism or Wholism
Risk to reward ratio	Progressively unfavorable	Progressively favorable

The era of fighting illness, suppressing symptoms, and replacing worn out parts is waning. So is the detached, reductionist, mechanistic thinking of the body as an elegant object to be manipulated. This approach has largely driven policy and practice for the past three centuries¹⁸. The risk to reward ratio is progressively unfavorable or reaching beyond its peak and returning toward its minimus.

The era of engaging health, restoring well being, and renewing self-sustaining, homeostatic mechanisms is waxing. So too the engaged, relative, and biologic thinking that views life as an integrated wonder. This approach is likely to yield smarter policy and practice decisions for centuries to come¹⁹. The risk to reward ratio is progressively favorable. Virtuous cycles of sustainable prosperity can replace vicious, boom and bust cycles.

Nature of transitions is disruptive: Helpful transitions are symbiant based

Transitions, on any scale, are intrinsically disruptive²⁰. Examples of helpful disruptive transitions within this report's time frame are those from:

- Horse and carriage to hypersonic airplanes for mobility and transport.
- Abacus and slide rule compared to the super computer for doing math.
- Candle to the LED light bulb for illumination.
- Outhouses to pressure sensitive, temperature controlled commodes.
- Peat and coal to algae-generated hydrogen as fuel for heat.
- Largely suppressive therapies and gross surgery to stem cell and immunomic therapies for health.

Mechanistic science produced wonders of technology premised on the body wearing out, running down, and needing to be triaged during that inevitable

process.

The reductionist view is based on statistical means and compares people to statistical ranges. The integrative view is, however, mutually exclusive. This biological symbiant view looks at the splay of data and compares biota with them seeking the fullest possible attainable expression for each. The fundamental substantively different building blocks of the intellectual tool-kits, the social fabric that is constructed from them, as well as the driving values that emerge from either the mechanistic view or the integrative, biologic and homeostatic.

- In the mechanistic view, nature is to be monetized and replaced when worn out. Converting black gold of topsoil and liquid gold of petroleum to solid gold bars and bionic replacement body parts²¹ at ever-higher costs are results of lives lived frenetically and out of balance; *Koyaanisqatsi*²². ‘Them that has the gold makes the rules’ is a *liet motif* of mechanistic societies.

In the integrative view, nature is a sustainable process and renewed by prudent trustees for generations yet to come. Biotic products and ghee or clarified butter, are the ‘liquid gold’ or ‘concentrated sunshine’ in this view. Continuously improving the topsoil as a sacred trust, through use of renewable fuels and methods assuring agricultural surplus with high plant resistance to pests and high nutrient density. Consequently, they are key to what we know as civil society, particularly the relevance of science to society and vitality in the arts. ‘Them that has the gold’ are ‘stewards and trustees for future generations’ is a *liet motif* of integrative societies.

- In the mechanistic view, descriptions of watchmakers, assembly lines, and wars abound. Decline in function from young adulthood through the end of life in statistically normal people, who may be far from well, is taken as confirmation that, however elegant, the body wears out rapidly enough that bionic replacement parts and lifetime therapies aimed at inhibiting some biological function are given priority in funding, in intellectual property, and in the marketplaces of ideas as well as products.

In the Integrative view, descriptions of guardians, gardens and civil society abound. A careful look at the full data shows decline in function from young adulthood through the end of life in average or 'normal' people is actually the product of selective disuse, essential nutrient lack, toxin excess or unresolved distress that results in progressive loss of function. This is seen as opportunity to renew, rebuild, restore and maintain the highest level of function attainable by the individual through the entire lifespan with only modest need for 'heroic' interventions. By recognizing individual variances over time, it becomes clear that the body can be guided to rehabilitate, in almost all cases, even when 90% of the original gland or system has been destroyed. Therapies aimed at promoting, renewing or enhancing biological functions are given priority in funding, in intellectual property, and in marketplaces of ideas as well as products.

- In the mechanistic view, policy and practice are largely based on opaque, laissez faire and marketplace-dominated solutions where short-term profit often dominates decisions and priorities.

In the Integrative view, policy and practice are largely based on transparent, cautionary principles and sustainability-driven or wisdom based solutions where renewable vitality and sustainability are the essential criteria.

- In the mechanistic view, engineering and rigidity are high priorities. Industrial, financial, and intellectual systems tend to aggregate. When such systems too tightly couple, amplification of negative human qualities and vicious cycles are enabled. The boom and bust cycles of extractive mining, over-leveraged banking, and opaque money making schemes are examples. This approach to disease and life management is largely reactive.

In the Integrative view, bio-mimicry and resilience are priorities. Industrial, financial, and intellectual systems tend to disintermediate. Such systems remain flexible and resilient through autonomy and virtuous cycles are enabled. Sustainability and improvements in the common good are values in sustainable mining, prudent banking, and transparent money making schemes. This approach to disease and life management is mostly proactive.

- In the mechanistic view, “how much” and “how large and novel” are high values. The gross is appreciated and sufficient. The subtle is met with skepticism and cynicism. Examples are gross anatomy, gross domestic product, gross approximations, and gross noises. While valid, these approaches are limited to approximations and statistical comparisons.

In the Integrative view, “how well” and “how sustainable and

renewable” are high values. The gross is acknowledged and insufficient. The subtle is included with appreciation and embraced. Examples are molecular biology, well-being index, nano-details, and nature’s sounds. These approaches integrate exact yet often seemingly counter-intuitive details and individual appreciations.

- In the mechanistic view observers are disconnected from what is observed and isolation emerges as an illusion of detachment. Absence of data is often taken as absence of effect. When we know little, effects are often obscured or seem disconnected. History is often forgotten. Lessons are relearned and seen as dangers.

Integrative view, when observers are recognized as participants and subjects, systemic inter-connectednesses, effects and patterns emerge more clearly. Mindfulness practices that cultivate nonattachment abound. Anticipatory data is collected and intensively modeled using global and historical data. History is remembered and new challenges can be embraced as opportunities.

- In the mechanistic view, the meanings of evidence in science and in the law are orthogonal. Hypothesis exclusion dominates scientific method. Observers are isolated from what they observe. Precedent and ‘divine writ’ dominates in the law.

In the integrative view, evidence in science and in science courts start with common meanings to key concepts and common agreement on evidentiary process and qualifications of experts. Experience of hypotheses leads to harmonization of values and goals; of outcomes desired and incentives provided in scientific

method. Observers are enfolded within what they observe. Organic, Talmudic, Adwar-Vedic methods dominate in the law.

- In the mechanistic view, problems are solved on the level they are created. Analysis and consensus of the experts are principle problem solving tools.

In the integrative view, problems are solved at a higher level than their creation. Experience and consensus of the affected are principle problem solving tools.

- In the mechanistic view, by making nature an object to exploit, the cost of devastating an environment is modest, the short-term profits are high and reaped by a few while the cost of restoring 'the commons' is enormous. Social pressures to avoid these devastations are modest.

In the integrative view, by appreciating the interconnectedness of all life, the cost of devastating an environment is seen as too risky, the trustees of future generations see short-term profits as piracy and the cost of renewing or sustaining 'the commons' is modest. Social pressures to avoid these devastations are strong.

- In the mechanistic view, bodies are fueled by calories that are largely perceived as interchangeable. 'A calorie is a calorie' as Fredrick Starr frequently opined. Fast food and an agricultural system driven by quantity rather than quality emerge. The social values of eating in community are minimized and disincentivized. Gratitude is ignored or taken for granted.

In the integrative view, bodies are fueled by complex, interdependent systems that are assessed by their overall resilience, proficiency, and results. Slow food and an agricultural system driven by quality rather than quantity emerge. The social values of eating in community are maximized and incentivized. Gratitude is valued or appreciated.

- The mechanistic view experiences body, mind, and spirit as distinct and independent. The dichotomy between mental and physical health that burdens healthcare practices and policies grows from this assumption.

The integrative view experiences body, mind, and spirit as integrated and interdependent. The eternal braid between physical, mental and spiritual aspects of life is appreciated.

The ten comparisons of mechanistic and integrative views are summarized in the next table.

<Table N TBA. **Comparison of Mechanistic and Integrative Views**>

Consequences of the mechanistic view include the planet marinating in ever more complex electromagnetic smog and chemical soups without the usual slow onset that allow for adaptive mechanisms to cope or compensate to the extent possible.

The accelerating pace of change is a substantial distress for all life. Life is experienced as based on a will to dominate, subdue, and otherwise

tame nature²³. Life is generally seen as a collection of objects rather than communion of subjects²⁴.

By comparison, integrative views recognize that nature responds to nurture at all levels. Rain forests are being re-grown from spent oil palm plantation desolate land devoid of all biota in just eight years by applying integrative permaculture and biodynamic techniques rather than the 50-200 years to re-grow a rain forest projected by computer generated, 'nature to be controlled' models²⁵. The rain forest Willi Smits has crafted in just seven years at Samboja Lestada in Kalimantan Indonesia is a living example. A novel combination of high touch and appropriate technologies are thus converged.

The accelerating pace of change is welcomed as challenge and opportunity by those appreciative of the opportunities thus presented to attain progressive aequanimity. Life is experienced as nurtured by, intimately connected with, and participant in nature. Life is generally seen as a communion of subjects²⁶.

Further, information and economic bias prevent too many from access to actionable, safer and more effective solutions to their personal or community issues. Results achieved by respectfully applying biology and following sustainable feedback evidence are the more likely path to successful balance between innovation and survival.

The predominant intellectual tool kits typically used by each perspective and thus progressively shape their experience of life.

(See **Table 2. Comparison of Intellectual Tool Kits**)

Table 2. Comparison of Intellectual Tool Kits

Category	Conventional, Mechanical	Emergent, Integrative
Intellectual high point, Context	Descartean, Pasteurean, Newtonian, Mechanistic, Reductionist	Einsteinian, Béchampian, Feynmanian, Relativistic, Electrodynamic
View of natural world	Nature is to be monetized, & replaced when worn out	Nature is sustainable source & renewed by prudent trustees for generations to follow
Descriptors	Watchmakers, machines, wars	Guardians, gardens, peace
Policy & Practice Values	Laissez faire, market driven	Cautionary principles, sustainable communities
Priorities	Engineering, rigidity	Biomimic ry, resilience
Preferences	More and bigger	Sufficient and sustainable
Consequences	Marinate biota in a chemical & electromagnetic soup, supported by limited evidence	Sustainable innovation; constructive disruption to innovate healthier, more sustainable technologies
Risk management	Absence of data often confused with data of absence of effect	Deep observation includes rich data to mine for possible effects
Aphorisms	Them that has the gold makes the rules for society	How we care for the least among us tells much about us as a culture
Relationship to natural world	Mankind subdues nature	Mankind nurtured by and within nature

Assumptions compared

Conventional, reductionist, mechanistic assumptions are precedence-based and/or fiat-based. The frequency and intensity of stressor is unprecedented. This largely uninformed and poorly documented experiment in restructured living is based on the following six governing assumptions²⁷:

1. Chemicals and electromotive forces (EMF) are safe until proven harmful,
2. Innate protective factors will compensate and reduce harm,
3. Toxicants have linear dose-response curves,
4. Xenotoxins have additive and predictable interactions,
5. The biosphere can trap, dilute, and safely metabolize anthropogenic toxins,
6. Regulation is best used to respond to problems that emerge.

These six assumptions seemed reasonable when formulated in the 18th - 20th century. Novel industrial chemicals became the basis for wealth and a transient abundance that, in turn, influenced social and political decisions toward later regulation. The priority was to promote and not to limit or restrict the engines of economic growth²⁸.

With hindsight's benefit, each of the above six assumptions turns out to be *fatally* flawed as applied. All too often the cumulative effect has had significant global costs²⁹.

“The philosophies of one age have become the absurdities of the next, and the foolishness of yesterday has become the wisdom of tomorrow” is appreciated anew³⁰.

One era's orthodoxy indeed becomes the next generations heterodoxy and vice

versa³¹. Pendulums swing; bubbles burst; trust deserves evidence-based verification. Deeper understandings lead to unexpected experiences that are experienced as dangers or opportunities by the pace at which they come and the re-thinking needed to appreciate their value and implications.

The following are extrapolations of the above assumptions based on learning from history's lessons. Much available data is recent and still incomplete. What follows best fits currently available data. This enables more predictive modeling or scenario building so that consequences can be better foreseen, better anticipated.

A 'best fit' of available data yields a sobering present and futures that range from dystopic to eutopic. Choices being made now are likely to have amplified consequences because of the current *lack* of resilience factors replenishment in biota that have the signature of anthropogenic cause. Models³² and scenarios³³ are included to help clarify some of the complexity.

<insert visual of summary of John Sterman and CDC models and Jay Ogilvy scenarios>

Choices, causes and consequences

Chemicals, electromagnetic fields and radioactive elements with long histories in the biosphere have well known traditional safety and risk profiles³⁴. Often referred to as natural products and native fields, these are in contrast to novel anthropogenic chemicals and EMF, often at levels or concentrations far from what biota have been previously adapted³⁵.

Full safety tests are needed *before* general use permits are issued to newly created chemicals that are found to persist and to build up to more than ten

times background ambient, historical levels. This is to avoid the examples below where initial trust of safety or acceptable toxicity was *not* supported by follow up observations from the field. This experience can teach us how to *avoid* such consequences going forward, as they are much harder and more expensive to clean up for or from afterward.

This approach derives from the heretofore-unexpected disruptive effects and interactions of some chemicals and/or electromagnetic radiations known in aggregate as xenotoxins.

This approach also provides incentive for biomimetic approaches that waste not and reutilize components in ways that can be described as ‘cradle to cradle’ rather than ‘cradle to grave’.

Parallels between macro and micro biota include:

- Health of the ocean³⁶ parallel to cell fluid³⁷ as they both acidify,
- Rain forests³⁸ parallel to lung health³⁹ as they erode due to oxidative stressors,
- Impaired health of agricultural topsoil⁴⁰ parallel to the body’s connective tissue ground substance (cellular topsoil) as their repair competencies decline⁴¹.

Seveso⁴², Bhopal⁴³, Exxon Valdez⁴⁴, Chernobyl⁴⁵ and Three Mile Island⁴⁶ serves as graphic examples from which there is still much to learn about risk management and risk mitigation.

Examples of anthropogenic chemicals, fields, and isotopes include:

- **Toxic minerals (TMs)**⁴⁷ with lead⁴⁸, mercury⁴⁹, arsenic⁵⁰, cadmium⁵¹, and nickel⁵² as the most studied examples.
- **Volatile organic compounds (VOCs)** are solvents like trihalomethanes (THM) such as chloroform⁵³, methylene chloride⁵⁴, and ethylene chloride⁵⁵, as well as benzene⁵⁶, xylene⁵⁷, toluene⁵⁸, furans and ethylbenzene (BXTE)⁵⁹.
- **Persisting organic pollutants (POPs)** include hormone disruptors⁶⁰ such as diethylstilbesterol (DES)^{61,62}, phthalates^{63,64} and bis phenol A (BPA)⁶⁵; PCB/PBBs⁶⁶ and dioxins⁶⁷ as well as formaldehyde⁶⁸, fiberglass⁶⁹, milled mica (asbestos)⁷⁰, biocides such as chlordane, kepone, heptachlor and malathione⁷¹, mood⁷² and pain modulators⁷³ among other medications.

While VOCs are typically solvents, POPs are typically plasticizers, pesticides, herbicides, fungicides, antibiotics and preservatives. In addition, the levels of medications, biocides and other chemicals downstream from pharmaceutical and chemical manufacturing facilities are substantial while rarely removed by water treatment or other environmental actions. Concern grows as VOCs and POPs contaminate and build up in ground water used by plants and in drinking water used by people⁷⁴.

- **Electromagnetic fields**⁷⁵ (EMF), electromagnetic radiation⁷⁶ (EMR) and sometimes known as electromagnetic smog⁷⁷. The extremely low frequencies (ELF), particularly those that resonate at brain wave

frequencies sometimes have subtle yet cumulative distress or resilience reducing consequences⁷⁸.

For electromagnetic smog⁷⁹, studies are barely beyond anecdotal and pilot stage⁸⁰. Examples of electromagnetic smog include visual, acoustic, sensory, somatic, and piezoelectric pollution of the environment, and their resonance with or transparency to, the organism or situation in question. Biological resonance gives reason for caution because the input energy can destabilize the receiving structure or function. Biological transparency reassures because it means passive interaction and no perturbation of the organism or its environment⁸¹.

- **Radioactive isotopes**⁸² include naturally occurring radon and tritium as well as anthropogenic radioactive elements such as plutonium, uranium 235, iodine 125 and 131, cesium 137, strontium 85 and other heavy yet unstable and therefore radiation-emitting isotopes largely man made or concentrated by human ingenuity⁸³.

Larger, even better designed studies are needed to assess more fundamentally the *processes* by which we introduce and interact with technology. A balance between safety, comfort, convenience, cost and consequences is possible⁸⁴. Priority deserves to be given to collection of actionable information. Incentives are usually more cost and outcome effective when they are evidence-based, employ end-use / least-cost efficiencies, and integrative in scope⁸⁵.

The extent and impact of these anthropogenic chemicals on daily life is profound, perplexing and too often distressing. This is more

striking, given that less than four percent of chemicals in commercial use have been well studied to date and barely 0.04% for interactions among them (See section 3, **Issue Dimensions** below)⁸⁶.

Protective factors operate only in states of health⁸⁷.

Combinations of distress, nutritional deficits, and cumulative toxin exposure can shift cells into survival mode wherein elective protective mechanisms are down regulated so that the cell can survive the acute situation. Interactions between distress, nutrient deficits, and toxin exposures can be either positive or negative depending upon their aggregate amounts, interactions, and stress resilience of the biotic form exposed.

For too many, survival mode becomes the habitual state within which the person or organism operates with marginal, rate limiting availability of essential nutrients and learned adaptations to stressors. Environmental degradation can create synergies of additional distress. Chronic, degenerative, autoimmune, developmental, and fertility syndromes emerge coincidentally and, on a statistical basis, are linked.

<insert **Table 3.** Chronic, degenerative, autoimmune, developmental and fertility syndromes causes by acquired host function impairment>

This is because of both human and environmental, cumulative repair deficits also known as inflammation, often amplified by oxidative and perceived stressors. Clinically, autoimmune conditions usually co-exist. For example, adult diabetes, inflammatory bowel diseases and thyroiditis commonly co-exist. When one autoimmune condition is found, looking for others is likely to be productive.

Biological protectors include metallothioneins and oxidation-reduction regulators known as antioxidants.⁸⁸ They accept and deliver an electron's energy without harm and transfer that electron to a productive acceptor. Absence or insufficiency of antioxidants results in oxidative stress and free radical damage to delicate cellular systems. Metallothioneins soak up toxic metals and prevent their contribution to oxidative stress and antioxidant consumption. Oxidation-reduction regulators include ascorbate, glutathione, tocopherols, coenzyme Q10, B complex and most other vitamins and minerals such as potassium, magnesium zinc, chromium, and selenomethionine in their ionic form⁸⁹.

Toxicants often have hormetic, amplified effects and non-linear dose effects⁹⁰.

Xenotoxins often occur in uncontrolled combinations with synergies of toxicities and adverse effects that become multiplicative due to the under appreciated synergies of effects at sub-molecular and biotic levels⁹¹. Xenotoxins are the toxic assets of biology; the compounds that are taken in and increase risk or induce harm in that organism under those conditions.

TM, VOC, POP, EMF and radioactive element mechanisms of action are often so subtle that sensitive and predictive measurement systems are just now becoming available to allow effects to be systematically studied and reported⁹². While not surprising in retrospect, the effects of compounds that persist in the environment is that decades or generations too often separate exposure and effects. Children and the elderly, the poor and those with health disparities are disproportionately at risk and least likely to be studied⁹³.

Paradoxically, and in part to protect them, children and the infirm have been understudied in controlled experiments of anthropogenic effects on health⁹⁴. This means the more at risk or vulnerable populations are often under studied.

The **biosphere** has a large but finite capacity to neutralize anthropogenic toxins that persist in the environment⁹⁵. When near saturation, systems show unexpected perturbations and then dysfunctional locking together or *loss* of variably variable resilience just prior to catastrophic collapse. These behaviors are largely unpredictable from the stable, *i.e.*, homeostatic state⁹⁶. These responses leave both cellular and planning or policy systems bereft of adaptive solutions that are effective and available⁹⁷.

Regulation can be used to sustain transparency and opportunity to anticipate avoidable problems based on globally available information⁹⁸. Anticipatory process includes interdisciplinary information sharing and systems thinking. Avoidable problems are those where, by not remembering history, very similar mistakes are too often repeated^{99,100}.

This is particularly important when 87% of what is conventionally done in medical practices is by convention rather than from an evidence basis, according to the Office of Technology Assessment of the U. S. Congress in 1987¹⁰¹ and updated several times since^{102,103,104}.

The glacial rate of curricular change in medical schools over the last thirty years suggests an opportunity for a new ‘Flexner Report’ to do what the original report catalyzed a century ago: A transformation of medical education from largely mentored and pluralistic to science based and

medical center focused. It is time to return to technology in service of humanity.

The departmental and reductionist approach that achieved much in improving public and personal health in the 20th century. The emerging trans-disciplinary and integrative sciences show signs of yielding more caring and competent health professionals to help restore the sustainability of other life forms.

**Biological Complexity, Homeostasis, Unity of life and Disease Risk:
Flight, fight or *insight*... there are *three* choices.**

“... that a disease is complex or multi-factorial does not imply that simple solutions cannot be found or that clinical advance following insight cannot be swift.”

J. A. Rees, *Science*, 2002; 296:698-701

Biota created and sustained the conditions for life using a non-toxic subset of the chemical periodic table with water as the universal solvent and 100% recycling. The unfolding of life has operated under more or less constant environmental conditions allowing the laws of biochemistry and biophysics to entrain sub-molecular quantum electro-dynamic events and macroscopic order emerges¹⁰⁵.

Life, then, may be understood better as interconnected rather than isolated biota.

The biosphere regulates the planetary environment. The biosphere adapts to the physical state of the planet enabling astonishing biological diversities. Life systems adapt to and adjust the environmental milieu, allowing life to sustain and fully express itself. As our scientific understanding advances, this remarkable

reciprocity of life, where everything fits together ‘just right’, grows more complex and more interrelated is revealed. Taken together, this is descriptive of biota practicing parsimony¹⁰⁶.

Better known for the Henderson-Hasselbach equation about chemical acid-alkaline balance, Henderson expressed appreciation for the unity and symbiosis of life:

“The properties of matter are the course of cosmic evolution are now seen to be intimately related to the structure of the living being and to its activities; they become, therefore, far more important in biology than has been previously suspected. For the whole evolutionary process both cosmic and organic, is one, and the biologist may now rightly regard the universe in its very essence as bio-centric.”

Lawrence J. Henderson, *The Fitness of the Environment*, 1913

The vast spectrum of life emerging with such varied patterns of morphogenesis; such an astounding array of sizes and shapes; surviving in such wide ranging habitats; using such vastly different feeding and reproduction patterns, yet using but one universal metabolic palate derived from just a handful of simple molecules¹⁰⁷.

Despite or because of mass and individual extinctions and environmental pressures, the core metabolism of life has remained unchanged across planetary time and the extremes of environment. The biochemistry of archaea, monocellular organisms, dinosaurs, ginko trees, and all biota maps to a single common core of intermediary metabolism. This universal biochemistry of life has shown a remarkable stability and invariance. This biochemical palate reveals fundamental constraints and optimizations of aqueous, carbon based life¹⁰⁸.

While elegantly simple, homeostasis is simply elegant in balancing biology's complexity. To appreciate homeostasis in biology, one needs to appreciate that life exists at non-equilibrium conditions. "...the complex phenomena demonstrated in systems characterized by nonlinear interactive components, emergent phenomena, continuous and discontinuous change, and unpredictable outcomes. Complexity is usually understood in contrast to simple, linear and equilibrium-based systems."

Anthropogenic actions threaten the homeostatic resilience of cell functions¹⁰⁹, primarily from the cumulative forces of xenotoxins coupled to increased unresolved distress with concurrent decline in nutrient density and physical activity. Eating more calories with less essential nutrient yet more xenotoxin content when coupled with mobility and activity decisions dominated by short-term convenience and comfort are examples of how to lose homeostatic ability to reset and re-equilibrate. Fertility, developmental, metabolic and autoimmune disorders emerge as consequences of homeostasis loss.

Healthy organisms operate far from equilibrium states, manifesting properties that arise from an astonishing array of non-linear, anabolic and catabolic interactive components with unpredictable outcomes.

The human body is an integrated heterogeneity of local autonomy operating within system wide coherence over wide orders of magnitude: 10^{12} in space, 10^{27} in time, coordinating 10^{15} cells (including gut and skin organisms) with a total of 10^{27} molecules participating in over 10^{10} reactions each second occurring in cells with a collective membrane surface area of 10^6 square meters¹¹⁰ with an as yet uncalculated number of independently functioning micro-compartments creating localized energy circuits and autonomous molecular systems that are able to function without obvious connection to the larger organism¹¹¹ yet able to handle a

multitude of internal and external stressors or perturbations.

In this resilient state the organism is able to handle environmental challenges. The introductions of anthropogenic toxins are increasingly documented to disrupt biological control systems sometimes in vanishingly small amounts and often with synergistic disruption of cell or system fundamental components¹¹². This is discussed in more detail below.

Developments in complexity theory, systems biology and informatics point to how a resilient state occurs through the amalgamation/cooperation of feedback, information processing, and inter-connected networks. The ability of self-organizing, complex adaptive systems to deal with perturbations and maintain homeostasis is fundamental to living systems¹¹³.

Claude Bernard, the father of modern physiology, stated “... all of the vital mechanisms, varied as they are, have only one object: That of preserving constant the conditions of life in the milieu intérieur...”¹¹⁴ raising in western science the idea of physiological stability.

The re-emerging concepts of self-restoring systems were developed by Holmes¹¹⁵, Osler¹¹⁶, Underhill¹¹⁷, Pavlov¹¹⁸, Cannon^{119,120}, Selye¹²¹, Maslow¹²², Thomas¹²³, Gold¹²⁴, Glaser and Kiecolt-Glaser¹²⁵ and McEwan¹²⁶ and have become known as feedback auto-regulation of stressors or homeostasis.

The ‘flight or fight’ response dialectic we suggest deserves to be extended as ‘flight, fight or *insight*’. The option of being at peace while under stress or of being able to resolve conflict rather than flee or fight is an extension of this much quoted but too limited dicta.

Biota also have syncopated rapid change under environmental pressures such as during the ‘Precambrian Burgess shale’ period studied by Stephen Jay Gould and colleagues¹²⁷ providing us models of what happens to biota under extreme adversity.

The Earth stewardship championed by Gifford Pinchot¹²⁸, Rene Dubos¹²⁹, Buckminster Fuller¹³⁰, Thomas J Berry¹³¹, Amory Lovins¹³², Eric Chivians¹³³, Brian Swimme¹³⁴, Fritjof Capra¹³⁵, Edward O. Wilson¹³⁶, and Richard Cizik¹³⁷ serve as examples of how to live in harmony rather than in contention with other biota. Huang Ti¹³⁸, Hippocrates¹³⁹, Galen¹⁴⁰, Maimonides¹⁴¹, Avenenna¹⁴², Ashoka¹⁴³, Zarathustra¹⁴⁴ and Tilopa¹⁴⁵ are the wise shoulders on which this rests.

As applied to a logical understanding of disease, mechanistic ideas lead to modern allopathic medicine’s primary focus on comparison to statistical ‘normal or usual reference values’ and the use of medications to mangle out of range results or findings¹⁴⁶.

The mechanistic approach has applicability when a specific factor is isolated and responds to a unitary intervention¹⁴⁷. This approach has severe constraints when applied to complex disease processes where multiple causes and multiple systems are involved¹⁴⁸.

Biologic Cycles and Complexity:

Elegantly simple; simply elegant from cradle to cradle

He uses statistics as a drunken man uses lampposts... for support rather than illumination.

Andrew Lang, (1844-1912), Letters to Dead Authors (1886)

Complexity and network models of biological systems provide novel insights. Homeostasis emerges as a property of such biological networks and their interconnections rather than functioning as an autopilot in an airplane. The body stands in contrast to how mechanical machines are built. In the mechanical world, starting from a genetic blueprint, parts are brought together to create a functioning unit¹⁴⁹.

In contrast, life emerges as an integrated whole at all levels — from genes to modulated genetics known as epigenetics or metabolism in organ systems, with the remarkable ability to demonstrate both local autonomy and long range interconnectedness. These awesome actions span over 10^{16} orders of magnitude in space and in time while sustaining homeostasis and health. Further, at room temperature, biota demonstrates quantum mechanical properties of superconductivity, coherence, and non-local interactions, now that we have the models to appreciate and the sensitive tools to confirm such actions¹⁵⁰.

Kauffman simulated genetic networks by stipulating a range of values in the number and strength of connections in the elements of a network that for nearly all values, as long as the elements were interconnected, the system achieved order and stability. As he expressed the stability of interconnected networks need not be planned but could obtain, “order for free.”¹⁵¹ His work suggests that there is Carnot cycle for non-equilibrium thermodynamics where biologic life exists as well as for equilibrium thermodynamics where only the life of the mind exists.

Chauvet uses mathematical modeling of biological systems to show that the organization of cells, tissues, organs, and organ systems could arise spontaneously to create a stable state¹⁵². Systems biology sheds light on the need to analyze

metabolism by looking at the dynamics, how they are controlled and the overall design¹⁵³.

Interconnectedness with the Environment

“Man as been endowed with reason and creative powers to increase what has been given him, but so far he has not created but destroyed. There are fewer and fewer forests, the rivers are drying up, the game birds are becoming extinct, the climate is ruined, and every day the earth is becoming poorer and more hideous.”

Anton Chekov (1860-1904), *Dyadya Vanya*, 1899

The environment is not “out there”, separate and disconnected from people as assumed in reductionist thinking¹⁵⁴. We are within and interrelated with the environment as recognized by observation in integrative thinking¹⁵⁵.

The connections between people and the environment may be inexplicable¹⁵⁶.

- The water we drink has been recycled for eons inside the earth.
- The air we breathe is not continually created but exchanged with all organisms.
- The elements and nutrients of our bodies are from the soil; recycled with remarkable efficiency and lack of waste.

- All cells share the same susceptibilities to novel, long lived toxins. The expressions differ by species and biologic context.

The 20th Century brought a deluge of chemicals novel to living organisms.

- Ambient air is a chemistry lab, indoor pollution at home and work is often ten to one hundred times more contaminated with anthropogenic chemicals.
- Our food and water come along with xenotoxins, hormone disruptors or medications that passes through urban water treatment plants unprepared for their presence.
- Almost daily, studies find more adverse reactions at lower levels for chemicals previously believed to be safe. The more sensitive and specific the tests, the more easily documented are these profound yet previously under appreciated effects.

Polluting our surroundings, only to re-expose all life to these same xenotoxins due to their persistent recycling lacks common sense and is logically counterproductive. It helps to view biological systems using ecological principles, rather than reducing them to a compilation of multiple disconnected entities. We now know that we cannot isolate an organism from its place in its ecosystem or view ecosystems apart from the biosphere.

An understanding of life as a planetary phenomenon emerges. Science aspires to comprehend the processes of biogenesis, the transition from non-life to life. While Szent-Gyorgy pointed out that only biota maintains

unsaturated electron shells as a working definition of life¹⁵⁷, the basic and clinical implications of this observation have barely been explored.

Evolution is not so much “survival of the fittest, red in tooth and claw” as a network of cooperation and a ‘grand synthesis’ of outcome optimizations. It now appears that the relatively rapid emergence of life on the early earth was made possible by self-organizing metabolic systems that shared biosynthetic pathways¹⁵⁸. This biochemical universality has persisted throughout evolution and across all species, as evidenced today in a single chart of intermediary metabolism for all life¹⁵⁹.

At cellular and molecular levels, we are kin with all biota, from the mightiest to the least¹⁶⁰. We share the same core of carbon-based metabolism, the same energy currency, genetic code and basic cell structures with all earth’s biota¹⁶¹.

An awesome interplay occurs between the genome, metabolome, and proteome during disruptive transitions in gestational and neonatal development, during environmental niche adaptations and in response to stressors. Providing and acquiring resources from their surroundings, organisms in biota are active participants in maintaining and balancing their ecosystems¹⁶². Biological interdependence and stability emerged from this long history of interconnected webs with overlapping interactions¹⁶³.

With this understanding, it is helpful to view biological systems using ecological principles, rather than trivializing them to a compilation of multiple disconnected entities.

We now know that we cannot isolate an organism from its place in its ecosystem or view ecosystems apart from the biosphere and have a full appreciation of their strengths and risks. As we attempt to modify and finagle our surroundings, trying to influence and control individual properties of the living world, we really have no way of predicting the result and consequences. It is at peril of survival that we ignore or disregard these over-arching ecological principles that allowed life to develop sustainability.

A few examples linked to disruption in traditional eco-systems are the dramatic increase in chronic disease, the vulnerability of industrial agriculture, and the rise of antibiotic resistance, among others. The Mechanistic agriculture views bio-production units as objects to be used and exploited in contrast to integrative agriculture's view as co-dependent parts of biota. The integrative view is more sustainable.

Bio-mimicry emerges as an innovative approach to developing solutions to our problems by emulating solutions in the natural world. By studying biological principles and processes at all levels of organization scientists hope to provide sustainable solutions to human problems. From microbes to mammals, organisms have found what works and is sustainable. Life has engineered all of its amazing designs using a water soluble, non-toxic subset of the periodic table, at ambient temperature and with essentially 100% recycling¹⁶⁴.

Platform technologies are emerging from this work yet barely the surface of

biomimetic opportunities having been engaged.

Epigenetics includes nutrients, toxins, or environmental exposures that silence or activate gene expression after DNA transcription¹⁶⁵. This reality reframes the thinking about environment *or* genes. Particularly during fetal development, epigenetic changes can influence genetics at any time of life, setting the stage for a variety of resistances or illnesses¹⁶⁶.

Further, these epigenetic changes can then be passed on to future generations¹⁶⁷. Thus we are, quite literally, the sum of what our parents, grandparents, and great-grandparents ate, thought and did in the context of their environment. Indeed rats deprived of licking; a rodent's form of nurturing, produce more stress hormones from a loss of methylation by change in glucocorticoid receptor genes¹⁷⁷.

Decreased birth rates, increased birth defects and susceptibility to behavioral developmental disorders and decreased academic performance give pause and raise concern.

- **Scale:**

Global ecosystem disruptions occur as xenotoxins disperse throughout waterways, soil, and air. These disruptions remain challenging to calculate and accurately model. Conservative estimates include a reduction of 8.8 years of life for the average person in industrial society with the disease costs linked to TMs totaling at least \$100 billion annually¹⁶⁸. Similar tolls are taken by VOCs, POPs, and radionucleides. Given how limited and primitive is our data on their effects¹⁶⁹; it is likely that these are *under*

estimates of the true human and financial costs.¹⁷⁰

- **Potential to kinetic energy:**

Further, electrons are maintained in high-energy states without degradation to thermal background radiation with a flow of 800 amps in humans at rest over tiny RedOx electrical potentials in myriad overlapping cycles with a typical person having total membrane surface area of over 1.3 square miles, approximately the size of Central Park in New York city¹⁷¹.

- **Size:**

A typical cell is just 1/1,000 inch in diameter, has as many as 200 trillion molecules with a nucleus 1/4000 inch in diameter¹⁷². Within the nucleus enough data to fill 600,000 pages if read linearly.

Chemical reactions are estimated to transact at the rate of 500 trillion per second. Manufacturing, communicating, reproducing, digesting, excreting, each of these involve hundreds of enzymes that the cell itself constantly renews. All of this happens in a state of dynamic disequilibrium with continual repair and highly efficient recycling¹⁷³.

- **Integral health:**

To maintain metabolic good health requires the harmonious integration of vast arrays of molecules. Humans consist of $\sim 10^{15}$ cells including microorganisms in alimentary tract and on skin, containing $\sim 10^{27}$ molecules¹⁷⁴. The body is estimated to perform

over 500 trillion reactions each second creating, renewing and remodeling the structure and function of tissues and organs¹⁷⁵.

Integral to or masters of the natural world

“Humankind has not woven the web of life. We are but one thread within it. Whatever we do to the web, we do to ourselves. All things are bound together. All things connect.”

Chief Seattle (1786-1866) Suquamish chief,

1854 Address to President of the United States Ulysses S. Grant

When released toxins persist, we end up marinating ourselves in these xenotoxins as they diffuse and recycle, endlessly on a human time scale¹⁷⁶.

Issues include:

- **Absence of adequate developmental neurotoxicity testing** is a concern¹⁷⁷. The assumption of safety for novel chemicals introduced into the environment unless or until harm is proven to a level of scientific consensus has proven a costly error. For example, umbilical cord blood samples taken after birth find hundreds of xenotoxins, including many banned decades ago, as they persist and recycle in the environment^{178,179}.

- The **ability to adequately monitor pollutants**, when the levels that cause harm are below the detection limits of generally available laboratory testing. A more sensible assumption is the cautionary approach with the burden of safety on the source of a novel compound in regard to control system effects¹⁸⁰.
- **TMs, VOCs, POPs, EMS, and isotopes disrupt biological processes** in multiple, synergistic ways. Being essential nutrient deficient and being sedentary increase the above risks that include:
 - a. **Decreased ATP** and other high energy compound production that results in reduced energy for key cellular processes: Repair, digestion¹⁸¹, detoxification, immune function¹⁸², biochemical synthesis and elective protective mechanisms are sacrificed first in favor of survival needs¹⁸³.
 - b. Enzyme inhibition ensuring disruption in body **homeostasis**¹⁸⁴, metabolic control¹⁸⁵, detoxification, hormonal regulation¹⁸⁶, neurochemical balance¹⁸⁷, neurotrophic¹⁸⁸ information integration becomes disintermediated¹⁸⁹.
 - c. **Oxidative stress**¹⁹⁰ causing depletion of the body's antioxidant defenses, in particular glutathione and ascorbate that are vital to maintain the critically important oxidation/reduction ratio in cells, the RedOx cell potential¹⁹¹. If this ratio is increased, more free radical damage results causing widespread cellular damage, increased vulnerability to infectious agents, neuronal¹⁹² and system inflammation¹⁹³ with resultant system wide dysfunction due to permeability changes secondary to lack of repair, itself due to

dendritic cell under function¹⁹⁴. Recent research demonstrated at environmentally relevant exposure levels to chemically diverse toxicants increased oxidative stress that results in disruption in cell signaling pathways¹⁹⁵.

- d. **Cumulative repair deficits** identified by Jaffe¹⁹⁶ as chronic inflammation¹⁹⁷ in any part of the body that is stressed, exposed to xenotoxins or not getting all the needed nutrients¹⁹⁸.
- e. **Bioconcentration**, with consumption rate or half life from months to millennia, compared to seconds to hours for most natural compounds¹⁹⁹.
- f. **Binding to proteins** throughout the body and altering their structure, causing a wide range of adverse consequences often at the most active and vulnerable sites. The clinical results include hypertension and hypercoagulation syndromes, loss of homeostasis and loss of innate anti-cancer surveillance, and emergence of oxidative stress due to antioxidant deficits²⁰⁰.

Functional Developmental Xenotoxicology and System Sensitivity

“Survival of a complex system (cell) is constrained by the least available essential item.”

Russell Jaffe (1947-) based on Justus, Baron von Leibig, (1803-1873)

Neurodevelopment is exquisitely poised and tuned. Neurodevelopment usually operates so well that its remarkable complexity and interconnectivity, its adaptive

and self-correcting nature is easily overlooked or taken for granted²⁰¹. Brain development²⁰² is continuous, beginning early in embryonic life and continuing throughout the life span²⁰³.

Life is poised around metastable, multi-faceted oscillometers and inter-dependent cycles. When resilient oscillation gives way to rigid repetition, sustainability has declined²⁰⁴.

Anthropogenic perturbations can have profoundly subtle consequences at great distances in time and in space from the exposure²⁰⁵. Interlocked systems tend to interlock ever more tightly until they become too rigid and inflexible prior to catastrophic collapse due to vulnerabilities intrinsic to rigid interlocking within systems²⁰⁶.

As an example, the creation of neural networks requires an intricate process of sequencing and synchronization:

- **Differentiation** to be more and more specialized²⁰⁷,
- **Proliferation** to replace apoptotic, worn out cells²⁰⁸,
- **Migration** to go where needed or the milieu is more favorable²⁰⁹,
- **Axonal extension** to connect and reach out²¹⁰,
- **Synaptogenesis** so that nerves connect; impairment of this arborialization²¹¹,
- **Gliogenesis** to protect and repair nerves²¹², and
- **Myelination** to insulate nerves and facilitate information flow²¹³.

The above are organized around apoptosis or selective programmed cell death that results in neuronal pruning²¹⁴. This leads to a central nervous system (CNS) and a gut nervous system (GNS) with virtually instantaneous amplification factors up to seven orders of magnitude. This means immense information processing capacity for integrated sensory awareness and a sensitivity and efficiency at close to quantum theoretical and physiochemical limits with exquisite efficiency of energy transfer or conservation²¹⁵.

The **CNS** and **GNS** are able to:

- Respond visually to a single photon in the retina and a single photon in the enterocyte²¹⁶.
- Respond auditorily at near molecular vibration thresholds in the ear²¹⁷ and neurochemical oscillations in the gut associated lymphoid tissue (GALT)²¹⁸.
- Smell and taste a handful of molecules on the tongue²¹⁹ and the indoles, skatoles and polyamines that reflect colonic health and exquisitely stimulate olfactory nerves²²⁰.
- Sense minute pressure changes in the covering of the brain and on the skin²²¹.

Because of this complexity, sensitivity, connectivity and lengthy development, the human nervous systems²²² are susceptible to dysfunction and interference during each stage of growth²²³, with exquisite windows of pre- and post-natal vulnerability to xenotoxins and EMF^{224,225}.

Of significance, the developing brain is more sensitive to essential nutrient deficits, impaired detoxification, oxidative stress, and accumulation of TMs²²⁶,

VOCs²²⁷ and POPs²²⁸, than adult brains²²⁹. In addition, compared to adults, infants and young children are at greater risk from environmental exposures, because of their immature metabolic and detoxification systems as well as their higher body surface area and respiratory rates per unit body weight²³⁰.

Children are usually most at risk. Environmental pollution results in proportionately greater intake in children compared to adults. Compounding the problem, children's behaviors also result in higher exposures and intakes of toxins when compared to adults. This recognition has led to increased focus on children's health with several initiatives currently underway to document the depth of the problem²³¹.

We may not have the luxury of waiting until sufficient studies are done to reach scientific consensus before needing to assess the connections²³².

Detoxification: Staying Resilient in an Intoxicated World

”Foolish consistency is the hobgoblin of little minds.”

Henry David Thoreau, *Walden or Life in the Woods*, 1854

Our bodies have natural protective mechanisms and detoxification pathways. In good health the body manages successfully and excretes the total daily load of waste toxins, both endogenous and exogenous; both intrinsic and anthropogenic. Toxin excretion is the sum of the losses in urine, stool, sweat, and desquamated skin, lost hair and nails.

Human detoxification systems depend upon:

Antioxidant intake to neutralize free radicals and protect from oxidative stress.

Metallothionein ability to soak up and carry TMs safely out of the body. When the body is in healthy homeostasis, metallothionein is produced in abundance. When nutritional deficits or distress deplete the body, metallothionein production is down regulating as the cell switches to an internal survival or protection mode. As a consequence bioaccumulation of all TMs increases, increasing oxidative consumption of protective antioxidants.

1. **Liver** detoxification that transforms toxins to more water-soluble forms that facilitate elimination. Phase 1 conjugation, phase 2 sulfhydryl binding, phase 3 sulfation and lipotropic mechanisms are all involved.

Bile is a vehicle to eliminate fat-soluble toxins as long as the diet has enough fiber to bind such toxins and prevent their enterohepatic reuptake before elimination.

While 40-100 grams per day dietary **fiber** intake is considered healthy, typical Americans consume less than 10 grams per day. In addition to binding toxins for safer excretion, these fibers also act as pre-biotic sources for healthy pro-biotic intestinal bacteria.

Low temperature saunas (105-110°F) are able to reduce some toxins by mobilizing them into **sweat oils** that are excreted through oil pores on the skin. It is recommended to remain in the low temperature sauna until an oily sheet forms on the surface of the skin. A warm shower with loofa or wash cloth and castile or goat's milk soap to remove these oils before they are reabsorbed back into the skin.

Hair, fingernails, and skin that the body uses to slough or excrete toxins by depositing them in hair, nail, and/or skin. Daily sloughing of these tissues is about half a pound or 225 gm. This provides ample carrier for a few milligrams of daily toxins. It requires cell work or energy to deposit the toxins in the tissues on their way out. Health cells have abundance of energy to accomplish this task. Cells in survival or protective mode do not and this pathway of excretion is reduced proportionately to the cells energetic status.

These detoxification systems have worked since before recorded time. We now face comprised detoxification from TMs, VOCs and POPs for many reasons:

1. Exposure exceeding detoxification systems capacity,
2. Persistent low levels of unknown exposures to which the organism has limited capacity to adapt,
3. Long half lives of synthetic compounds causing bioaccumulation in the biosphere,
4. Affinity to bio-accumulate in particular body tissues,
5. Progressive inability to break down toxins due to impaired detoxification competences,

6. Nutrient deficiencies in essential items that can not be made by the body,
7. Individual genetic, epigenetic or attitudinal variations.

The 20th Century brought a surge of chemicals novel to living systems with unprecedented and unpredictable collateral effects. A reinforcing cycle too often ensues whereby toxicity decreases cell energy production that further impairs detoxification creating increased levels of toxins that decreases cellular energetics and can lead to accelerated, programmed cell death known as apoptosis or transformation into an abnormal cell that divides without stopping, often with deficits in Vitamins D3, vitamin A retinol, vitamins E tocopherols, tocotrienols and selenomethionine.

Diet and Lifestyle

Diet is critically important, as nutritional awareness is a defense against environmental toxicity²³³. Diets deficient in essential micronutrients make the system less able to handle toxins efficiently. Biodynamic or organic foods decrease pesticide exposure and provide increased levels of healthy minerals and nutrients to enhance detoxification. A nutritional regimen for ASD minimizes TMs, VOCs and POPs exposures and provides enriched nutrition to provides the needed essentials while facilitating biological detoxification. In addition to defense against environmental toxicity, proactive nutrition can have a positive impact on physiology, lipid function²³⁴, membrane information processing²³⁵, oxidative stress²³⁶, cell signaling²³⁷ as well as their role in genetic and epigenetic expression²³⁸.

Below are general recommendations. For more details, specific information and sources for healthier choices. (See Figure 4. **Recommended dietary choices to**

eat for health the Alkaline Way and green products guide²³⁹, Figure 5. Supplemental resources and Figure 7. Resource guides for healthier living).

Assessing and removing TMs

Assessment and removal of TMs requires specialized predictive and provocative tests that are sensitive, specific, and reliable. A professional is needed to appropriately assess toxic burden, determine how quickly or slowly to move these toxicants, choose comprehensive antioxidants and buffering minerals to enhance recovery and minimize effects of residual TMs²⁴⁰, monitor essential and toxic mineral levels, and monitor clinical progress.

The best source of information on the efficacy of toxic metal removal therapy comes from the Autism Research Institute's database of parent reports²⁴¹. Symptom improvement was reported by 76% of parents, the highest response rate of any biomedical intervention or drug therapy. No effect was reported by 22%, and 'got worse' by 2%. The better/worse ration of 38:1 was higher than for any other intervention. When there were side effects these were mostly transient and mild and included increased stimming, hyperactivity, and irritability.

Using foods that naturally remove TMs is also recommended. Garlic, ginger, onions, brassica sprouts, and eggs contain sulfur compounds that complex with and help remove safely TMs from the body²⁴². Similarly, adequate ascorbate (buffered vitamin C) and probiotics²⁴³ are known to accelerate TM removal from the body. Buffering minerals, particularly magnesium²⁴⁴ and zinc, facilitate TM excretion when present in healthy, sufficient amounts as indicated by first AM urine pH in the 6.5-7.5 range suggesting adequate cellular buffering capacity²⁴⁵.

Chelation therapy is sometimes criticized as 'unsafe and experimental'. As in any medical procedure there are risks and benefits that need to be fully understood. By

comparison, according to the American Association for the Study of Liver Diseases²⁴⁶, acetaminophen (Tylenol™) overdose is the leading cause for calls to Poison Control Centers (>100,000/year), accounts for more than 56,000 emergency room visits, 2,600 hospitalizations, an estimated 458 deaths due to acute liver failure each year, and is implicated in nearly 50% of all acute liver failure in the USA. Non-steroidal anti-inflammatory drugs (NSAID) such as Motrin™, Alleve™, and aspirin are documented to cause 16,500 ± 5,000 deaths per year, making them the 15th most common cause of death in the USA ahead of Hodgkin's disease, ovarian cancer, and asthma²⁴⁷. An estimated 103,000 hospitalizations per year are due to NSAID consequences²⁴⁸. Lower risk therapies to manage mild to moderate pain are often applicable but not provided. From stretching and acupuncture to hydrotherapy and acupressure, from massage to Pilates and Trager Mentastics, from Alkaline Way eating to ascorbate and polyphenolic supplements the presumed and implicit superior efficacy of 'magic bullet' therapies still dominates conventional care and mechanistic medicine.

The problem of being over-diagnosed²⁴⁹ and then over-dosed²⁵⁰ is coming into focus. From pain medications to sleep aides and antibiotics, from mood modulators to erectile dysfunction treatments, higher risk and higher net cost are accepted in exchange for the convenience of taking in something that will do to us what we need. The alternative is for us to be in relation to our needs, identify the healthier options or choices and implement them.

The result includes a 'silent epidemic of iatrogenesis'²⁵¹, with many physicians and most patients unaware of the issue²⁵².

When a physician prescribes an NSAID it is *not* usual and customary to warn the patient that they might die from the medication. An adverse reaction to acetaminophen or ibuprofen is part of the "standard of care". On the other hand, an

adverse effect from nutrients²⁵³ or integrative treatments, these make headlines disproportionately with the implications that the therapies are inherently unsafe²⁵⁴. Operationally and in the court of public opinion, these treatments are held to a higher standard of safety. It is misleading and costly to imply that functional approaches are somehow more dangerous than conventional standards of care. The facts show traditional medicinals to be as or more effective when appropriately applied and safer in terms of cost to treasure and life quality.

Towards an ASD Typology

“We will suffer for all we have done and only then will we understand how wonderful was our planet.”

Norm Schwartz (1948-) paraphrasing James Lovelock, (1919-),
The Vanishing Face of Gaia: A Final Warning: Enjoy It While You
Can, 2009

Analyses that presume ASD is a single condition with a spectrum of symptomatic expressions often miss subgroups because data averaging of the whole group obscure or ‘wash out’ the subgroup’s distinctiveness. Further, too often the absence of data is taken as data of absence.

To develop a comprehensive, functional and integrative model the following premises are suggested:

Look to molecular control points for vulnerable sites linked to developmental challenges.

Complexity theory, systems biology, network theory, and scenario planning are fundamental to appreciate these inter-relationships and reciprocating systems.

Epigenetic or phenotypic adaptations, preferably those that are low risk and internally consistent.

Engage the family as colleagues in observational assessments of what works for each person.

Physiology and psychology are optimized first using the measures and metrics of functional psychoneuroimmunology²⁵⁵ and metabolomics. Natural products and supplements are used to restore healthy levels of essential nutrients known as pharmacognosy. This allows for a higher gain, lower risk use of pharmacology. Compliance is better and side effects fewer when the physiology, psychology and pharmacognosy before pharmacology approach to evoking the healing responses²⁵⁶. Integrative medicine seeks to remove the obstacles to recovery and reinforce recovery competences. This includes appreciation of the capacities to heal often referred to as the placebo effect²⁵⁷.

Mitochondrial dysfunction^{258, 259} is now thought to be involved in over 30% of ASD cases²⁶⁰. Known disruptors include causes of oxidative stress such as TMs, VOCs, POPs, and nutrient deficient diets²⁶¹. Oxidative stress depletes glutathione²⁶² and ascorbate among other antioxidants; calcium and magnesium buffering minerals and other nutrient *deficits* made worse by metabolic acidosis or lack of buffering minerals in the diet. A parallel is observed in the acidification of the oceans due to CO₂ build up in the atmosphere²⁶³. Globally, the oceans absorb 22 million tons of CO₂ daily²⁶⁴.

Many of the metabolic and biochemical abnormalities in ASD are found in pathways that evolved early in evolution and are shared yet protected by all biology²⁶⁵. They have been preserved and protected over the eons because they protect the integrity of the organism. These core pathways are involved in the fundamental processes of life-energy production, detoxification, DNA expression, and membrane signal processing²⁶⁶. As such, they provide robustness and resilience to both internal and external perturbations when balanced. Recovery from imbalance when homeostasis is lost and survival mechanisms dominate is more challenging.

Studying the system wide dysfunction and altered biochemistry in ASD we find many core, conserved pathways to be adversely effected. These pathways are foundational to life, have been preserved and protected because of their critical control functions and homeostatic regulation and provide resilience from both internal and external perturbations as discussed below.

In order to provide a framework for understanding ASD and a correlation of behavioral response with altered molecular and cellular function. This suggests ASD can be understood as a consequence of a defined set of perturbations in highly conserved and protected biochemical processes that previously were quite rare and are now being seen with increasing frequency due to increasing stressor exposures that cumulatively overwhelm critical communication, energetic or sensory systems.

The six categories below are proposed as parsimonious in understanding ASD subtypes (See Figure 1. **An Integrative Flow Chart for Assessment & Management of Autism Spectrum Disorders (ASD)**). The flow chart details the six subtypes of ASD for those interested in clinical case management and are

described briefly below:

RedOx regulation of electron flow, energy transduction, and cell electrical potential reflects in antioxidant levels and oxidative stress markers.

RedOx potential includes antioxidant protection, electron flow and oxidative stress expression. **RedOx** reflects cell vitality as a function of antioxidant electron carriers that block oxidative stress and free radical damage when present in sufficient amounts. RedOx regulation of electron flow, energy transduction, and enzyme modulation and cell zeta potential are reflected in antioxidant levels and oxidative stress markers. Important metabolic relationships include such ratios as creatine to creatinine, potassium to sodium, zinc to copper, calcium to magnesium, glutamine to glutamate, lactate to pyruvate, ATP to ADP, and omega 3 to omega 6 essential fatty acids²⁶⁷.

Epigenetic efficiencies including digestion, assimilation, elimination, nutrient and methylation sufficiency. Autoimmune conditions are common in people with impaired epigenetic competence²⁶⁸.

Epigenetic competences to assess how completely are foods digested, assimilated and eliminated, as well as uptake of each of the essential nutrients. Digestive ecology includes:

- **Prebiotic** fibers²⁶⁹ including both soluble and insoluble fibers²⁷⁰ that bind toxins, increase motility and promote a healthy probiotic organisms as well as a healthy 12-18 hour transit time from consumption to elimination²⁷¹. 40-100 grams daily intake is

the healthy range for fiber intake while typical Americans consume less than 10 grams fiber daily putting them at risk of intestinal maldigestion²⁷², dysbiosis²⁷³, enteropathy, and repair deficits²⁷⁴ from protein calorie malnutrition²⁷⁵. Metabolites in sweat, stool and urine suggest opportunities for deeper understanding of metabolomic responses in ASD²⁷⁶ and PPD²⁷⁷.

- **Probiotic** organisms that break down our food so we can assimilate it, synthesize helpful molecules based on mucosal interactions, metabolize toxins, and protect us from pathogens. Pathogens can only proliferate when there is a deficit of healthy microflora due to medical therapies, distress or inadequate daily intake of required probiotics, typically 10-40 Bn active, colony forming unit (CFU) organisms²⁷⁸. Use of antibiotics risk probiotic deficit and maldigestion as a consequence²⁷⁹.

- **Elective, protective molecules** such as:

Mucins that are complex carbohydrates synthesized by the mucosa and secreted into the intestines to trap partially digested food remnants to prevent them from invading the intestinal linings²⁸⁰.

Secretory IgA (sIgA) is a specialized antibody produced in the intestinal lining and secreted into the intestine to trap foreign invaders before they get into the body²⁸¹.

Metallothionein is a glycine-cysteine protein that carries helpful zinc and magnesium. Toxic minerals bind to the cysteine

sulfhydryl and displace the zinc or magnesium. Metallothioneins are present in the GI and GU track, in the plasma and spinal fluid, indeed everywhere toxic minerals might be. Produced in abundance when we are healthy, they are substantially down regulated during essential nutrient deficit. We suggest the more common bioaccumulation of toxic minerals today is due, in part, to down regulation of metallothionein. This program specifically up regulates or induces the production of metallothionein and other helpful, protective or electively synthesized molecules.

Bile acids are produced in the liver and introduced into the intestines through the biliary track, bile acids enhance uptake of fat and fat soluble vitamins like A, D, and E from the intestines. They also interact with mucins and fiber to trap and prevent re-uptake of certain toxins.

Anabolic to catabolic balance including elective protective renewal balanced with remodeling or auto-cannibalism²⁸². This includes host hospitality to commensal or aggressive infectious agents, from parasites to fungi, from bacterial flora to viruses, from mycoplasma to prions.

Anabolic/catabolic balance²⁸³, including induction or suppression of elective protective mechanisms through regulation of DNA transcription²⁸⁴ as well as RNA²⁸⁵, RNAi²⁸⁶ and RNAa²⁸⁷ translation, modulation, and such applications as enzyme efficiency and kinetics. Health exists in the homeostatic zone where impulses to build and repair known as the anabolic impulses balance the impulses to rehabilitate and renew, the catabolic impulses.

Anabolic / Catabolic state reflects repair competences or their deficit, folate-based methylation²⁸⁸ capacity to modulate genetic expression and toxin metabolism. Methylation systems add or subtract methyl group making compounds more or less moveable. Proper reading of DNA, protein synthesis and transport²⁸⁹, cytochrome based detoxification systems, homocysteine related cardiovascular risk, and basement membrane repair all depends upon various methylation systems²⁹⁰.

Detoxification leading to formation of less toxic, more water-soluble excretory products as sulfates, hippurates, glucarates, and mercapturates, described below.

Transulfuration is the addition or oxidation of sulfur to increase solubility and excretion or elimination of waste products and xenotoxins²⁹¹. Glucuronidation²⁹² adds glucuronic saccharide and hippuration²⁹³ adds glycine to a xenotoxin to produce the glucuronate or hippurate thus increasing solubility and elimination rate.

Anabolic to catabolic balance includes:

Efficiency of the Krebs' **cell energy**, citric acid (TCA) cycles,

Elective protective renewal balanced with remodeling or auto-cannibalism induced when essential amino acids, fatty acids, or other nutrient cofactors are deficient or depleted by free radicals generated by xenotoxins or by distress.

Detoxification competences to safely convert wastes and toxins into more water soluble and thus more easily excreted, less

harmful substances. Bioburden toxins can be defined as the total load in an individual creating, in contrast to healthier states, a state wherein the individual cannot metabolize and excrete comparable toxins exposures without bioaccumulation.

Detoxification leading to formation of less toxic, more water soluble excretory products as sulfates, hippurates, glucarates, and mercapturates²⁹⁴. Porphyrin production reflects both heme synthesis efficiency and is exquisitely sensitive to exposure to TMs such as lead, mercury, arsenic, cadmium or nickel²⁹⁵. Synergy of interaction among toxic minerals is observed in many situations²⁹⁶. While understandable from an integrative model, it is hard to comprehend, even counter intuitive, within the mechanistic model.

Somatosensory integration for information processing and quaternary effects such as platelet activation by collagen²⁹⁷.

Somatosensory systems integration and information processing by the peripheral and central nervous systems is important, particularly the reticular activating system (RAS) in the brain stem. Somatosensory integration for information processing and quaternary effects such as platelet activation by collagen, and,

NeuroImmunoHormonal²⁹⁸ control systems including control neurotransmitter²⁹⁹, immune³⁰⁰, and hormonal modulatory molecules³⁰¹.

NeuroImmunoHormonal³⁰²: The functional integration³⁰³ of neurotransmitter³⁰⁴, immune³⁰⁵ and hormonal system actions³⁰⁶; known

as the Governing Vessel in traditional Oriental medicine. Our sensory systems generate enormous, overwhelming amounts of information. Various systems filter and organize this information so we are not overwhelmed by it. The circuit of sensory, peripheral and central processing, and motor or action nerves needs has its information gated, filtered and presented.

Certain people with ASD seem to have defects in one or more of the information collection, organizing, interpreting, and feedback loops. This includes dendritic cell surveillance systems³⁰⁷, immune activation³⁰⁸, glial cell activation, immune regulation or dysregulations³⁰⁹, CNS hypoperfusion due to altered blood brain permeability or choroids plexus altered permeability.

GNS hypoperfusion due to altered gut blood permeability or lymphatic altered permeability. NeuroImmunoHormonal control systems include key neurotransmitter, immune, and hormonal regulatory molecules³¹⁰.

Coincident with ASD increase is concurrent observation of system wide metabolic function and profound functional disruption in multiple biochemical pathways described above.

Ecology and ASD

The obligation to endure gives us the right to know.

Rachel Carson, Silent Spring, 1962

The rise in ASD parallels the rise in chronic illnesses perhaps linked to a commonality of multiple environmental exposures at critical times in pre or post

natal development leading to a breakdown in homeostasis, tolerance and vitality in susceptible individuals³¹¹. Those affected with ASD are not necessarily dissimilar to typical children but reflect greater sensitivity to environmental exposures and cumulative epigenetic effectors³¹².

Accumulating evidence links ASD both to environmental toxins and impairments in eliminating such toxins. Xenotoxin effects are rarely noticed immediately but rather build up slowly over time with adverse effects occurring at any point in the lifespan³¹³. Links between environmental pollutants and a wide range of neuro-developmental³¹⁴, behavioral and learning problems have been reviewed³¹⁵.

Comparing ambient environmental levels of mercury³¹⁶ and ASD rates³¹⁷, a significant increase in special education need is linked to higher mercury levels. For each half ton or 1000 lb of environmentally released mercury, there was a 43% increase in the rate of special education services and a 61% increase in the rate of ASD. There was also an association between total toxicity as determined by the toxic release inventory and autism rates³¹⁸ (See Figure 2. **Map of xenotoxin coincidences with ASD prevalence**).

Examining atmospheric mercury emissions³¹⁹ in relation to ASD prevalence researchers found that for every 1000 pounds of industrial released mercury and power plant emission there was respectively a 2.6% and a 3.7% increase in ASD. Distances from exposure source are an independent predictor of ASD rates. For every 10 miles from industrial or power plant sources, ASD risk decreased by 2.0% and 1.4%, respectively.

For comparison, annual atmospheric mercury release from power plants is estimated at 100 tons or 220,000 pounds. At 454 grams per pound, 220,000 pounds equals 99,880,000 grams that translates to 99,880,000,000,000 micrograms, the level at which mercury is toxic to biota. Other sources contribute

an additional two to four times more mercury to the environment each year. This translates to several hundred million micrograms of mercury per citizen being emitted into the atmosphere each year.

Researchers examined ASD rates in proximity of residence to toxic landfills³²⁰. This tests the hypothesis that ASD may be linked to repeated exposures to multiple toxicants³²¹. Areas of highest rates of ASD coincided with the highest density of toxic landfill sites while the areas with lowest rates of ASD had the lowest density of toxic landfill sites³²². (See Figure 3. **Cases of ASD are more frequent adjacent to toxic landfill sites in New Jersey**).

In addition, they looked at total number of ASD cases per state and found a statistically significant correlation with the number of toxic Superfund sites and ASD rates in 49 of 50 states.

Children with high levels of pesticide metabolites were 6 times more likely to show ‘progressive development delay (PDD) problems’ than children with low levels³²³.

Mothers living closest to fields with the highest tonnage of organochloride pesticides during pregnancy had a six times greater rate of ASD in their offspring than mother not living near fields that used pesticides. ASD risk increased with the pounds of organochlorine pesticides applied and decreased with distance from field with pesticides.

Investigators found that for every ten-fold increase in metabolites from organophosphate pesticides rates of PDD more than doubled³²⁴.

Comparing mothers of typically developing children with mothers of children with ASD epidemiologists found use of pyrethrin pesticides, commonly used in pet flea

shampoos, sprays for ants, flies and cockroaches, from conception to parturition doubled the incidence of ASD. The highest risk was during the second trimester of pregnancy³²⁵.

Connection to Autism Spectrum Disorders and related Progressive Developmental Delays

ASD embraces a variety of structural and functional developmental disorders. ASD and PDD have gone from less than 1 per 10,000 births to more than 1 in 100 births, from rare to epidemic in barely half a century³²⁶. This rise is largely anthropogenic in origin and represents a *real* increase in incidence and prevalence^{327,328}.

Connecting the dots: Nutrition, activity, distress, xenotoxins and ASD

If we can grasp that we are the world we depend on, then we will find where we truly belong and get on with seeking a way to live in harmony within a rich, vibrant community of living things.

David Suzuki (1936-) and Amanda McConnell (1970-),
The Sacred Balance (2007)

Xenotoxin stressors deplete essential nutrients and increase the risk of deficits by being free radical oxidizers. As a systemic consequence of oxidative stress³²⁹, altered somato-sensory and affective communication and mobility among other mitigatable risk factors occurs by depleting antioxidants due to oxidation and altered RedOx potential for the cells, loss of buffering minerals due to metabolic acids that pull minerals with them during excretion, or by damaging delicate sub-cellular control systems³³⁰. The sum of these disruptions and dysfunctions in control systems is exemplified herein by reference to ASD³³¹.

Xenotoxins include the TMs, VOCs, POPs, EMF, and radioisotopes that operate as surprisingly efficient oxidative and metabolic disrupters of biological control systems³³². Exposure to these risk factors at vulnerable times, particularly in the preconceptional period as well as during the second trimester of gestation appears to dispose to ASD³³³ and PDD, among other developmental consequences, as discussed below³³⁴.

Dimension of the issues

- **How much:**

Most TMs, VOCs, POPs, EMFs, and radionuclides are now present and re-circulating in the environment at 1000 fold or more, that is at least three orders of magnitude greater concentration than 100 years ago³³⁵. They are either anthropogenic or were previously sequestered away and have been liberated by human influences. The unintended consequences of acidifying the environment so that previously sequestered toxins are now more soluble and biologically active, of accelerating the pace of changes that promote distress, of reducing the nutrient density in the diet at the same time the stress and xenotoxin exposures that increase consumption of essential nutrients are increasing. This is a ‘perfect storm’ of issues that cumulatively may overwhelm endogenous systems³³⁶, leaving them in survival³³⁷ or ‘essential only’ rather than proactive or ‘thrival’ mode.

Biological systems can be effected and affected by cumulative toxic burden yet not be able to adapt well without significant stress that is costly to the organism’s core system energetic resilience and

restorative mechanisms³³⁸. Biological adaptive capacity is remarkable in breadth and depth yet finite³³⁹.

Multiple systems show signs they are being pushed beyond their adaptive capacities³⁴⁰. These include digestive, immune³⁴¹, hormonal, and neurochemical systems³⁴² at a cellular level. These include ASD³⁴³ and PDD³⁴⁴ learning disabilities³⁴⁵, mood disorders, metabolic syndromes³⁴⁶, senility, and cancer.

That such systems become more interlocked and rigid prior to catastrophic collapse is an engineering principle expressed in biological terms³⁴⁷. Recent disruptions in the financial system are the same process expressed on social systems³⁴⁸.

- **Relative risk:**

When present together, xenotoxins are not equivalent and multiplicative. Synergistic effects often occur. Synergies of toxicities among TMs³⁴⁹ such as lead, mercury, cadmium, arsenic, and nickel occur³⁵⁰. Interactions among VOCs, POPs, EMFs and radioisotopes in regard to functional effects on biota are less well documented yet appear to follow similar patterns of emergent and extensive interactions³⁵¹. Further, toxins are more potent when the internal or external environment is more acidic compared to optimal function, or lacking in protective antioxidants³⁵² leading to intensified oxidative stress³⁵³ and cumulative repair deficits in cells and systems³⁵⁴.

- **Chemical array:**

According to the Environmental Protection Agency (EPA), over 104,000 synthetic chemicals have been introduced into the environment in the past century; with an estimated 1,000 new ones introduced every year³⁵⁵.

Only about 4% have been studied for their toxicities and adverse effects on neurodevelopment and only about 40 or 0.04% have been studied for interaction of effects. From the few studied, there is strong evidence that at least 200, and some evidence for at least an additional 1000 novel xenochemicals, as teratogens, neurotoxicants³⁵⁶, hormone disrupter, and or immunotoxicants³⁵⁷ that effect the body's control mechanisms³⁵⁸. The most common mechanism of toxicity is oxidative stress with the location dependent upon the particular chemical elective affinities of the molecule. Different molecules partition or have selective affinity for being in certain molecular locations, often the most biologically active and thus vulnerable³⁵⁹.

Often xenotoxins exert the effects at the most active and vulnerable sites within biological systems. This means a selective increase on toxic effects because of the preference xenotoxins have for being at the sits of molecular 'action'. This includes places where chemicals bonds that are energetic enough to power the cell such as ATP, GTP, ITP, and PEP or the translation, transcription or epigenetic modulation³⁶⁰ of the particular individual's genetic code³⁶¹.

Essentially all cells have microscopic "batteries" called mitochondria

that produce energy from sugars and fats or aminoacids and turn it into a multiphosphate energy storage system known as ATP, the universal energy source of the body's economy. Brown fat cells are particularly rich in mitochondria, however, their enzyme catalysts that produce ATP are "uncoupled" from one another. The result is that the energy in the glucose and fat is lost as heat, the way the work of a car engine is lost as heat if the car is stuck with its tires spinning.

Some people perform as if their cell batteries are partially decoupled leading to symptoms of excessive fatigue, impaired immune, digestive, hormonal and neurochemical resilience and increased pain levels.

Summary, Conclusions and Recommendations

Progress is impossible without change, and those who cannot change their minds cannot change anything.

George Bernard Shaw (1814-1885)

These are Dickensean 'best and worst' of times; the lessons of history are there to learn from or repeat errors³⁶². We are also learning animals. Learning includes awareness of the choices and consequences of what we eat and drink, think and do. While subtle and of longer duration than many peoples attention span, more people than ever are developing parallel wisdom and knowledge moment by moment awareness, awareness through movement and participation in community. Experience of the consequences of choices highlighted above can help guide smarter future choices.

This represents a paradigm shift from exploitation of nature as a viable option and the implicit acceptance that: ‘Them that has the gold makes the rules’³⁶³. ‘Them that has the gold’ usually make decisions for themselves that do have irrevocable consequences for the shared commons³⁶⁴ whose tragedy has been articulated³⁶⁵. The notion of being able to make decisions in isolation and that the consequences are not irreversible has been challenged for decades by the data, just now being modeled and appreciated in the policy and general community. While strong, the human capacity for denial is finite.

Gibbons³⁶⁶ and Coburn³⁶⁷, Needleman and Durant³⁶⁸, DeDuve³⁶⁹ and Morowitz³⁷⁰, Prigogine³⁷¹ and Einstein³⁷², Dyson³⁷³ and Witten³⁷⁴, Thomas³⁷⁵ and Weissmann³⁷⁶, Said³⁷⁷ and Schimmel³⁷⁸, Ghandi³⁷⁹ and Dharmawara³⁸⁰ help speed our transition from isolation to participation, from care of sickness to healthful caring³⁸¹; from eco-exploitation to eco-partnership³⁸².

Restoring primary proactive prevention and healthful caring to the center of health care is under way³⁸³. Annually, 100-250,000 lives and \$200-500 billion can be saved³⁸⁴. As awareness translates into political will, change happens. Our current priority to ‘pay for procedures and tasks’ is constraining a more effective debate about scalable solutions³⁸⁵ to the escalating cost and declining value in return as healthcare services and procedures provided³⁸⁶.

Increasing awareness of where we are and how we got here has value if our goal is a sustainable and prosperous world held safely in trust for those as yet unborn³⁸⁷.

We can de-couple payments from procedures and tasks³⁸⁸.

We can re-couple payments to outcomes desired³⁸⁹ and better accountability of care delivered³⁹⁰. Healthful care delivered, risk reduced, value rendered and

received and health promoted³⁹¹.

For the trustees of future generations this choice remains available yet too rarely chosen, however attractive for the future beneficiaries³⁹². An analogy to energy security planning is helpful to track choices and consequences³⁹³. Food safety, indoor and outdoor environmental quality and mobility safety for humans³⁹⁴ and other animals³⁹⁵ have been handled in ways that suggest an urgent need for cost effective, sustainable outcomes³⁹⁶.

As we seek solutions that create virtuous cycles of better health and lower net cost, primary proactive prevention and healthful caring show the most promising returns on investment, indeed, ROIs so strong that public-private partnerships can be created to fund such initiatives as long as the investor reaps industry standard rewards.

In the disconnected payment and reimbursement mechanisms operating within healthcare today, the budget that provides the initial investment in better health is often not the budget that reaps the benefits of that better health³⁹⁷. Coupling payments to desired outcomes; providing incentives for what we want would be helpful and refreshing changes within health care debates and action plans³⁹⁸.

The choices, then, are to continue to increase the risk of global environmental and human health collapse due to impaired defense and repair mechanisms and ever more resistant or aggressive pathogens *or* engage a cautionary approach while we work out the scientific details. In addition, we have the option of devoting resources to possible breakthroughs based on mechanistic models or implement what we know that works yet largely do not yet implement with dividends of resilient protective mechanisms restored and repair system needs met.

Environments, societies, and individuals benefit from a small amount of pressure or stress. Equally general is the erosive and regressive effects of too much perceived pressure or distress³⁹⁹. Perception and inner adaptation are more important than external events in determining the effects of excess stress. Those with better coping and self-soothing skills are more resilient and healthier during times of rapid change and increasing stresses.

By all observed measures, we are in late phases of cumulative social and individual distress. A consequence is that biological systems become more interlocked and rigid. Rigidified systems are more vulnerable to collapse at the system level, subject to policy paralysis at the societal level. From this something new yet largely unpredictable arises, phoenix like. Unprecedented cumulative stresses and unexpected or unintended consequences are drivers for novel adaptations to difficult conditions⁴⁰⁰.

In a sense, all this confirms the classic wisdom that:

- A stitch *in time* saves nine.
- An ounce of prevention *is* worth a pound of cure.
- Primary prevention saves *while* treatment costs.
- Nature cures and professionals are appreciated.

A wide variety of seemingly unrelated autoimmune, developmental and chronic conditions are ever more prevalent. These include:

- Fertility failures,
- Pre-maturity at birth,

- Caesarian section rates,
- Developmental and learning deficits including ASD,
- Digestive disorders⁴⁰¹,
- Autoimmune conditions along with behavioral, mood and impulse control disorders. Autoimmune conditions include asthma, dermatitis⁴⁰², eczema, psoriasis, multiple sclerosis, rheumatoid arthritis, irritable bowel syndrome (IBS, enteritis or colitis), diabetes, connective tissue diseases, glomerulonephritis, and a host of other self-attacking, immune dysfunction conditions like chronic fatigue immune dysfunction syndrome (CFIDS) and myo-fascial or fibromyalgia musculoskeletal pain syndromes.
- Cardiovascular diseases and
- Cancers.

The above list represents only the more common challenges.

In common among all of these diverse causes of suffering and impairments in quality of life is loss of homeostasis; functional loss of self-regulating feedback control systems previously highly conserved. These systems derive from a limited biochemical repertoire, give rise to such effulgent diversity and now, perhaps for the first time, are under an unprecedented assault on molecular protective mechanisms occurring concurrent with this epidemic of epidemics of chronic impairment in quality of life and costly remediation of medical maladies. With mindfulness practices, compassion as a social norm, and modest use of scarce resources these are almost entirely avoidable. (See Figure 6. **Derivation of all amino acid building blocks forms five small molecules** and Figure 7. **Resources guides to healthier living**).

The rise in ASD appears to represent converging neuro-developmental and

connective tissue structural and functional dilemmas⁴⁰³ (See Figure 8. **Altered Neuronal Processing in ASD**):

- **Disrupted biochemistry** that impairs core cell energetic control systems thus weakening immune defense and repair systems resulting in related dysregulation in hormonal and neurochemical systems⁴⁰⁴,
 - Assaults on behavioral, learning, and intelligence that impact **hormonal and neurochemical control centers** conserved and protected over eons yet now showing increasing evidence of multiple and mixed previously unobserved dysfunctions⁴⁰⁵,
 - Impaired ability to **reproduce** successfully, and,
 - **Unsustainable perturbations in ecology** reflecting in other biota the same processes.
- The Price-Pottenger intergenerational experiments with cats suggests caution in light of how those classic experimental observations seem to be reflecting in society today. While further studies are needed, anthropogenic toxins have impacted all life at fundamental levels⁴⁰⁶. Successful reproduction, learning capacities and quality of life are all reflecting the consequences of multi-generational treatment of planning and acting as if biology was understandable in mechanical terms.

The value of being proactive, prudent and pragmatic about further increases in persisting xenotoxin introduction is clear⁴⁰⁷. The Wingspread Conference convened a group of scientists, ethicists, lawyers, and activists to develop

guiding principles for evaluating decisions that affect human health and the environment⁴⁰⁸. The emergence of biomimetic disciplines within engineering, biomedical technologies, architecture and building materials provide twin opportunities: Participate in a rapidly growing, profitable set of emergent platform technologies that produce superior function in products with substantially more integration of reuse cycles to minimize long lived land fill needs.

The Wingspread ‘manifesto’ called upon government, corporations, communities and scientists. "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof..."^{409,410}

Martha Herbert an integrative neurologist applying whole-body, whole-person approaches to ASD concludes⁴¹¹:

“The rise in autism diagnoses, along with the rise in other immune and chronic illnesses, is really a wake-up call. Put alongside the warnings about the ecological instability of our planet, it shows that our situation is serious. It calls for pulling out all the stops and throwing our best intelligence, resources and organization into getting a grip. Autistic individuals may not be “different” from the rest of us but simply “more sensitive” to environmental injury—they maybe the “canaries in the coal mine” warning us of impending greater disaster. If the level of environmental insults continues to rise, more children and more adults—and more of life on earth will experience harm.”

ASD rates increase is *not* due to better diagnosis⁴¹², changes in reporting, or diagnostic substitution⁴¹³. Their findings support environmental xenotoxin exposures and essential nutrient deficits as the most likely cause for most ASD increase⁴¹⁴. Funding for researching *genetic* causes of ASD is 10 - 20 times greater than for all other factors. A more balanced approach to ASD support in relation to opportunity⁴¹⁵ would help verify and confirm the value of promising epigenetic and functional immunomic⁴¹⁶ approaches. Currently, they are severely constrained by lack of perceived public and private funding priorities. (See Figure 9. **Autism Rates Compared to Mental Retardation Rates 1992-2006.**)

How we respond to the disturbances and distortions in biologic systems that have been largely conserved and protected since Pangea and Archea is both a product of and a challenge for our time⁴¹⁷. Solving these problems will more likely occur at a meta level, not at the level of their creation. The solutions will more likely come from disruptive thinkers and more transparent, flexible systems that are integrative and functional rather than from refinements and improvements upon more mechanistic systems⁴¹⁸.

Opportunities and dangers abound⁴¹⁹. We can apply the evidence with wisdom and compassion, caution and anticipatory modeling. The transitions will often be disruptive. The results are self-evident in the residual impact on quality of life and sustainability of human, financial, and biotic capital. The result is that we will be healthier, wealthier, happier, and wiser; sustainable and welcome in the cosmos following one set of sustainable and trustee-worthy choices. Almost the opposite result can be expected from the other set of 'presumed innocence until harm or risk-proven' choices.

How information is filtered by our brain stem and by policy teams matter. The social contract between the governed and the government as modulated through

governance mechanisms is the product of choices over which we have influence based on the aggregate effects of individual choices. Thomas Jefferson's confidence in the people to govern wisely, even through transitions as disruptive as the agricultural to industrial economy would today be challenged by the pace of change and the implications of decisions that press for solution. When fully informed, there may be wisdom in the body politic. The lack of transparency and the mirages presented in media today decrease the transparency necessary for effective governance and decision making by individuals or their institutions.

With prudence and anticipatory risk reduction, it is possible to live well and happy even in stressful times⁴²⁰.

These times are indeed changing, paradoxical, and anomalous⁴²¹. It is wiser, safer, more secure, and outcome successful to experience being enfolded within rather than operating in isolation from biota. The choices made in eating, drinking, thinking, and doing determine whether nature is experienced as embracing or isolating.

Looking back there are lessons to be learned and cautions to be remembered. The cautionary principle can be practiced⁴²². While learning from the results of choices and actions detailed above, we can cease and desist from those actions that produce short-term gains for a few and long term expensive devastation for the many. Including the costs of consequences from an action taken in the cost or price of that action is a practical way to apply this approach. Such approaches are already applied to the cost of certain chemicals, tobacco and alcohol products through certain licenses or permits required. Including the full lifetime or life cycle costs in the price of the product will favor the sustainable and biomimetic with collateral benefits of virtuous cycles and improved quality of life.

Looking forward, action based on enlightened self-awareness of the interconnectedness of all life is suggested as more sustainable. Birth with reverence, lifelong meaningful work, and passing on with dignity can guide sociopolitical policy development as more leaders think in integrative ways about this emerging sustainable and inclusive social contract.

The mechanistic approach remains valuable within its areas of strength. Similarly, the emerging integrative approach has limits. While the mechanistic approach will contribute in the future, the integrative approach has deep roots in the planetary wisdom traditions that have stood in wait for the embrace of humanity; that shrink away from the clutch of humanity. The choice is how to set priorities; how to shape the debate; how to filter and organize the information, how to commune and communicate with biota.

More virtuous, and fewer negative cycles emerge from extending the audacious hope provided by integrative sciences, from physics to physiology; from wisdom traditions to medicine, the youngest science.

Further, given a constitutional right to the pursuit of happiness, Americans have the right, this suggests, to feel well enough to pursue happiness emergent from a life well lived. The cost of health care as a social privilege is proving too high; the cost of health care as a social right can be affordable and sustainable.

It may be time for our governance and policy systems to be reassessed in light of preferred assumptions that result in the ability to ‘pursue happiness’ including feeling well enough to be *able* to pursue such happiness.

The Alkaline Way to healthful living is a descriptive, inclusive term that includes

appreciation that:

- Eukaryotic cells throughout biotia are acidic in function, producing net acid, and yet alkaline by design, requiring input of buffering minerals to neutralize excess metabolic acids with buffering minerals that activate enzyme catalysts essential for healthy cell functions.
- Required nutrients uptake and removal of metabolic waste products efficiently, effectively depends upon enough of all required elements.
- Healthy cells stay alkaline and resilient; cells lacking any required or essential component become acidic, metabolically run down, and go into survival mode.
- Antioxidants provide proactive prevention from oxidative stress when present in adequate amounts where and as needed. Antioxidants are conserved and recycled when their environment is slightly alkaline; they are rapidly consumed when cell chemistry becomes more acid. When high quality antioxidants are available, as the ‘family’ or ‘team’ of essential nutrients required meeting the oxidative stress levels of the individual or of their environment resilient tolerance is the rule. The literature is also replete with studies questioning the benefits of antioxidants. In common, these studies use nutrients as ‘magic bullets’ employing one member of a family or team of nutrients single variable experiments, appropriate to study questions that are uni-variant, *i.e.*, have a single variable such as a single nutrient, drug or reaction to study. The double blind, placebo controlled trial (DBPCT) is an example of scientific method appropriate to single variable studies. Complex questions such as those engaged herein have different scientific methodologies appropriate to their study.
- Healthy, elective protective mechanisms, abundantly present when homeostasis operates, are down regulated or shut down when significant distress, deficits in essential nutrients or excess exposure to toxins result in loss of homeostasis and emergence of a ‘fixed’ state of ill health. The least available essential element becomes the rate-limiting item in the system in

question. This far-from-equilibrium and ‘stuck’ or ‘fixed’ state is characteristic of chronic, degenerative, and autoimmune diseases. Healthy states are resilient, self-renewing and self-correcting. All this is included in the terms homeostasis and tolerance.

Understanding good and ill health’s causes provides insight and opportunity to restore balance in molecular metabolism that is usually *oscillating equilibria*. A common theme throughout this work is that deeper understanding of molecular advances appreciated from an integrative and functional perspective provide opportunities to feel and function better, to reduce risk and disability, to rekindle the human healing responses, and to reduce risks or reverse impairments.

Nature is nurturing and shows signs of distress; is maternal and shows signs of being severely challenged; in usual ferment and unusual foment. Nature is protective of all biota and willing to shed the parasitic in favor of the symbiotic.

Sensitive, specific, and predictive tools are selected. Realistic assessments of environmental toxins, their interactions or synergies of interaction and what can be done to live healthfully in times of unprecedented:

1. Rates of change,
2. Chemical exposures too often linked to loss of homeostasis,
3. Cumulative perceived distress.

Autism Spectrum Disorder (ASD) is discussed in particular detail as a paradigm for cautions ignored leading to unforeseen consequences and greater suffering.

How this has happened and what we can do in response is presented. Opportunities exist to resolve issues systemically and invoke virtuous cycles that reinforce better outcomes. This contrasts with dangers, dysfunctions and unforeseen consequences that dominate the current general understandings and that grow out of a mechanistic, limited

misunderstanding of how biology and biota operate. Some of this grows from classic assumptions now proven outmoded or wrong. Some of this grows from distortions introduced by media and marketing premised on appearances and size rather than quality and sustainability.

If we seek different outcomes, then we must start with different incentives and know the outcomes desired. To paraphrase the sage Hillel, ‘If we are not for ourselves, who will be for us? If we are only for ourselves, what are we? If not now, when?’⁴²³.

Figure 1. **An Integrative Flow Chart for Assessment & Management of Autism Spectrum Disorder (ASD)**

An evidence-based flow chart is presented to help differentiate ASD subtypes. The value includes better documentation of predictive, sensitive, and specific tests. These functional and provocative tests improve case definition in clinical practice, in case registries, and in outcome evaluations.

The hypothesis being tested is that there are six distinct subtypes of ASD, each with different molecular causes and corresponding clinical expression. Analyses that assume that ASD is a single condition with multiple symptomatic expressions have difficulty identifying subgroups when data averages for the whole group are taken. This means that subgroups may not be seen despite being present.

Too often the absence of data is taken implicitly as data of absence.

This approach is based on an Integrative Medical model:

1. Look first to molecular causes of developmental challenges. Emphasis is on epigenetic or phenotypic adaptations, particularly those that are low risk and internally consistent.
2. Engage the family as colleagues in observational assessments of what works for each child.
3. Employ biology and psychology before pharmacology.
4. Empirically stratifies ASD into six subtypes, each with distinctive manifestations

ASD Causations

The sum of host hospitality and xenotoxic total load appears to create impaired function and the depletion of essential factors needed for detoxification, energy production's proton gradient, and essential nutrients that activate enzyme catalysts and serve as protective antioxidants to protect from oxidative stress damage, all at the molecular/cellular level. Consequences manifest systemically and functionally.

An individual's risk of adverse neuro-development depends on the complex interaction of degree, chronicity and timing of exposures, genetic and epigenetic factors and nutritional status. The potential downstream consequences can affect multiple body systems and leads to altered information processing, neuro-endocrine-immune control system disruption, abnormal metabolism, increased pathogen susceptibility, altered gastrointestinal ecology. These result in multiple symptomatology and the varied clinical presentations that are labeled as ASD.

Figure 1 continued. ASD Typology and subtype stratification

ASD is complex. ASD challenges us to go beyond single variable explanations to the complex, hormetic and synergistic effects of oxidative stress due to antioxidant deficits, net acid excess due to buffering mineral deficits, and neurochemical distress due to loss of homeostatic feedback. Bioburden toxins can be defined as the cumulative load in an individual in contrast to healthier states wherein the individual can metabolize and excrete comparable toxin exposures without bio-accumulation.

We propose the following typology for ASD subgroups, updated since its presentation by invitation at the Defeat Autism Now (DAN Think Tank) in September 2008 and Autism One in March 2009:

1. **RedOx** reflecting cell vitality as a function of antioxidant electron carriers to prevent oxidative stress and free radical damage,
2. **Digestive** ecology from prebiotics to probiotics; from mucins to sIgA; from metallothionein to bile acids,
3. **Anabolic/Catabolic** reflecting repair competences or their deficit (neural and systemic inflammation),
4. **Detoxification** competences to safely convert toxins into more easily excreted and less harmful substances,
5. **Somatosenory** information processing and analysis,
6. **NeuroImmunoHormonal**: Neurotransmitter, Immune and hormonal system functions and known as the Governing Vessel in traditional Oriental medicine.

It is proposed that the above six subtypes address the defects responsible for ASD and parallels exist at both behavioral and sub-cellular levels of observation (see Flow chart below: **Suggested six subtypes of ASD and their characteristics**).

Figure 2. Map of xenotoxin coincidences with ASD prevalence

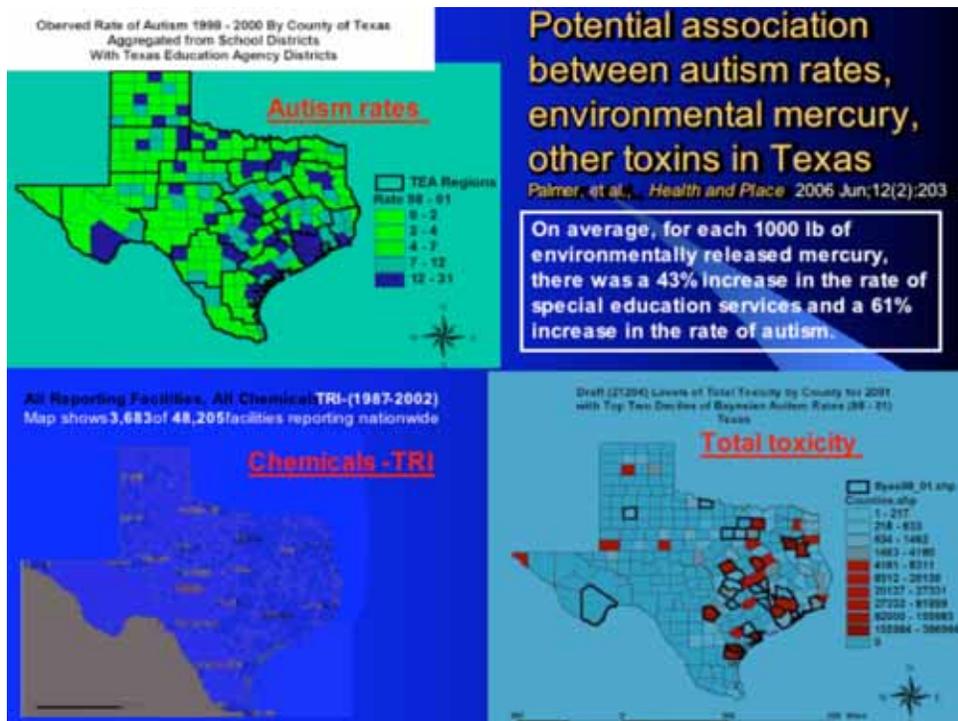


Figure 3. Cases of ASD are more frequent downwind from coal-fired power plant in New Jersey.

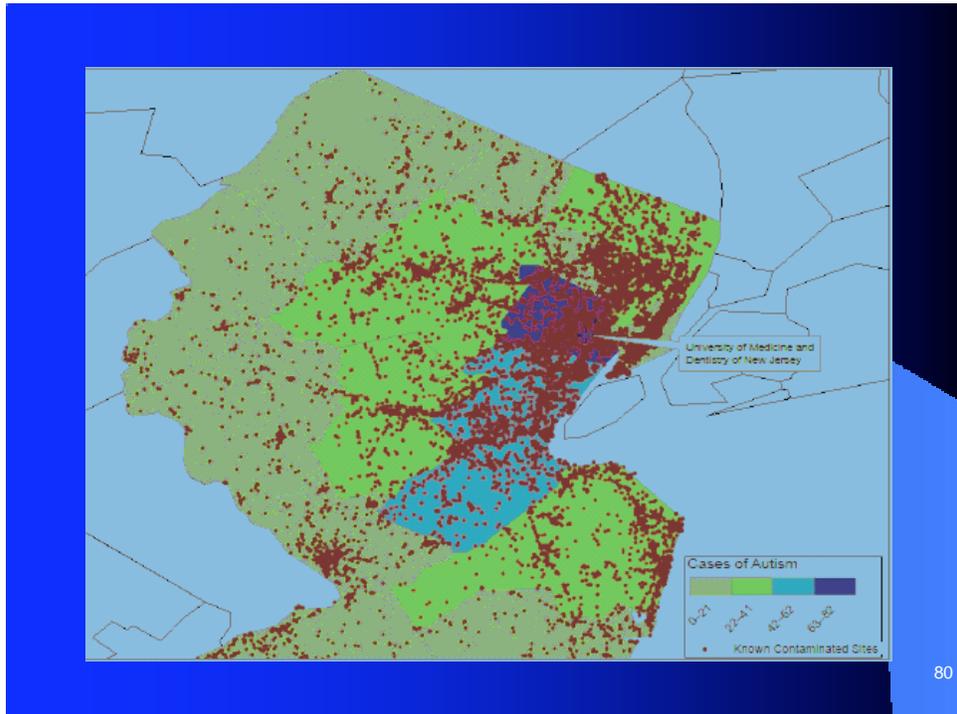


Figure 4. Recommended dietary choices to eat for health the Alkaline Way

Food: Choose fresher, unprocessed whole foods grown to vine ripeness locally as available, organic and biodynamic when possible⁴²⁴. High fiber foods help remove toxins. Avoid artificial sweeteners, corn sweeteners, HFCS, preservatives, colorings, and plastic packaged and irradiated foods; glass containers are preferred for storage⁴²⁵. Stevia⁴²⁶, agave⁴²⁷, formaldehyde-free raw maple syrup⁴²⁸ and raw honey⁴²⁹ are preferred sweeteners. Join CSA (Community Supported Agriculture) farms when available⁴³⁰.

Alkaline Diet: High in minerals that buffer excess acidity, decrease TMs absorption by binding to dietary fiber and support all three detoxification pathways⁴³¹.

Water: Pure water is essential; dehydration hinders the body's ability to eliminate waste and keep resilient. Most commercial testing focuses on bacterial counts, more important are pesticide levels, heavy metals, hormone residues, volatile organic compounds or fluoride in your tap water⁴³².

Clean Air: Use fresh flowers and all natural oils or incense; **avoid** air fresheners, sprays, perfumes, cleaning agents, new paints and carpets that smell, dog and cat flea treatments, fly repellents, house fumigations, timber treatments. Gas heating and cookers need to be checked for carbon monoxide output. Avoid soft furnishings, chairs, sofas, that are treated with poly-brominated biphenyls (PBBs) or other stain and fire retardant treatments⁴³³.

Personal Care Products: Nearly all deodorants contain aluminum, which is readily absorbed, perfumes and cosmetics can contain multiple potential toxins⁴³⁴.

Clothing/Laundry: Detergents and fabric conditioners are common allergens, and contain multiple synthetic chemicals. Choose natural products. Use baking powder, washing soda, and ceramic ionic cleaning discs⁴³⁵.

House and Garden Chemicals: Many potential toxins. Avoid lawn herbicides. Do not allow children to play on treated lawns for *at least* 3 weeks after spraying. Use organic compost; avoid commercial compost, especially that from reprocessed water treatment solids⁴³⁶.

Figure 5. Supportive Interventions

Micronutrients: Adequate amounts are essential to support the body's complex metabolism⁴³⁷. Children, who are deficient in micronutrients are predisposed to enhanced uptake and reduce removal of toxic metabolites⁴³⁸ and toxic minerals⁴³⁹. Deficiency in essential minerals like magnesium promotes uptake of toxic ones like lead⁴⁴⁰, mercury⁴⁴¹, cadmium, arsenic, and nickel^{442,443,444}. Zinc and Magnesium are essential for biological TM removal by displacement⁴⁴⁵. A high potency multiple vitamin and mineral supplement is recommended with all active ingredients, full disclosure labels, and containing forty active nutrients⁴⁴⁶.

Healthy Fats and fat soluble vitamins: Deficit in beneficial fats affects over half of all adults, omega 3 (EPA, DHA, CLA)⁴⁴⁷, omega 6 (arachidonate, GLA) and omega 9 (Oleate) essential fatty acids (EFAs) are required for membrane fluidity, resilience and function⁴⁴⁸ as is carnitine for fat metabolism⁴⁴⁹. As exposure of skin to sun has reduced so has the vitamin D3 levels in our body⁴⁵⁰. Healthy levels of active vitamin D are 50-80 ng/ml in the blood⁴⁵¹. When levels fall below 25 ng/ml, all cause cancer risk doubles⁴⁵² and osteoporosis risk increases⁴⁵³. Even the molecular mechanism of action has been worked out⁴⁵⁴. Similar benefits are associated with intake of retinols (vitamin A)⁴⁵⁵, tocopherols and tocotrienols (vitamins E), and quinones (vitamins K)⁴⁵⁶.

Prebiotics and probiotics: Encourages beneficial intestinal ecology that toxic load and facilitates detoxification of chemicals and production of essential nutrients. Lactobacillus, Bifidobacteria, and S. thermophilus are examples of health probiotic microflora that must be replenished regularly to maintain healthy digestive function and health promoting intestinal benefits⁴⁵⁷. 20-40 billion active organisms a day are consumed by healthy people all over the world through fermented foods such as yogurt, pickled vegetables, and other digestion promoting fiber⁴⁵⁸ rich, prebiotic⁴⁵⁹ foods⁴⁶⁰ that nurture the probiotic organisms⁴⁶¹ that do the work of digestion⁴⁶² and intestinal detoxification⁴⁶³.

Antioxidants⁴⁶⁴: Vitamins A, B complex, C, eight forms of E, folate, coenzyme Q10 and buffering minerals are all free radical traps and reduce or prevent oxidative stress^{465, 466}. The amounts of nutrients are based on their consumption rate or half-life⁴⁶⁷. Ascorbate or buffered vitamin C is the principle protective and recycle antioxidant in biology⁴⁶⁸. Intake of amounts determined by individual need for ascorbate or based on self-calibrated determination of need is recommended⁴⁶⁹. There are multiple benefits from adequate ascorbate from neutralizing the effects of TMs, VOCs, POPs and EMF stressors to better immune defense and repair functions, improved bile flow, fat metabolism, adrenal stress hormone function⁴⁷⁰, better intestinal digestive ecology⁴⁷¹, improved tetrahydrobiopterin function, neurotransmitter production, increases glutathione levels, improves iron absorption and a safer laxative when and as needed⁴⁷². Ascorbate is the most common molecule in most cells. Taken in its fully buffered form, ascorbate remains among the most needed yet safest molecules studied⁴⁷³.

Sulfur: An essential detoxification element, two hepatic detoxification pathways require sulfur. Good food sources are ginger, onions, garlic, eggs, and brassica sprouts⁴⁷⁴.

Methylation Support: Methylation pathways support detoxification and depend upon B-12, TMG (trimethylglycine), DMG (dimethylglycine), folinic acid (active folate), glutathione, ascorbate (buffered vitamin C), and sulfur amino acids and bioactive compounds⁴⁷⁵.

Supportive Therapies: Including epsom salt baths, infrared saunas, and stretching exercise that all mobilize toxins from subcutaneous fat onto the surface of the skin while improving overall circulation⁴⁷⁶. Showering after sauna therapies are recommended to wash toxins off before they reabsorb through the skin⁴⁷⁷.

Figure 7. Resources guides to healthier living

1. Stu Feedenfeld’s “Guide for Environmental & Biologically Friendly Products”
www.stocktonfp.com/Resource-Guide.pdf
2. Health Studies Collegiums resources available through www.PERQUE.org and www.ELISAACCT.com
3. Save our kids, heal our planet: www.sokhop.com
4. Collaborative on Health and Environment: www.cheforhealth.org
5. Children’s Environmental Health Institute: www.iceh.org
6. We Can Solve the Climate Crisis: www.wecansolveit.org
7. Environmental Health News: www.environmentalhealthnews.org
8. Our Stolen Future: www.ourstolenfuture.org
9. Pesticide Action Network: www.panna.org
10. Coming Clean: www.chemicalbodyburden.org
11. Natural Resources Defense Council: www.nrdc.org/health
12. Beyond Pesticides: www.beyondpesticides.org
13. Greenpeace Chemical Kitchen: www.greenpeace.org
14. Alliance for a Healthy Tomorrow www.healthytomorrow.org
15. Food First and school lunch gardens [www. foodfirst.org](http://www.foodfirst.org)

Figure 8. Venn Diagram of Altered Neuronal Processing in ASD

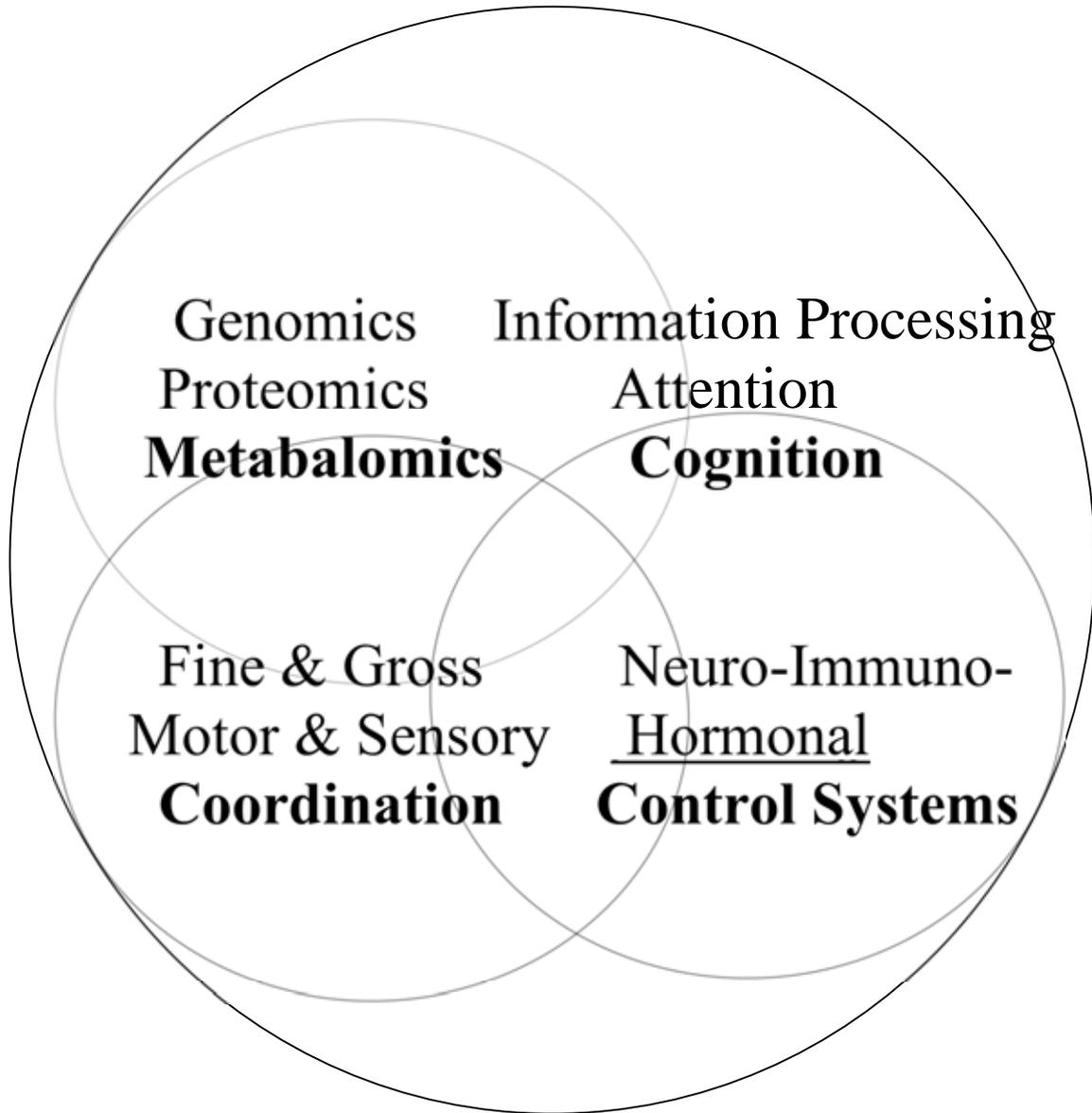
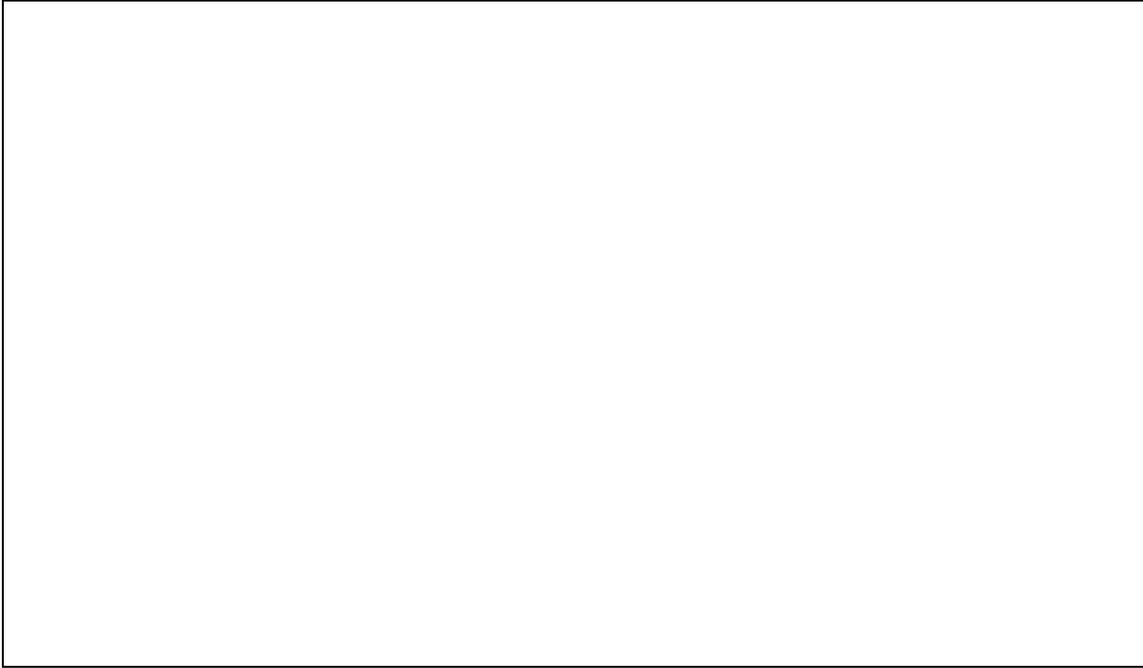


Figure 9. **Autism Rates Compared to Mental Retardation Rates 1992-2006.**



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