CHANGELESSNESS, AND OTHER IMPEDIMENTS TO SYSTEMS PERFORMANCE[1]

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INTRODUCTION

In the paper is a concern for the decreasing capability of humans to appreciate that which they have an increasing ability to manipulate. Articulated in a 1970s U of Penn systems sciences dissertation[2], this was ascribed to a seriously limited capacity for context appreciation. This was proposed as a consequence of an historic emphasis on reductionistic ideas and analytical thoughts, not holistic ideals and systemic thinking. This was similar to the notion that humans become adept at achieving short-term results, but not at managing their longer-term consequences.

The systems science platform of the 1970s, especially the planks developed by the Ackoff/Ozbekhan/ Trist group at U of Penn, argued that appreciation of connections was a better route into context-sensitive systems than was traditional analysis of parts[3]. While there was ambiguity as to what this meant it was sufficiently attractive to encourage much fruitful research and several innovative dissertations.

Concern for context and how humans choose to understand or ignore it continues to be an important theme for systems science researchers. It has led to a series of

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[1] An important precondition to classical knowing was the appearance of objectivity. The quest for this supported the idea that there need to be a constancy of what was known, i.e., to be scientific you needed to be able to ask the same question again and get the same response. This would be sufficient evidence that a researcher had "stood aside" from the researched situation. By inference, the distance between viewer and object was a quality where the greater the distance the greater the quality. This generated considerable "explicit" information about phenomena, but now the concern has moved to what David Bohm has called the "implicate order," especially of phenomena that are dynamic and nonlinear. He argues how these phenomena must be engaged. Additionally, under conditions of discontinuity and rapid change how helpful is it to repeatedly ask the same question?

[2] "Regulation of Environmental Deterioration," Hawk, D.L., Dissertation, Social Systems Sciences Program, University of Pennsylvania, 1979. The thesis was that environmental deterioration resulted from an inability to appreciate context. This was because social systems have become addicted to use of an analytic frame of partial thought. The most worrisome aspect of the resulting dilemma was that the same analytical model that had created the situation was now being used to resolve it. The situation was doubly damned by then being formalized and institutionalized via a legal system that was designed for stable environments. The recommendation from the work was to move from the "legal order" model, that values stability, to a negotiated order approach, that embraces dynamics.

[3] This notion was introduced in the 60s by Sir Geoffrey Vickers in his work as to why and how appreciative systems differ from rational and analytic constructs. While they can accommodate much more, they also require much more innovative management methods. West Churchman's work on *Design of Inquiring Systems* and the Systems Approach and its Enemies offered similar ideas.

interesting questions. Many agree that context is important, if for no other reason than to give meaning to discrete acts. The first question then becomes, why do most people still ignore context in their work? Why does the segmented route to partial analysis of part processes continue to define the mainstream? Why does it attract the major resources and the basis for most of what we consider to be innovative breakthroughs? And finally, why has systems terminology been so widely applied while the systems approach has itself been so widely avoided?

STRENGTH OF THE ANALYTIC PARADIGM

During the 1970s the systems sciences were gaining strength, applications and noteworthy results. By the mid-1980s, the early attempts to achieve a holistic systems science perspective in many areas has been largely suspended. Work had shifted to more clearly defined problems that could be addressed in what was seen to be a more productive manner via partial analysis of pre-reduced parts. The results were similar to those that had initiated general systems research several decades before.

During the 1990s concern returned to deeper relations between parts, between parts and their environments, and about systems instability. Questions regarding the meaning of analytic conclusions resurfaced. Signs of this were seen in a growing acceptance of Chaos Theory, an increased credibility for ventures like the Santa Fe Institute, and cross-disciplinary endeavors that generated highly innovative technology.

This should have provided credibility for a return to the systems science agenda of the 1970s. It did not. There was recognition that the analytic agenda was clearly insufficient to the needs facing society, but the response was an acceptance of systems' terminology and a rejection of systems perspectives and philosophies. Why? The reasons for this and the research to better understand and respond to it are at the center of current concerns in systems sciences, and in this paper.

The Trist, Ozbekhan and Ackoff depiction of our inhabiting richly connected situations that could better be managed as problematiques or messes seemed to gain ground against the analytic tradition of problems seeking solutions. But, somehow, this was not to be. In management, the ease of learning and teaching case-method approaches carried the day. The situation appeared to be changing, but somehow it was being transformed from a base camp of logical positivism into a Lewis Carroll world of Alice-in-Wonderland. The terminology of the systems approach was used more for its marketing appeal than as a means to access more meaningful research questions. The situation thus became even more "problematic" and "messy" that what was originally envisioned by the Ozbekhan and Ackoff articulations.

The Alice world now had dynamic terms for putting a new spin on static, and pretty boring, models. It could use change as the central concept in an argument for careful monitoring of the continuation of the traditional. It could use general systems terminology to argue for policies and practices that stand in opposition to systems thinking. The result is that systems concepts appeared to be used for temporarily shoring-up the tradition whose weaknesses had initiated the need for the systems approach. The irony is great. The need to find a way out is even greater.

The idea of contextual appreciation was a way to improve the seeing of systemic connections between things. Some things might thus be done better, while other things might simply be left undone. This has since been turned upside down by opponents to the “systems agenda” via their use of the concepts to built a researchers’ Alice-in-Wonderland Garden. Examining and dissecting context had become a means to conserve the traditional instead of modify it. Contextual appreciation was thus a trendy term for new ways to reduce and analyze context. As such it was not used to see the richness of connections that defines context.

Instead of understanding context, analysis dissects it. This allows humans to do things pretty well as they previously did. For example, instead of using context understanding to see the web of relationships between humans and their natural environment, analysis could be used to save parts of that environment from parts of what humans do. The Environment could thus be “protected” from the worst aspects of what humans did and presumably will continue to do. The term environment and the values demonstrated by a 20th Century environmentalist have come to rely heavily on the terminology of the systems approach, but not the framework. The emphasis should instead be on how to avoid approaches that allow old deeds to continue via new labels.

This requires a return to some historical moments where fateful choices were made around profound distinctions. These are profound because they continue to underlie human attitudes about reality and change. This may also explain why the systems approach has had such limited success in its battle with the analytic tradition. To illustrate what this means in some detail a research venture[4] that deals with problems of environmental protection is outlined in the next section. At its basis it encountered the problem of how to get a social system to move from a tradition that abhors change to one that can embrace it, as well as avoid using new terminology to hide the weaknesses in business-as-usual.

The same logic is used in the concluding section to suggest why there are weaknesses in all systems of thought, include the one we know as systems theory. A weakness is outlined there that comes from the reductionistic tradition, is a clear indicator of an anti-change attitude in science, and is endemic to the systems approach. While opposing the reductionistic tendencies of changelessness in science, systems theorists have themselves fallen prey to a trap they consul others to avoid. This concerns an almost blind faith in the dreams allowed by negative entropy. This added to the general societal bias that avoids questioning most traditions, is doubly troublesome. It encourages humans, including systems scientists to believe they can invent perpetual motion machinery and thus over-ride entropic processes. In a research endeavor outlined near the end of the paper it will be pointed out that this belief, and the systems of thought it fosters, was the single greatest obstacle to environmental appreciation and improvement, as it was formulated in some 1970s and again in the 1990s research venture.

CHANGE[5] AS KEY TO CONTEXTUAL APPRECIATION

[4] The venture was established to see if it was possible to change an industry without use of the state’s mechanism of legal order to force the change. The philosophy behind this came from systems sciences work in the seventies that demonstrated how if the legal order mechanism was successfully used that the ideal would by definition be lost. Thus a means to induce change was needed that did not rely on exterior force but interior value shift. In some ways this is simply the age-old Faustian Problem; i.e., the long-term expenses of short-term avoidance of the characteristics of change. This was the good news.

[5] The concept of change, its clarification and its management, is critical to society. The concept is only being accepted as “difference-over-time.” We need to find a way to expand this to accommodate what we have long accepted as “difference-in-time” with change, or “difference-over-time.” Product design in society has

A clear and fateful choice was taken in 5th Century Greece[6] and China. The subject was the phenomena of change as it related to reality. The objective was to find a way for humans to deal with the relationship. The decision profoundly impacted how humans came to perceive, interpret and manage their separate and mutual realities. On one side was a deep faith in the security offered by a utopian state of "changelessness." Therein, reality was defined as <u>that which did not change</u>. Whatever appeared to change could be disregarded. Where change emerged, it could be assigned to an area of no/low importance. Changelessness, in policy and practice, could be a legitimate way of life. Where the forces of change were too great, changelessness could always shift a little bit, and become slightly mobile as a form of "stability." This fixed stability could even be allowed to move a bit more and expand to include the idea of "sustainable."

The alternative route was different in a profound sense. It was for whoever became intrigued by the aesthetics of change. Beliefs about it were held with similarly strong conviction, but as can been see, by far fewer people. Those embracing change defined reality as <u>that which did change</u>. Emphasis was with the beauty of that which was dynamic instead of the protection offered by what was static. The choice was between a changeless state and a state of change. At the most general level the debate dealt with how humans would negotiate with nature. At a more specific level the debate set the stage for how humans would confront themselves and each other.

Parmenides of Elea was the early proponent of reality as a "changelessness state." This was the same theme of Plato when he argued that the ideal that lay behind appearances was as fixed as it was unknowable. Heraclitus of Ephesus argued instead for reality as "a state of change, not a change of state." The two lived during the same era. They offered a clear choice to citizens of pre-500 BC Greece. Both of course presented strong evidence to support their logical framework. The basis of society's eventual choice was probably not on the evidence presented.

This 5th Century BC choice, as it occurred at about the same time, on both sides of the world, provided a fundamental distinction for paths to human development. It also implied very different rules of engagement regarding how humans would relate to other humans, their surroundings, and, ultimately, themselves. The choice taken was clearly on the side of social conservatism via the passion for changelessness. Platonic fixations and Aristotelian structures won. This is perhaps one of the most fundamental problems facing the now-fading 20th century. How the consequences of that choice conflict with contemporary reality may be the key dilemma of our age. If so, this provides a new way

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largely been limited to trading in difference-in-time issues. In fact, difference-over-time governs the success and failure of difference-in-time organization. In this way the contextual can be integrated into the phenomenal. In the past this was impossible. Some of the reasons are outlined in the Watzlawick, et.al. book on: *Change: Principles of Problem Formation and Problem Resolution*, New York: Norton Publishers, 1974.

[6] <u>A basis for the frame of reference</u>: This dichotomy presents one of the most fundamental of early human choices regarding societies and their structures. The choice was between Parmenides of Elea, who advocated that reality was changelessness, and Heraclitus of Ephesus, who argued for the reality in change. In the East the choice was between Confucius, who was essentially on the side of Parmenides, and Laotse, whose beliefs coincided with those of Heraclitus. This became a foundation of the belief systems for the design of human: systems of governance, concepts of law and formation of social institutions, and the built environment. Humans sided with Parmenides. This was perhaps a consequence of their wanting stability in the face of change. It will be argued that humans have paid a heavy price for their early luxury. This is seen in the design of the institutions and artifacts, including urban regions and the values behind the bodies that create and govern them.

to see and understand the difficulties in contemporary cultures, institutions, artifacts and ways of knowing. As such, it provides some clues as to how all of the above might be improved.

In summary, the changeless perspective assumed that whatever changed didn't exist or could be assumed to be unimportant to human affairs. This perspective was especially strong in classical physics until the late 19th century, and even prevailed in some aspects of early 20th century relativity theory. For example, Einstein was primarily responsible for the momentous break with Newtonian physics, but yet he showed a fondness for maintaining a connection to stability by arguing for the cosmological constant. This would allow there to be sufficient matter to keep the universe from infinite expansion. We see similar tendencies in most religions, legal systems, economic assumptions and other areas of social expectation that attempt to bind groups together. The change perspective assumed the existence of a quite different worldview. Phenomena that did not change were dead, or were negligible as compared to the dynamics that governed the human condition. The emergence and acceptance of the change perspective can be seen as a critical part of the development of much of contemporary science, e.g., modern biological science understanding beginning in the 1920s.

Each offered a different vision of reality, and different constructs and concepts for negotiating with it. Important to research outlined herein are the alternative consequences of each view. Each set out to know, make, maintain and negotiate with a very different set of conditions for the improvement of human well being. Each designed, fabricated and supported a very different social and physical environment. Each came to form a different relationship to a different view of nature. The choice made in 500 BC led to a fateful division on the pathway of human development. Changelessness was the apparent choice, leading to design of institutions and artifacts that are intended to deny the more dynamic forms of existence. Significant resources have clearly been invested in processes that resist change. The purpose here is to create a knowledge base for those that want to embrace change as a viable attitude and method to research.

There are three major issues in the choice concerning change that need to be understood, in order to shift the societal bias in what we do and why we do it. They are:

1. Being Seduced by Stability and Related Arguments for Changelessness
2. **Embracing the Systemic and Other Counter-Arguments for Change**
3. Researching the Distance Between Changelessness and Change

1. SEDUCED BY STABILITY AND RELATED ARGUMENTS FOR CHANGELESSNESS

"Daring it is to investigate the unknown, even more so it is to question the known." [7]

The continuing bias towards achieving a changeless society is easy to see in societal institutions and their history. Governmental structures and the political institutions set up to promulgate them may seem to appear to be innovative and creative. They want to appear "progressive," or somehow associated with change, but where they suggest such luster they either loose it quickly or show signs early on that they did not

[7] Watslawick, et.al, ibid, p. xi.

really mean it in the first place. Recently established bodies, such as those for protecting the human environment from humans, or for recycling products, or for working towards a sustainable life, are recent examples of conservatism masking itself as innovation. These exemplify continuance of an attitude formalized in 500 BC Greece, and China, and that will undoubtedly carry over into the next millennium. Older institutions of modern society, such as its legal system, is approach to governance, and its belief in the role of marriage, may also qualify as instruments of changelessness.

It is now important to reconsider the 5th century decision for artificial stability as it has been used to create a platform. We need to experiment with a new human contract that could be more sensitive to the change processes that unfold regardless of human desires. This would involve fundamental research and experimentation. It would also need an integration of conceptual frameworks similar to that sought by the framers of general systems theory.

This would involve research defined as "a process to search again in order to see clearly for the first time." This would value different parts of the search process and would require a different approach to seemingly intractable problems of contemporary society. It would necessitate an interdisciplinary approach to contemporary problem resolution. It would require a new appreciation and understanding of change dynamics.

Maintaining non-change, even anti-change, characteristics in the face of ever-increasing forces of change has become too expensive for most societies. Even rich societies have found that the cost of traditional boundary maintenance is too great and the advantages too questionable. While still disallowed by the dictates of the current system biases, some very attractive methods are available. A few groups profit from the current discontinuities, but the majority of the world's population ends up with hopelessness to face unrelenting changes that are seen as beyond their means of control and understanding. They have been disabled. They cannot effectively respond to the dynamics in their own environments because the models they occupy stem from a rational scheme that doesn't exist because it continues to pretend existence of a changeless state. The expenses of maintaining the resulting mismatches are great.

It is critical to begin to work towards improvements in our vision, models and measures of the phenomena of the urban environment. This can improve our understanding of how science and technology can best aid in the management of environmental change dynamics. As more of the earth's population is drawn to the places that seem filled with environmental hope while they are managed as base-camps of industrial hopelessness an alternative is needed. Critical to this is new knowledge for realizing new potentiality. Perhaps it is time to start reinventing wheels and raising questions about other truisms.

2. EMBRACING THE SYSTEMIC AND RELATED ARGUMENTS FOR CHANGE

"Plus ca change, plus c'est la même chose." and how to get things to not remain the same, when they change.

As we approach the beginning of the 21st century a new mix of exciting social and technical possibilities are available for improving the qualities of the human condition.

These involve the means for rethinking social institutions (that govern and support social well-being), exciting ideas for rebuilding the made-environments (that provide the stage-set for human potentiality), and new models for redesigning technologies (that can enhance relations between humans, and between humans and their natural environments). Still lacking are models, methods and measures that allow integration and management of these resources.

In the 1950's, leading members from various disciplines argued for a need to integrate the significant scientific and technological resources that were just then seen as beginning to emerge. This was the beginning of what is now known as the "systems science approach."[8] The scientists posed a set of very challenging critics of the limitations of continuation of industrial based models for developing and using science and technology. They pointed to the need for and possibilities in a somewhat sketchy "post-industrial, bio-cybernetic era." The essence of their argument was that there was a clear need for a new set of ideals to drive knowledge creation. Basic to their agenda was an interdisciplinary research approach to achieving integrative and innovative ideals. Their work came from a new set of research ideals and called for a new set of methods. Their aim was to create new knowledge about how future human environments might be improved. The agenda was dismissed during the 1980s but in recent years their bio-physical-social proposals have been actively re-addressed by the work of a few scientists.

Many of the economic, political, scientific and technological elements necessary to experimentation with the systems science approach were lacking when it was first articulated. Some of the missing resources have since been developed. Still lacking is dependable knowledge of the principal processes behind change dynamics; processes that appear to be caught up in the unseen limits of known rational models. We should reconsider the current scientific-philosophical model of research in light of the trouble it is having with dynamic processes. Central to this work is the concept of change, how it is defined, modeled, measured and managed. Change tends to exist just outside the limits of unaided-rationality[9]. We need to carry out research that better serves human needs in their efforts to best realize the consider potentials that have become possible.

3. RESEARCHING CHANGE

> Goethe's greatest contribution to the discovery of the mind was that, more than anyone else, he showed how the mind can be understood only in terms of development. In Kant's conception of the mind…development has no place. He claimed to describe the human mind as it always is, has been, and will be. There is no inkling that it might change in the course of history, not to speak of biological evolution or the course of a person's life."[10]

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[8] This is exemplified by the sub-component of AAAS known as the General Systems Society. Their 1954 agenda began with concern for the growing complexity of societal problems, misallocation of limited resources and the lack of ecological understanding of human activities, and how most of these problems were the result of an overly reductionistic model of science that was bound to the tradition of disciplines. Related to this were the founders of early cybernetic thinking and the Macy Conference that involved some of the same people and concerns.

[9] Unaided rationality refers to the definable limits of any single approach to rationality, and suggests the greater potentials in being able to also accommodate the non-rational in any human situation. In this it is a more general and very different construct than Herbert Simon's "bounded rationality" in economic thinking.

[10] Kaufmann, Walter, *Discovering the Mind*, New York: McGraw-Hill Book Co., 1980, p. 25.

Research is needed to find new ideas and objectives for understanding the human condition. One obvious research location is where human potentiality, and associated problems, is seen in their greatest concentration – *the urban environment and the systems that produce it*. A focus could be to identify the key variables that govern the change dynamics of the urban environment. This problems and promises of this are great. This is problematical because it is the location of the most dense human activities and is very illustrative of the myriad of connections and disconnections that define the current human situation. It is promising for the same reason.

The urban environment most clearly demonstrates the negative aspects of the decision taken 2,500 years ago. The current urban condition is in fact more clearly understood via the contradictions that come out from trying to see cities as fortresses against change while the contents of these forts contain the dynamic phenomena of life. The difference must be reconciled, or paid for the cumulative mismatch. While the earlier choice seems to have been the least expensive in first cost, its consequences appear to hold a very high set of second costs. Even the maintenance costs are becoming very high. Selecting the change paradigm had problems but that route, by its nature would have required a continual reconciliation of life-cycle costs. The nature of the changeless path was to resist change until there was a crisis, thereby insuring the non-linear change process that was initially the greatest worry of those advocating changelessness.

The price that is being paid for continuing with the tradition of changeless continues to grow. There needs to be a better way to negotiate with the continually unfolding reality that we know to exist in spite of our best efforts at control. Costs have always been associated with this process, but, somehow, something is now different. The costs are beginning to rapidly escalate. The costs come from unresolved contradictions that accompanied the choice and growing maintenance problems. They are primarily carried by our context but seem recently to have surfaced internally to the human condition. It is time to examine the other side the twenty-five-hundred-year old choice dichotomy.

RESEARCH INTO CONTEXT APPRECIATION

Human beings have significant problems in being human. The difficulties are manifest in many ways but are clearly be seen in the way in which humans relate to each other and their surroundings. The potentials for improvements in these relations are very great, but so too are the difficulties in finding success. In part this is because of serious shortcomings in how humans conceptualize reality (i.e., as changelessness) and in part due to how material resources essential to human existence are conceptualized (i.e., as infinitely recyclable). Problems with humans relating to their environments begins with their attitudes towards themselves and their environments, especially as those two things relate to change and entropy.

This shows up most clearly in the entropy construct and how we choose to interpret it. Alternative interpretations of entropy are available. Just as with the concept of change, how a nation, group or individual chooses to interpret entropy provides an important clue to how they will manage their relations to their environments. The dominant attitude is that entropy doesn't matter, and where its influence cannot be avoided, the consequences can be recycled. This attitude stems from an interpretation of entropy from the ideas set by James Clerk Maxwell (1831-1879) and Ludwig Boltzmann

(1844-1906). Each, in a different way, felt that entropic processes might somehow be reversed, with the major reversal mechanism being human intellect. This homocentric scenario is similar to that found throughout industrialization.

This prevalent attitude towards entropy allows for belief in reversing it, known as negative entropy. This is overtly optimistic. It tends towards arrogance and is generally ignorant of evidence of change, decay, time, irreversibility and other realities of nature. Systems theorists are guilty of the same bias. They should be the first to experiment with alternative "attitudes" towards entropy, especially those coming from more holistic visions than what was offered by Bolztmann. This would allow appreciation of deeper interpretations of how humans relate to their environments. This would allow serious critic of utopian dreams associated with concepts of "recyclability" and "sustainability," and more recent requests to being sustainable. All these are simply revisitations and continuances of the2,500 year old decision for homocentric control by advocating changeless systems.

An endearing and enduring aspect of the systems approach is that it encourages one to see relations and connections to a larger system of order. It encourages a more holistic stance and innovative, alternative viewpoints. Early on, GST recognized the critical role of attitude in shaping and setting viewpoint. As was pointed out in the first section, attitude helps determine what we see and fail to see. In its favor, the systems' attitude has encouraged many researchers to stretch their thinking. This appears as fundamental and explains the innovative nature of doorways opened by systems thinkers into the arena of scientific discovery and innovation. None-the-less, the systems viewpoint has had its own flirtations with changelessness. An important symptom of this is seen in the early attitude of GST towards entropy where life-forces were felt to exhibit neg-entropy phenomena.

Believing that something is possible, as well as desirable, is a precursor to humans making investments to bring it about. For good as well as bad ends these beliefs can become a magnet for the enthusiasm and other resources needed to work towards accomplish. This generally beneficial process can sometimes be counter-productive, depending on the ideals. The changeless attitude in negative-entropy is one example.

Many researchers believe that the entropic processes can be negotiated with, and, where sufficient intellect is applied, even reversed. This has been a GST attitude since the 1950s, is consistent with the changelessness agenda of 500 BC, and supports the middle-ages religious belief that via information from God humans could create perpetual motion machines. In all three ways the significance of the 2nd Law of Thermodynamics could thereby be ignored and humans could continue to do pretty well whatever they wanted. If we now add the possibility to recycle things, if they can't be reversed, we have escaped all responsibilities.

How the systems perspective views these ideas is critical. Current indications are worrisome. Systems people somehow have developed attitudes similar to the reductionistic groups that they initially criticized. They had some trouble in the late 1960s in responding to the AAAS challenge of Garret Hardin when he criticized the fundamentalistic political-economic belief system of the day that felt Adam Smith's ideas were sacred. In 1968 he asked scientists to reconsider the environmental dilemmas that resulted from the individualistic, results-oriented focus of their individual activities. He restated the challenge in 1998 where he argued why "Freedom in a commons brings ruin to all." (Hardin, 1998) As was reprinted in a recent issue of *Science*:

> "It is easy to call for interdisciplinary syntheses, but will anyone respond? Scientists know how to train the young in narrowly focused work; but how do you teach people to stitch together established specialties that perhaps should not have been separated in the first place? With Adam Smith's work as a model, I had assumed that the sum of separate ego-serving decisions would be the best possible one for the population as a whole. But presently I discovered that I agreed much more with William Forster Lloyd's conclusions, as given in his Oxford lectures on 1833. Citing what happened to pasturelands left open to many herds of cattle, Lloyd pointed out that, with a resource available to all, the greediest herdsmen would gain - for a while. But mutual ruin was just around the corner." (Ibid, 1998)

The essence of Hardin's recommendation was rethink underlying human assumptions while shifting towards a more interdisciplinary approach to human problems. Supportive of the systems agenda, Hardin felt we should look towards context and see the "underlying nature of things." Hardin's initial problem with the fate of the commons supports the concern with our current use of the entropy concept. This was consistent with the concerns of systems thinkers like A. Rapaport and K. Boulding. For example, Boulding proposed a model of human activities that would dampen the economic enthusiasm for competition and increase the concern for resources entering and exiting socio-economic systems. He argued how inputs could be seen in an alternative, more dynamic, system of value and how externalities of outputs should be factored in. This approach lost to the dream of negative entropy possibilities associated with resource recycled and even creation. The concept of sustainability seems to take us even further down the utopian dream world where under the banner of everything matters nothing in fact does matter.

One of the founding fathers of the General Systems Research Society, Gerard von Bertalanffy, appeared to accept the attitude that life was essentially in opposition to entropy. As mentioned before, others around him were not so convinced but the optimism was to great to be ignored. Boulding was concerned about negative entropy not because resources were infinite or finite, but because of the consequences of resource use. Recycling they only led to them being even more used (Laszlo, 1972). None-the-less the possibility of neg-entropy was widely adopted in the thinking of the Society's membership. Most of the second generation systems thinkers adopted this stance without thinking.

Most interesting science and technology development now takes place outside discrete disciplines via an interdisciplinary approach, but seldom by systems scientists. The prior comments may provide some hints as to why.

The idea, i.e., possibility, of negative entropy is a problem in several ways. These can be seen easily in specific research to deal with specific environmental problems. This author is involved with two such projects at this time. Both began with a criticism of the limits of the forced regulatory structure to get an industry to improve itself. Both required using a model of change dynamics. Both called for an appreciation of the situations of which they were a part, as well as a high level of innovation for redesigning them. The idea of entropy was found to be a critical indicator of such appreciation. The idea of negative entropy was found to be a maor impediment to success. It provided an escape hatch to insure that the only approach that would get anyone to move would be forced regulation, although, of course, not very far.

THE ENERGY STAR APPROACH TO IMPROVING ENVIRONMENTAL APPRECIATION

In the Spring of 1996 a project was begun for the U.S. EPA. Within the Energy Star Program this work was to see if an industry could be changed without use of regulation to force it to change. I was asked to undertake this venture due to what I had proposed in the reports from the empirical part of my dissertation in systems theory for Russ Ackoff's program in the University of Pennsylvania. The project began with an alternative conceptualization of problems in the relationship between humans and their environments. Individuals and individual companies would be allowed to work towards what was in their own interests, not that of a governmental employee. The trouble came to be how their interests came to be defined, which was a problem once again of context appreciation. The impediment to change was, once again, found to be in interpretations of entropy.

The research question was: "Can an industry generate information and processes to improve the relations between its products and the larger environment, without being directed by regulatory efforts? The industry is the one that builds homes within the U.S. While often ignored, this industry's products directly account for about 30% of the energy consumed within the country, as well as a related proportion of materials, and of course result in a similar proportion of the nation's air and solid wastes pollution. Indirectly, via the location and situation of the products, it accounted for another 20% of the nation's pollution problems. As much of the industry and most of its consumers know, the industry's products are generally of low quality as measured against those of other industries. Its wastes are significantly higher.

It was considered technically feasible to cut energy use and pollution from the industry's products yet early studies pointed out that it was not politically nor economically feasible to use regulation to attain this objective. The industry lobbying group was one of the most powerful in the nation, accounting for almost $100 billion a year in indirect subsidy to the industry. A directive agenda had once been attempted via DOE energy "guidelines." This approach was stopped before it could get started due to political resistance. This brought the EPA to assume that the costs of enforcement would be prohibitive. Thus, an alternative approach had to be tried in order to achieve some of the Rio agreement objectives on Global Climate Change.

My work for the 1970s dissertation in systems sciences on alternative methods for regulating environmental deterioration was seen as attractive. In essence, it argued that a non-regulatory, non-directive approach to self-regulation of pollution externalities was in most cases more efficient, and in some cases the only possibility. The research found there to be no good and bad guys in the area, but a large amount of bad information (ignorance) and many bad feelings (hatreds and mistrust). To turn this around the normal policing function had to be turned into an information function that would not direct behavior but encourage the behaviors of learning and adaptation. The situation of pollution could then be turned form a legal orders system to a negotiated order solution. This would require a new sense of context appreciation and people who were able to embrace change. This was the basis for the 1996 Energy Star Homes experiment.

The project has been moderately successful except for continuing attitude shortcomings. The objective is to get the industry to improve its quality by 30% more than what was proposed by a set of building regulations, without using the regulations. This means in essence about a 50% overall improvement in the industry. About three hundred producers are now taking part in achieving the much higher standards as required to receive the Energy Star label[11], and several thousand houses have been built, their is a lingering obstacle to even more significant change. It centers on the changeless paradigm and the negative entropy belief in perpetual motion machines as outlined above. It is very difficult to change the dominant attitude is that it doesn't matter what humans do with materials and energy, since people are so smart that they can override whatever difficulties that will arise later. Some of the new technologies in the area are clear representatives of mis-directed efforts to create perpetual motion machines. This includes: geo-thermal heat pumps, solar collectors and PV roofs, as they are now conceived and produced.

Most home producers and especially home consumers deeply feel that there are more than sufficient resources for making and operating infinite homes. Where shortages or problems with quality emerge, the solution lies with "recycling." Via the recycling argument "It just doesn't matter what is done or bought."

The biggest block to this non-governmental, no-cost project is to find ways to inform the public as to why what is produced and bought does matter. Only this will get this most conservative of industries to change. Recent discourse on sustainability only furthers the difficulties in achieving change. The Energy Star initiative continues. More work now needs to be done with the customers. Clarifying the entropy issue may be the most effective way to bring a new sense of appreciation into the situation. It can begin with a better understanding of the fundamental nature of the concept and how humans have articulated this nature in different ways for different purposes. The issues of entropy exposed earlier in this paper need to be examined at a deeper level in order to appreciate their fundamental importance to change.

The Entropy Dilemma and its 19th Century Roots

The speculation of pre-19th century scientists converged in a 19th century articulation of the concepts of time, energy and materials, and how these relate to asymmetries in the environment. Two kinds of asymmetries were noted as important. The first was time itself. The second was with regard to things over time. William Thomson (1824 - 1907) dealt with the first in his elaboration of "the universal tendency of entropy to increase." (Thomson, 1852). Rudolf Clausius (1822-1888) brought meaningful technical articulation to the second asymmetry via his theory of the workings of the internal combustion engine. He in essence argued that the internal combustion engine can only "work" if there is a loss in order, defined as potential to do work, in its larger environment.

[11] The Energy Star label is the same as the one you will find on your computer under the screen saver option. 100% of the world's computer manufacturers are now enrolled in this program, that is voluntary.

From this point the scientific and technological argument turned to whether the entropy issue can be symmetrical or must be asymmetrical? Are natural processes reversible or not? Most areas of science have taken a decision about the debate. While the physical evidence has been on the side of absolute irreversibility there has long been a metaphysical faith that parts of the physical world eventually be found to exhibit a possibility for reversible ordering. Religions have always been steeped in the belief for this potential. Much credit for its emergence in science should be given to the work of Boltzmann. He turned the Second Law of Thermodynamics from its exceptionless nature into one that was statistical. The problem plaguing Boltzmann until his end was that if entropy is reversible, than why was entropy not higher in the past?

The debate continued through the work of Karl Popper (Popper, 1956) into the work of Davies, (Davies, 1974) to that of John Preskill, Kip Thorne and Stephen Hawking in 1998. The last three individuals are noteworthy scientists that illustrated their best thinking in a bet made relative to the validity of the entropy law within the total universe relative to separate behaviors they could study in various corners of the universe. This deals with the general acceptance that the law holds at the universe scale but may not need to in some isolated corners. Their wager had to do with where and when entropy held. More specifically, the discussion centered on what happens to information when it runs into the bottomless pits in the universe called back holes?

> *"Dr. Hawking and Dr. Thorne bet that the information - whether consisting of letters, numbers, the binary digits on a computer disk or even the arrangements of atoms in a rock - is gone forever. Dr. Preskill wagered that it could not possibly be."(New York Times, 1998) The essence of this argument gets to the fundamental differences between relativity and quantum mechanics. It seems that one will need to be modified to explain the entropy at black holes. If this argument sounds familiar it should. Its related to the argument as to whether or not the universe keeps expanding, or as Einstein felt, there was a cosmological constant of mass that would balance it out into the relative calm of changelessness.*

Recent research helps resolve aspects of the entropy debate. It deals with the paradoxes raised in the 19th century and sets the stage for implications in the 21st century. Beginning in 1981, an IBM researcher, Charles Bennett, gave resolution to the dilemma of Maxwell's Demon by showing how a perfectly efficient engine was impossible not just in fact, but also in principle. He showed how even Maxwell's "demon" must expend energy in the process of becoming sustainable via "saving" energy. The "demon" has to forget each transaction prior to the next encounter. Relying on work by Rolf Landauer some years before, that the only steps in computation that necessarily produce waste heat are erasures of information, Bennett could show the perfectly efficient engine to be impossible. One caveat remained in the dilemma posed by Maxwell. Bennett's proof relied on classical physics thus there remained a shadow of doubt relative to entropy's operations in the realm of quantum mechanics, and then of course within statistical thermodynamics. In a 1997 Physical Review article by Seth Lloyd of MIT it is shown that in the wholly quantum world the "demon" is even less efficient than he was in the classical world.

In the fall of 1998 further evidence of the sanctity of entropic process, and thereby change processes, emerged from the CPLEAR collaboration at CERN in Geneva and the KteV collaboration at Fermi National Accelerator Laboratory in Illinois. They found:

> "This shows that you can't turn the clock backward" and always get the same results, says CPLEAR spokesperson Pagagiotis Pavlopoulous." And "These rates differed by about 13%, 'It's a huge effect,' says Fermilab physicist and KteV collaborator Vivian O'Dell. The amount of time asymmetry is just about right to fix the CP asymmetry first observed over 3 decades ago. 'I don't think anyone is surprised but everybody is very happy,' says University of Chicago theorist Jonathan Rosner. Why the decays should look any different forward and backward is still a fundamental mystery. But particles, like falling wine glasses, seem to know that the passage of time cannot be easily undone." [12]

The general issue of the nature of the entropy law is thus now settled in science. Entropy holds firmly at all levels of reality. It is time to carry this understanding to the larger consuming public. The implications are significant. This is a fundamental shift. It will clarify the current questions of what is sustainable about relations between human actions and their environments. In light of the entropic process, can any human activity be considered "sustainability?" Perhaps it is better to say it shouldn't be, so that the concept of change can be better embraced in order to work continuously to infinitely improve what we do. The possibility for human arrogance in the entire sustainability dialogue looms large.

This agenda also calls for reconsideration of fundamental distinctions between open and closed systems in light of what is now known of systems of living order. We could begin this be returning to early distinctions on the subject as made by Ludwig von Bertalanffy.

> "Thermodynamics expressly declares that its laws apply only to closed systems. In particular, the second principle of thermodynamics states that, in a closed system, a certain quantity, called entropy, must increase to a maximum, and eventually the process comes to a stop at a state of equilibrium. The second principles can be formulated in different ways, one being that entropy is a measure of probability, and so a closed system tends to a state of most probably distribution…So the tendency towards maximum entropy or the most probably distribution is the tendency to maximum disorder.
>
> However, we find systems, which by their very nature and definition, are not closed systems. Every living organism is essentially an open system. It maintains itself in a continuous inflow and outflow, a building up and breaking down of components, never being, so long as it is alive, in a state of chemical and thermodynamic equilibrium but maintained in a so-called steady state which is distinct from the latter." (von Bertalanffy, 1968)

The distinction between open and closed systems has proved to be beneficial to a fundamental understanding of relationships between entities and their environments, but it is perhaps unfortunate that the entropy concept was introduced to assist in the ordering of these relationships. It is clear that entities find a means to interact with their

[12] Science Now, http://sciencenow.sciencemag.org/cgi/content/full/1998/1020/1/7:00 PM.

surroundings and in so doing come to define themselves by defining an environment. Angyal formulated this process quite clearly in his early work on systems theory but there is a weakness that lingers in the reasoning that needs to be addressed. The weakness comes from the bias towards believing in entropic processes as reversible, which happened to also support mainstream thinking that supported changelessness over change.

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PROCEEDINGS

RUSSELL L. ACKOFF and THE ADVENT OF SYSTEMS THINKING

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FRIDAY, MARCH 5, 1999

7:30 – 8:00 AM ***REGISTRATION - CONTINENTAL BREAKFAST***
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8:00 AM **IDEALIZED DESIGN VIDEO - Cinema**
"*IDEO – the Deep Dive"* – featured on "Nightline"

8:30 – 8:45 AM ***WELCOME AND AGENDA***
Connelly Center Cinema

Matthew J. Liberatore, Associate Dean,
Villanova University.

8:45 – 9:15 AM ***"On Passing Through 80"***

Russell L. Ackoff, Chairman, INTERACT

9:15 –10:45 AM **SESSION I**

Business Applications of Systems I
Moderator: James Klingler, Villanova University
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OR

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Industry/Government Consultants: Jim Leemann
Rosemont Room