III-18. Causality: End or Means to Reality

Problem of assigning causality to an outcome, let alone the distant consequences, is ever present. Our collective and evolutionary memory has always served the vicarious purpose of making one aware of the dangers and opportunities in the world without really making us aware of even the identifiable variables. All this happens without explicit awareness of reasons and with only a vague inkling of a pattern that we may take for causality. So the challenge is how to identify variables and causality so as to predict outcome and consequences.

Widespread realization that actions have consequences is at least 8000 years old. Almost all over the world one expresses it as *what you sow is what you reap*. Such empirical ideas of causality based on outcomes are part of human evolution. They permeate virtually all aspects of human behaviors. Such formulations (wisdom) help us perceive reality as a hierarchy of characteristic structures, interactions, and relations. Sooner or later we learn that these can be independently manipulated. Such insights into the phenomenal world come from accumulated observations, evidence, and methods of reasoning. For example a useful construct, of say the course of an incoming storm, helps us peer into its future course.

Value created by such reality-based models have contributed far more towards general well- being than virtually any other human endeavor. By creating value, likes of Ampere, Pasteur and Einstein have done more to improve the human condition than any saint or martyr. Jawaharlal Nehru said:

"*It is science alone that can solve the problems of hunger and poverty, of insanitation and illiteracy, of superstition and deadening*

custom and tradition, of vast resources running to waste, of a rich country inhabited by starving people. .... Who indeed could afford to ignore science today? At every turn we have to seek its aid. .... The future belongs to science and those who make friends with science."

A simple statistical result would suffice to make the point. Until about 1800 AD the average life expectancy of a newborn was less than 30 years throughout the world and had changed little during the preceding 2000 years at least. It has not changed in countries where newer empirical measures have not arrived. Changes in nutrition, public hygiene, availability of antibiotics, and emergency care have raised life expectancy to over 60 years in most parts of the world.

Outcome versus consequences. Direct causality is difficult to establish in a multivariate and uncertain world. It prevents prediction of outcome, and assessment of the consequences. It is the main reason to keep the incremental search grounded in reality, and keep the inferences tentative until falsified.

Logic does not establish content or context. Outcomes can be deduced if all parts and relations are known. In such reasoning logical operators track the real world relations between the parts of the real content and context. Only in such a setting logic operators and their mathematical counterparts guide reason towards valid outcome by deduction. Four (*and, or, not, equal*) operators form the basis for all relations in mathematics. More complex operations (such as either / or, neither / nor, all, none) can be constructed as a string of the basic operators.

Operators build relations irrespective of the nature or content of the entities, which may be as real as an orange, or something beyond belief but conforms to the relations inherent in the operators. The four basic operators are bi-directional: the validity of *apple and orange* is the same as that of orange and apple

except for the order preference. Similarly *A or B* is equivalent to *B or A*.

The *not* operator negates an assertion of existence that can be verified by evidence. A *not* can not negate non-existence. Consider the assertion: *God created the universe*. It is grammatically correct, but that does not guarantee its validity.

(a) If it is a statement of an opinion, it has to be taken at its face value with faith.

(b) If it is asserted to be evidence-based, the burden of providing affirmative evidence falls on the person who makes the assertion.

(c) If it is asserted that *there is no evidence that God created the universe*, it is merely a statement of the state of knowledge. It can only be addressed in parts by examining the contents. That is long drawn out protracted discussion if both sides with an open mind are really interested in a valid outcome.

(d) Faced with that *it is not so*, the usual retort from the believers is *if not god then who did?* Here again the believers have tacitly assumed that may be evidence for their assertion is not there.

In short, reality is not created by assertions. But assertions are created to examine relations on the basis of evidence between the parts whose content and context is established. As noted above another effective way to examine validity of an assertion is to look into its *converse* and *implication*. Both of these can not be readily handled as simple mathematical constructs. On the other hand, such relations are integral part of real world experience. For example, one can not harvest without sowing (converse), one did not get a harvest even if the field was sown implies that there are

other variables in the process. Note that the operator based (logical) constructs do not demonstrate causality. However, a real causality is implied if the subject of assertion conforms to the operators (i.e. it is logical). The appeal of the logic operators is that defined slices of reality can be manipulated while remaining grounded in reality. However logical is not necessarily reasonable, but anything reasonable can not be illogical.

Often we do not know what we do not know. Nor do we know the full significance of what we do know. Logic operators keep us preserve the integrity of what we know. In working with it with operators and evidence reason can be guided within the within the framework of reality. Thus syllogisms are constructed without knowledge of the causality. For example inductive reasoning with generalizations tries to stay true to the nature and extent of the observed reality. Such assertions are often justifiable if there is greater utility of doing so than of not doing so. The assertion that *all swans are white* was modified when black swans were found in the Southern Hemisphere. Would a single white raven change the assertion that *all ravens are black*?

Extracting inferences from logical assertions: Rarely is anything accomplished through the grand visions heard from pulpits. The search for a reality-based reliable guide begins with the assumption that humans can understand the world of their experience, albeit incrementally. Senses provide evidence for the real world happening, albeit it may be corrupted. The pragmatic belief is that such efforts can be formulated as rules and models to describe the workings of at least the observable and testable parts of universe. Even for the inductive inferences of descriptive natural science where we merely observe and infer from experience, one cannot escape the need to seek independent verification and rationalization of the generalizations.

The staying power of a model resulting from such beliefs comes from its ability to accommodate orthogonal slices of universes. Evidence based inferences further expand the scope of the model. With each set of new inputs, assumptions behind successful models are tested against the expanded reality. Tested assumptions become enshrined as principles, laws and theories with greater predictive utility. From the practice of science, here are the stages through which models improve their validity:

(a) Rule of generalization become a natural law is the statement about how at least a part of the universe operates in terms of verifiable physical reality. The assertion that something cannot be created from nothing is enshrined in laws of thermodynamics that assert the conservation of matter, energy and information. Patterns coded in such laws often begin, as empirical assertions such as *all swans are white*, and then slowly graduate to the status of Laws of Motion which account for the planetary motions, as wells as the machines that started Industrial revolution. Ohm's law for conduction of electricity and many others are now part of the information revolution. Laws with too many limits or no predictive power lose their utility. Laws are falsifiable by evidence. Thus even a single experimental demonstration of *perpetual motion machine*, or *spontaneous generation*, or *omniscience* would invalidate the laws of thermodynamics, and with it may crumble the whole structure of the physical sciences and conceptions of causally deterministic reality. Fortunately, there is no imminent danger of this.

(b) A principle has a more general outline of assertions. Principles connote something deeper than rules and laws. For example, the principles of genetics are verified by inheritance of genetic traits. Principles guide specifics and permit examination of particulars within the domain or framework of acceptable generalization.

Unlike law, principle is not experimentally established, although its predictions are experimentally verified.

(c) A theory is a statement about how the universe operates. Examples include: the atomic theory for the smallest components of the living and nonliving substances; Darwin's theory of evolution and selection of species; or the theory of relativity about the relationship between space, time, mass and energy. Within their applicable domains each theory describes how nature operates on the widest class of phenomena on the basis of as few assumptions as possible. No matter how good a theory is in organizing the past and present, its real utility lies in its predictive power for the future. A theory has little appeal if assumptions are not testable and predictions are not independently verifiable. Acceptable theories are falsifiable through critical results. Predictions of a non-falsifiable theory are unlikely to be reliable, and invariably these are self-referential.

Useful models and theories have explanatory and predictive power. Their staying power lies in such utility. With each development an additional part of the universe is iteratively scanned, and another slice of the universe appears critically consistent or inconsistent with an emerging model. As the models come and go the debris of critical results of enduring reality persist in better models.

Physical laws encompassing the limited experimental contexts are recycled into a new theory or model. Inadequate models are not discarded until more effective new models are in place to adequately accommodate and account for the critical results. In this search *ultimate truth* is a never-ending iterative process, where causality is in the hierarchy of the parts and relations.

Hierarchy and mechanisms. What binds all scientific descriptions is the implicit belief that the evidence based assertions are not independent constructs. The level of confidence in scientific theories is not simply based on the fact that *no non-black raven has been found*, nor on the belief that the ultimate proof of the pudding is the eating. The confidence derives from a consistent set of parts, variables, and relations that describe the functional and mechanistic hierarchy from the subatomic to cellular reality, and possibly higher. At the very least nothing demonstrable seems to contradict it.

As we explore we uncover layers of hidden worlds. For a broad range of physical and chemical phenomena such diversity is reduced to a few invariant assumptions backed by a few variables, constants and parameters. Additional terms may be assigned in more complex situations. However with increasing complexity the level of confidence in the totality of such descriptions decreases. For example, very few biological models are at the level of a tested physical theory. Simulations of environmental and social sciences do not satisfy key criteria for testable closed and isolated systems. Approaches to deal with complex real-world systems are based on operational assumptions with a goal to identify the domain of probability. Hopefully, reason will follow if an order is found.

It is a recent development to relate function at one level of a hierarchy to events at another level. Such structure-function analyses have given confidence in reduction and mechanism. It is promising in the sense that criteria for validity are built into parts as well as the reality-based hierarchy. As promising as it appears, there are unresolved conceptual problems. At one end of the known hierarchy is the quantum behavior in the subatomic level. Behavior of this world cannot be reconciled with the known

deterministic methods that seem to work at the molecular and higher levels. Above that are the complex systems with too many variables that cannot be lumped together or analyzed meaningfully even with the brute force of conceivable computing power. In such complex systems, information impinges on the decision making process in too many ways. Few of these are formalized. In such an environment all pervasive and continuous *perfect* information may exist only for the purpose of rationalizations.

Can ideas from physical sciences be applied to laws governing human affairs? To facilitate human understanding, as through rules of mathematics or physical sciences, it is necessary to recognize that laws for physical reality are tentative in the sense that they have not been proven wrong. Also, a meaningful theory *of* everything, or for that matter a theory *for* everything including truth and theory itself, is wishful thinking. It suffers from the paradox of infinite divisibility as the smaller slices of universe tend to become less relevant in the context of the whole.

The same holds for a prescription of a desirable set of choices for all humans. The potential of a single species lies in the diversity of individuals, each able to adapt to certain niches and changing conditions. It is also intricately associated with other species and happening in the web of life. The deterministic uniformity of the physical universe (even for the simple gases) comes not from the uniformity of behavior of the individual parts, but from the behavior of the chaotic aggregates within the ensemble. Chaotic behavior of individuals, aggregates, and the diversity of the behaviors within the class are the hallmark of the entities that we classify as the viable and sustainable biological species of living beings. It is as fundamental as the deterministic and quantum behaviors.

Bio-logic: Consilience with an evolutionary rationale. The appeal of biological evolution comes from the demonstration that like everything else it is grounded in physical reality. Evolutionary outcomes have emerged in the face of large uncertainties from trial and error in virtually all possible niches over a period of more than three billion years on Earth. The total number of trials is large indeed. Such strategies have charted a course of action for survival, continuance, and sustainability.

Of course, such a snapshot of the present says little about why many more perished on the way. Tautology of *survival* is based on the current state of the species resulting from the changes that occurred randomly over a period of time among the groups of individuals. Often with minor evolutionary changes preexisting functions adapt or remove an organism. Individual functions that assure genetic viability of the species in the niche environment have little to do with the overall fitness of the individuals judged by some misguided external criteria.

Functional changes emerge randomly in individuals of a species over a period of time, and then the population genetics takes care of the rest. In the end, the snapshot of the current state of a species reflects a chaotic mix of changes that has thus far led to the reproductive success for survival in the niche environment. The only attribute of evolution is to perpetuate genes, and as a measure of *fitness* it relates only to past reproductive success. Of course, it is tautology. It does have an advantage of evolutionary experience if we look for it in order to formulate a law or principle to guide the future course.

Can the emerging lessons from the evolutionary experience can guide the deliberate course of human actions? It calls for human choices and decisions whose record is abysmal.

The 19th century formulation of *survival of the fittest* gave free reign to the culture of violence over the next century. Such knowledge-based-rationality of humans turned out to be worse than what humans call *the rule of the jungle*.

Lessons from biological evolution are far too subtle to set the course for global experimentation and tinkering. Natural selection is a rationalization of survival in a niche through processes that required constant changes for adaptation. In our hurry to look for a function with a reductionist mind-set, to arrive at a hypothesis we pick and choose facts and goals. Motives, biases and rationalizations can hardly be peeled way from our actions. A fact may be correct, but for a valid hypothesis one must explore all the relevant facts - direct, consequent and implicit.

Lessons from the suspected disasters of biological evolution can be used to reshape our goals and methods. To carry out the chores of living for some time to come, we may decide to better manage what we know may be a small planet inhabited by a diversity of interdependent life forms. It calls for room for doubt to guide our actions and expectations.

Consilience: Often, reason is not enough. Consilience is crux of reasoning with propensity for deriving conclusions by altogether different, but all-inclusive, means. It is a mindset to deal with situations about which we cannot even intuit. It is a real-time way to rationalize the world-view connoted by the worlds that we are trying to understand.

Inferences and probable premises form the basis for further reasoning. The relationship between facts and syllogistic reasons for a hypothesis may be a matter of debate for a system at equilibrium. Dealing with the evolutionary steady-state dictates even greater prudence about relationships that build on feedback. As somebody put it: *We may be able to design a perfect human being*

long before we know what those traits for perfection are. The task is not any easier for designing molecules, plants and other organisms. As it is turning out, many of the genetically modified organisms lose their viability within a few generations. Potential cures based on the gene-modification are also beginning to show undesirable side effects. In such cases we do not have wisdom of hindsight.

Distant causality with incomplete knowledge. Unintended consequences from the justified true belief in one desire or another include the population problems from improvement in the survival rate. Another is the over-consumption of resources that is built into the criteria for economic progress. Similarly the racial biases are built into the duplicitous policies and attitudes towards the barbarians. Clearly, except for not repeating the mistakes of the past, little can be done to undo the past actions. Yet, something has to be done at least for those that continue to suffer consequences of unresolved issues. The lesson from the history is that certainly, one cannot wipe the slate clean and start over again. Nor should one do so, or even forget the disasters without a challenge of inquiry. It is feedback.

The end and means argument for social issues and conflicts also comes from the condition of incomplete knowledge. Since knowledge is only provisional, natural laws guide to hypotheses conceived to be tested though practice. Application of causality in the affairs of man demands accountability and ability to resolve problems before too much damage is done.

Reason has limits. It is said that information relative to a problem leads to better decisions for future action. In this sense, methods of science have become arbiters of causality and even for the consequence evaluation. With the belief that the best of science is the triumph of reason, scientific reasoning is a kind of dialog between the potential and the actual, between what might

be and what is in fact the case. It is not the causality with immutable a priori. It is a pragmatic construct that predicts based on testable evidence and leaves room for doubt in the judgment. The trial-and-error (empirical and experimental) approach provides a basis for developing the working principles. All this can happen only within the limits of the hierarchies of the physical world.

Human society and the biosphere on which we depend are part of an exceedingly complex web. Its multiple states are only operationally discrete. Their stability depends critically on the local conditions. Pragmatism requires gradual, reversible and non-destructive methods of change. In altogether different context Bertrand Russell observed *such approach is important not only where it prevails easily, but also, and even more so, in the less fortunate times in which it is despised and rejected as the vain dream of men who lack the virility to kill when they can not agree.*

Delayed perceptions. Discounting the fact that even a broken clock is right twice a day, we probably agree that even in the absence of necessary knowledge certain individuals act more rationally in making their choices than others. Also not all actions of even the most rational of individuals can be characterized as rational. History tells us that many of the actions were recognized as rational by most only after centuries and millennia.

Actions are rarely initiated as a matter of thoughtful analysis in the context of the inflexibility of individuals versus variations within the species. Often, in a black-box fashion, we deal with and react to awareness of a stream of consequences resulting from the previous action. Awareness of inputs from event or happening instantiates the experience, which may be evaluated on the basis of prior knowledge for making decisions. Often the real-time actions are based on perception of the reality

and potential of the situations at hand. Rationality lies in the validity of perception that improves the reliability of consequences of actions based on the flow of awareness. For such purposes we have come to rely on tools at least as much as on the experience of the past.

Humans are tool-seekers and tinkerers. On the way to quick-fixes and to satiate desires we battle with ideas and chaos of choices. Need for wider input comes from the realization that humans are limited in important ways. Our actions are driven by momentum than by reasoning. Individuals rarely have the necessary knowledge to make informed decisions in real time. Individually we are able to come up with far fewer relevant choices. Moreover, we rarely seem to be able to make use of the relevant knowledge at hand.

Our ability to imagine alternatives and to speculate comes from group interactions. Through trial and error in thought and behavior we are forced to modify our hypotheses to move gradually away from darkness, hopefully towards the light in which we can see ourselves as well as others. Individuals accept social constraints on actions because plurality of thought and behaviors often takes us from a local to a more global optimum. This is how we learn that not all ideas are created equal. In the same fashion, chaos of choices does not necessarily offer the best choice of tools.

Tools have become synonymous with the solutions that one can pay for. Far more money is to be made by exploiting the way people make choices, than in asking them to make informed choices. Material success unleashed by physical and medical sciences has made desires virtually synonymous with choices in the marketplace. It has wider implications for the systems that are not at equilibrium. The flow of resources from globalized markets

is inherently unfair, one sided, and beyond the normal democratic controls. The forces that caused the great upheavals of the industrial revolution are now being exported over a very short duration to the unsuspecting. In the guise of globalization millions are disfranchised from fashioning their own tools.

Distant causality, synchronicity, and coincidence. Modularity of tools is also built into our ability to conceptualize. It is not always trivial to identify individual causal actions even for some of the most significant consequences. In refusing to deal with such limitations, acausality treats any relationship between events as mere coincidences. Even if one starts with the assumption that events of the universe are random and uncorrelated, our actions may be grounds for cohesion of events through local perturbations. At the other extreme is Jung's concept of *synchronicity*, according to which all events in the universe are connected, albeit in a chaotic way, whether or not we can recognize them to be connected.

To appreciate the origins of such tendencies, consider isolated news reports in which Americans, Israelis, Islamist, or Vietcong killed scores of people. Is it any different than carpet-bombing by the Allies of a French village in the waning days of WWII? By this time Germans had already retreated east and 7000 soldiers were left behind in this village of 4000 on the Western coast of France. Repulsive as it may be, most of us treat such sanitized reports as isolated events. Is it because we do not connect to causality unless we are touched more directly by the consequence? Do we need some tool (pretext) to make the connection?

To move the argument further, consider what caused death of the residents of an Afghan hamlet mowed down by a high-flying bomber sent there in response to two hijacked

airplanes crashed months earlier 7000 miles away into the Twin-Towers in Manhattan. We can talk about the bombs as the physical cause. Clearly, we cannot blame the bomb, even though the dead were hit by the bomb blasts. *Credit* or *blame* depending on the point of view is to be shared by the bombardier in the bay who opened the guns on cues from the pilot. Cues were programmed in some distant office. The operatives on the ground who did not even know that this action is going to take place provided information leading to this action. The same for the scientists who made super-efficient killing machines, or for the politicians who did not explore other options or did not leave other options open. Not by coincidence, as if to pass around the blame, institutions implement actions through hierarchies. You can blame an individual but not the entire system!

Regimentation, through a narrowly defined call for duty at every stage, restricts a role for individual decisions. Without any eye contact humanity of the individuals at the front is further marginalized. The residual associated guilt is *treated* with amphetamine pills prescribed to those on the *mission*. By doing away with the possible humanizing influences that come from active interactions between humans, only the institutions and machines can carry out their work.

In a sanitized, hierarchical, and multivariate world, we operationally, but not objectively, speak of physical cause (bombs), efficient cause (pilot and bombardier), material cause (electronic bulls-eyes, bombers), formal cause (battle strategy, war machine), and final cause (political decision). Clearly the people who developed the relevant science and technology have also contributed to deaths in that distant hamlet. The war-machine justifies this as a collateral-damage. Finally, causality of one's own fault kicks in if death is a consequence of just being there in the

middle of a bullfight. Clearly, when honors and accolades are accorded, many of the same people put forth different spins on their contributions.

The philosophy of assigning cause is far more involved. The political or legal descriptions standardize the cause as *the act of war* or *the security concerns.* Such excuses are phrased with clichés like *weapons of mass destruction* in the possession of the demonized adversary. Of course, our own weapons and methods are only for self-defense! When do we begin to blame the motives as the cause? Economic, imperialistic, and racial motives continue to be insidious and far more difficult to pin down.

Morbid examples, whether from epics or the evening news, make us pause. Our survival instincts evoke emotions. Our innate sense of fair play sometimes causes revulsion against such acts. Human instincts are often countered and blunted by constant barrages and spins. They desensitize us through rationalizations. At some point perceptions deteriorate to cynicism. That is the purpose of psi-op (psychological operations) fog away from the trenches. Wedges of faiths and skeptics give appearance of controversies where there are none. On the other hand, doubt (*syad nay*) appeals for active interaction to resolve identified concern.

Against Gods and Humbug