

Korean Scientists and Engineers Association in America (KSEA)  
3<sup>rd</sup> Young Generation Technical and Leadership Conference (YGTLC) 2007  
Fort Lee, NJ  
January 5-7, 2007

**"Coherent Structures in the Randomness"**

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I would like to speak about preparing for leadership roles in the world stage. As I see it, the Korean-Americans constitute a minority group and will remain so unless some genetic engineering is performed for the group with genes of mice or rabbits. The key is then to effectively engage in the war of ideas, in contrast to the politics of numbers. Several years back I heard a short speech by a Korean Ambassador to the U.S. After hosting the Olympics and successfully joining the Organization of Economic Cooperation and Development (OECD), the Korean administration had felt that Korea finally had it made, and went on to celebrate her coming of the age by throwing a big national party. But soon, he said, they had realized that that was not it!

I believe that ideas are important regardless of the minority status, in fact, extremely important for any group vying for an influential role. How do we then create them? It will require mobilization of the entire community. The ideas will have to be sold effectively, and this will take the trust of the larger community in which we operate and the social skills with which to communicate and persuade the fellow citizens.

Given these as our collective aspiration, I would like to comment on the nature of the age we are operating in and what the primary challenges will be, and conclude with a modest proposal. I would like to speak in a certain context, which I will define by stating the objectives. I assert that the educational framework is focused on productive, rather than successful, individuals, who are the generators of influential ideas and whose characteristics are such that the society will view them as societal contributors, and ultimately gaining the recognition as highly developed ethnicity for the Koreans. The state of the affair is that the public sees the Korean Americans as hardworking individuals but rather rough, like not fully polished gems, as an ethnic group.

As you know, rapid communication and rapid commerce characterize the present age. The rules of economic engagement are also changing. For example, scarcity of goods not necessarily dictates their price in the marketplace. If one has special knowledge, it has to be available freely in order for it to become valuable. Another significant element of the time is in the fact that the expectation of good life is universal, not limited to the privileged few. Individuals do not expect less just because they live in a less developed part of the world or born into an underprivileged or deprived environment. No matter where they are geographically or status-wise they no longer are willing to be

content with less than the best in convenience or technological sophistication. This means demand for equal access to wealth, opportunity, technology, comfort, health, leisure and all others that signify good life.

Of course, there is this information age. The age is, in my mind, akin to what was the dawn of aviation and the renaissance in the following sense. The magic of the information age is to lower the threshold for personal participation in the frontiers of human progress by another significant notch. Backyard mechanics and bicycle shop owners could tinker with flying, and you see how dramatic the progress has been out of such participation. I see that not only the scientists or technologists but also the humanists and social scientists as well as ordinary people are very much engaged in the enterprise because the age liberates them all from the bondage of wants. The fields are more level, and one does not necessarily have greater advantages over others because of education or any other such credentials. Consequently, everyone now has to compete on the strength of ideas.

There are new paradigms. The first of them is "Do more with less." Let me give you a simple example. Incandescent light bulbs used to expire unpredictably. Most bulbs would expire in a short time but often some would last for years. The manufacturers compensated for the lack of control of their performance by over-designing the filaments to meet the product specifications. Now the light bulbs expire in 750 hours or very close to this lifetime with little exception. The failure modes are understood and the manufacturing processes have been closely trimmed to the extent that the absolute minimum amount of material is used to make them.

The second paradigm is "Do everything scientifically." The scientific way of doing business is practiced in almost all human activities. For example, in grocery stores the owners would systematically study the patterns of customer movements and the products are displayed to maximize their visibility. Shelf spaces carry premium fees according to the degree of product visibility. You talk to athletic coaches and will find that they dissect all aspects of competing physically and their optimization has been implemented into training regimens. The scientific way has been permeated throughout our lives.

The third is reverse engineering as an attitude. In the preceding ages, new discoveries some times led to useful applications, often serendipitously. Instead of exploring the mysteries of the unknown, people now state the solutions that are desired and demand that necessary new discovery be made, whatever they may be, which would facilitate the solutions. What this means is that as a whole the world has become confident about solutions to all human problems, on the one hand. Obviously, our society and the whole globe have become more scientific, on the other, thanks to many successes of science.

To navigate in the world of this new order, one now has to bear in mind what scientific methods entail. There are two keys worth noting. One key to the success of scientific ways is that scientists have labored relentlessly to make our understanding of

nature simple. A minimum set of basic principles has been distilled, from which all forms of decisions and predictions can be derived. This drive to the simplicity of understanding is rather widely known. The other key is not, however. When you disclose new discoveries or present new ideas in one scientific forum or another, you face criticisms and questions as a rule. No one will compliment you in a substantive way as to how nicely the talk was given or arguments were documented. This relentless critiquing is the mechanism central to sorting out the essential from superficial elements of a new understanding. As the society embraces the scientific ways to solutions to ever-increasing extent, the culture of criticism and questions will become pervasive in all human interactions. I believe that we need to understand this less apparent flip side of the scientific methods and learn to engage in the sifting process with grace and patience.

It now brings me to the three basic challenges that I believe will confront the next generation Korean Americans in their preparation for, and waging of, the war of ideas. First of all, controlling of the agenda is extremely important. Instead of just working hard, you have to be able to define what the debates should be about in the first place. To be able to produce influential ideas will require continuous learning and the ability to think laterally. You must be able to see the big pictures and have a deep sense of how they are interconnected. Secondly, one needs an internal desire to excel, and this will be possible only if one has the commitment derived from a personal worldview, which incorporates both his or her individual aspirations and the societal ambitions. I believe that they must be integrated. Finally, dealing with the criticisms and questions will be a permanent requirement with everything that we do. That means the ability to "Disagree without becoming disagreeable." It also means, "Being courteous throughout the discourse." Often times, Koreans say that Korea is the country of great courtesy in the Orient but I would question that. I think being courteous means conduct with respect for, and considerations of, others because the discourse is a truly democratic process in the world of ideas and the other's ideas are important on their own. One has to patiently negotiate the sifting through many competing ideas for the best.

I would like to make the following suggestions. The first is strong education, which you would have no problem with. But I would highlight it as strong "liberal arts core" education as the building block of the higher education. Secondly, very wide ranged reading should be practiced as a life-long process, because that is when one's own worldview is formulated and refined. Without the personal worldview, the bosses, the parents, the government and everyone else will always drive you. Thirdly, continuous social interactions are to be folded into the basic lifestyle in order to develop and hone one's social skills. I have had the fortune of interacting with the top level leaders of many major corporations, including the CEO's, in the course of fundraising for my research and on behalf of Lehigh University. I have observed that their social skills are an incredibly important part of their influence.

For the balance of my time, I would like to describe some aspects of the dynamics of large physical systems that appear complex and random, and draw some conclusions from them (see the accompanying Powerpoint slides). Brownian motion, avalanches on a

granular pile and interfacial instability for laser-produced plasma (LPP) plumes are discussed. The dynamics in the respective systems appear complex but analyses reveal remarkably coherent structures and causal processes that underlie them. These have striking parallels in the world that are most likely to be encountered by up and coming young leaders, and therefore can offer some helpful or metaphorical lessons. When the physical systems are viewed as surrogate systems, for example, you can imagine using them to test how hypothetical changes in the system parameters would alter the system's response.

Colloquially, we tend to attribute the future outcomes of any decisions influenced by natural processes to the domain of unknowns that are driven by random processes. Leading the list are the extreme weather patterns, traffic flows, financial market activities, wide ranging environmental developments that we often call noises, and many others. There is growing evidence, together with our confidence to characterize them, that a large part of so-called randomness has consistent logical bases. On the most elemental level, motions of molecules within an aggregate system of molecules evolve according to a distribution of probabilities. More than a hundred years ago, Einstein showed that such motions cause spreading of molecules in space in proportion to the square root of the time elapsed; in contrast, an object alone travels a distance in proportion to the elapsed time. In fact, it is now possible to construct a sequence of dynamics that appears completely random by following a sequence of logical steps that is causal and repeatable. Such randomness can be an agent to steer the evolution of events toward a desired outcome. The rationale is that the randomness is often the outcome of competition among many players in the milieu, each pursuing own natural path. At a more complex level, human activities exhibit such seemingly random social behaviors. The talk is focused on illustrating the causal framework underlying the randomness, or the coherent structures.