The Taiji Connection

A Mathematical Psychology Foundation for Mindscapes and Information Systems – 1

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Abstract

Since Galileo, sciences have avoided logical paradoxes by substituting mathematics for logic and experiment for a priori knowledge. By calculating instead of reasoning, scientist could avoid many of the weaknesses that made logic prone to paradoxes while statistics kept the randomness that occurred during experiments under reasonable control. There were some problems with logic, however, that science could not avoid and philosophers could not repair. These problems were at the interfaces between logic and mathematics. Invention of the computer and developments in Information Technology would both amplify the difficulties and act as a catalyst that would speed up the consequences of these difficulties for pure mathematics, applied mathematics, and surprisingly, for theoretical and applied philosophy. Stated succinctly, the computer would combine with experimental science to drive theoretical science, literally, into chaos.

Despite adverse associations, chaos has advantages. In a mathematical sense, "elegant" means the simplest complete answer to a problem. There are however, limits to the scope of mathematical solutions. After all, mathematics is only about numbers, and Gregory Chaitin's discoveries of Omega numbers have revealed startling limits to calculation, limits that are not simply revolutionary, but evolutionary. In addition to their significance to mathematics, his discoveries imply a non-trivial application of Information Technology to the most profound aspects of human psychology, language and philosophy.

Though few behavioral scientists might consider Chaitin's simple, quasi-humanistic conclusions about mathematics a "significant discovery", its consequences for scientific theory in general, and General Systems Theory in particular are quite profound. This paper is about the consequences of Chaitin's discovery and the significance of Omega numbers. Together, they permit the application of mathematical psychology to Information Technology and the integration problem. Integrating Chinese methods of synthesis and the Western technology of analysis facilitates an information based definition of living systems and suggests a behavioral science approach to the human genome's integration strategy.

Keywords: integration, omega numbers, chaos, game theory

The Head of the Psychology Department X politely, but coolly, greeted the Chinese visitor on their first meeting. Their visitor spoke no Scandinavian language, and one had to listen very carefully to understand his English. On their second meeting, the Professor insulted the visitor by refusing to meet with him except by appointment, a rule that no other visitor and nobody else in the department had to follow. Thus Psychology Department X accepted a Chinese visiting professor as a visitor but rejected both his person and his paradigm.

Politicians, chief executives, immigration authorities and civil rights groups, all recognize this as an example of the problem of integration, an ubiquitous problem so complex that it seems virtually unsolvable by conventional methods.

Fractal Complexity

Chaos mathematician Michael Fielding Barnsley (1988), who sees “fractals everywhere”, would delight in this general systems formulation of the integration problem; because the structure of the problem, the problem’s psychological solution, and its ecological resolution, all are analogous to Barnsley’s elegant and beautiful fractal geometric image of three dimensional ferns. It was not very likely that either the personnel of Department X (or politicians directly or indirectly linked with Department X) would make any connection between the extension of chaos mathematics to applied biological modeling and the problem of integration. Likewise, Barnsley’s fern appears like an artfully lighted digital photograph taken against a black background, *not a mathematical algorithm selected to fit a natural object*—certainly not a fractal. Nevertheless, the analogy is far from being either stretched or subtle. The key is zooming in for a closer look, then asking the magic question—HOW?

Zooming in on Barnsley’s fern reveals a simple geometric structure that when magnified reveals itself to be identical to itself—but not a fern. In fact, successive magnifications reveal the same simple geometric figure. Fractals remind one of a Chinese puzzle box that has a box, within a box, within a box. The difference is that fractal algorithm is an infinite regression that can continue forever, but the Chinese puzzle box has a physical and therefore finite limit.

When viewed from the perspective of mathematical biology, the integration problem, represented by Department X, follows an analogous pattern. Before zooming in, we ignore emotional impressions and value judgments like “brutish” behavior, “bad” manners, or “terrible” public relations.

This first level of observation reveals the integration problem on a global scale. In this case, the term “global” is not simply a metaphor: the head of Department X is from the western hemisphere and the Chinese professor is from the eastern hemisphere. And the events that took place during this visit are representative of the integration problems faced by politicians and industrialists who have visions of globalization. Zooming in to the regional level, Department X belonged to a nation whose politicians were pushing membership in the European Union (EU). Of course China is a very influential leader in the Asian counterpart to EU. More interesting, the largest information industry company in Department X’s country was deeply involved in developments in China.

At the professional level, the cultural gap between western behavioral sciences and Chinese behavioral sciences was considerably greater than the gaps between Chinese physical and biological sciences. The events that occurred in Department X were an example of the integration problem faced by behavioral science. The professor’s treatment of the Chinese visitor definitely did not help any ambitions toward integrated projects between the two universities. Finally, at the personnel and personal level, the

case of Department X is a prime example of the integration problems associated with diversity.

The above fractal formulation of the integration problem implies fractal solutions, solutions that can be described as simple, elegant and essentially identical at every level. Fractals also suggests that the solution will be an algorithm that generates a repeating pattern that produces two images, a main image and a recurring sub image. And like many mathematical solutions applied to real world situations, the solution to the integration problem probably has an added importance to mathematics, an importance beyond that associated with the immediate problem.

Mathematical solutions

Andrew Wiles' proof of Fermat's last theorem is a prototype example of a mathematical solution that remains unsolved for three hundred years. Department X is an example of an organization of living systems that imploded. The convergence between behavioral ecological problems (like the integration problem) and pure mathematics problems (like proving Fermat's last theorem) is made complete by Gregory Chaitin's 20th Century discovery that *mathematics is not about the consequences of rules, it is about creativity and imagination.*

Nature's resolutions

But unlike mathematical problems that can remain unsolved for centuries until someone determines whether it has a solution or not, the integration problem is an ecological problem involving *living systems*. Problems involving living systems always have a resolution. Since any resolution's conformity to aesthetic rules of elegance, mathematical or otherwise, is purely coincidental, defining "elegance" as solutions that lead to human survival is sensibly making a virtue out of a necessity. In general, if one of our elegant solutions is not applied, then one of Nature's resolutions will most likely occur. Consequently, the theory here is formulated against the background of repeated warnings from ethologists.

Long range ethological trends suggest that increases in personal empowerment are the most frequent consequences of real world solutions. Though often "elegant", in an aesthetic, mathematical sense, our behavioral solutions are running afoul of Nature's resolutions. Ethologists suggest Nature's resolution to integration problems may lead to a very inelegant solution. A devastating implosion, after a long period of what seems to be perpetual conflict is very probable, but not inevitable.

For human researchers, discovering the necessary, and usually unique, solution is a complex, subtle, process; and application of the solution is apt to lead to results that are chaotic in the mathematical sense: but constructive from a "real world" perspective. Because the resolution is usually a catastrophe in both the mathematical and real world sense of the word. Specifically, if a solution is not applied, an implosion resulting in an organization with a pitiful fraction of its previous strength is almost certain to follow.

Ironically, though few might consider Chaitin's simple, quasi-humanistic statement about mathematics a "discovery", its consequences for scientific theory in general, and General Systems Theory in particular are quite profound. This paper will explore the consequences of Chaitin's discovery and the significance of Omega numbers. Together, they permit the application of Information Technology to the integration problem. The result is the integration of Chinese and Western psychology. In concert, they represent a formulation of applied mathematical psychology in terms of chaos. Thus, the fractal analogy becomes complete, and ecological problems can yield an elegant solution.

Evolution / Revolution

In Chaitin's, mathematical, sense "elegant" means the simplest *complete* answer to the problem. There are however limits to the scope of mathematical solutions. After all, mathematics is only about numbers, and Chaitin's discoveries have revealed startling limits to calculation, limits that are not simply revolutionary, but evolutionary. In addition to their significance to mathematics, his discoveries imply a non-trivial application of Information Technology to the most profound aspects of human psychology, language and philosophy.

Unlike many of Information Technology's advances which were so new they seemed to have little, if any, connection with what had gone before, Chaitin's studies were direct consequences of computing, the very heart of mathematics. Neither a sudden flight of fancy, nor the lightning insight of a single, gifted, individual: his conclusions end a hundred years of controversy regarding the foundations of mathematics. According to Ian Stewart (1990), Chaitin's discoveries belonged to late 20th Century developments that introduce a form of randomness.

For reasons that will emerge from the discussion below, randomness essentially negates classical concepts of truth, science and mathematics. In fact, no aspect of the human psyche, no aspect of human culture is untouched.

If these conclusions were simply revolutionary, a counter-revolution might be expected to revive classical or, at least, algorithmic paradigms with new faces and old vigor. There is, however, no such concept as counter-evolution, and there is very little likelihood that a system will remain stable after devolution. In any event, the probability of a reversal of evolutionary changes appears quite remote.

Perhaps it is the fact that, by definition, most organisms are "less prepared" for evolution, which establishes a new process and favors a new species, than for revolution; which often requires simple accommodations and replaces personalities. In this sense, evolution is far less forgiving and intolerant than revolution. All indications point to the changes generated by Information Technology resembling evolution more than they do revolution.

Because they share many of the same forces, relationships between the evolution and revolution are so complex it is often difficult to distinguish them. Further complications, revolution almost inevitably accompanies evolution: but the reverse has been rare. Almost invariably, the product of conscious political visions, combined with personal and public agendas, revolutions are simpler, but not nearly as simple as politicians present them. Politicians usually summarized their revolutionary objectives in terms of goals, and rationalize their actions in terms of logic—if at all.

In contrast, evolution is rooted in biology where goals are seldom, if ever, defined. Consequently, scientists describe evolution in terms of processes rather than goals: rather than true or false, processes have to be described in terms of rates. Rates inevitably include time as a variable and time causes extreme problems. In addition to rates and processes, biology is replete with random processes that force most forms of formal logic to stumble on its own paradoxes.

Long Live the Queen

Since Galileo, sciences have avoided logical paradoxes by substituting mathematics for logic and experiment for a priori knowledge. By calculating instead of reasoning, researchers could avoid many of the weaknesses that made logic prone to paradoxes; statistics kept the randomness that occurred during experiments under reasonable control. There were some problems with logic, however, that science could not avoid

and philosophers could not repair. These problems were at the interfaces between logic and mathematics. Invention of the computer and developments in Information Technology would both amplify the difficulties and act as a catalyst that would speed up the consequences of these difficulties for pure mathematics; applied mathematics; and surprisingly, for theoretical and applied philosophy. Stated succinctly, the computer would combine with experimental science to drive theoretical science,-literally-into chaos.

Two British mathematicians, Bertrand Russell and Alfred North Whitehead, started philosophy's trip to chaos. If their followers had been content to let mathematics remain the "Queen of the Sciences" and had tried to broker a marriage (rather than claim the crown by contending, as in *Principia Mathematica,* that mathematics was reducible to logic's axiomatic methods and analysis) both philosophy and mathematics may have at least delayed the inevitable. As it was, their entrance into what would be a hundred year controversy led to a series of studies that would not only lessen the authority of both philosophy and mathematics: it would leave the door open for experimental sciences to invade them both. It will be shown below that chaos came as a pragmatic consequence of substituting mathematics for logic, then combining mathematics with experiment.

A long process began when Russell and Whitehead crippled the axiomatic method by pointing out old paradoxes and revealing new ones. As part of what were to become frantic attempts to save the logic inherited from the Greeks, Russell did away with the strictly "either it's true or false" reasoning and introduced a hierarchy of perspectives—called the theory of types. The discipline Russell and Whitehead founded, in the process, was to develop into *meta mathematics*. Toward the end of the 20th Century, Chaitin was to describe contemporary meta mathematics as *a method by which mathematics looked at itself in a mirror*. However, philosophers and mathematicians who looked into Russell and Whitehead's mirror of meta mathematics were to find that the images of both philosophy and mathematics became increasingly distorted , until they were no longer recognizable as true images. Finally, Chaitin's computer aided meta-mathematics was to reveal a randomization approaching chaos; when Chaitin looked into its mirror. He cites the work of two important meta-mathematicians who influenced the construction of a computer aided mirror.

Austrian meta-mathematician Kurt Gödel, in the 1930s, began pretty much where Russell and Whitehead left off. In Chaitin's words, Gödel used Gödel numbering to "arithmetize meta mathematics". Gödel's results showed that mathematics does not prove all of its own true theorems: by its own definition, mathematics was incomplete. Thus to philosophers, scientists and engineers dependent on the authority granted by mathematics, mathematics became an invalid after Gödel's 1931 publication of his *Incompleteness Theorem*. Worst was to come.

In 1936, Allen Turing invented his *Turing machine*, which Chaitin describes as a mathematical model of a computer that can simulate any other machine. The Turing machine introduced a new concept, *uncomputability,* from which Turing derived a computer concept of incompleteness. His discoveries put conventional, axiomatic, concepts of mathematics and logic on life support. To this Chaitin was to add *randomness* and complexity. According to Chaitin, *randomness* is where reason stops, a statement that things are accidental, meaningless, unpredictable, and happen with no reason. It is where no mathematical pattern can be discovered because there is no mathematical pattern. The consequences of randomness for the "royal" philosophical status of mathematics are ominous.

It means that in some areas of mathematics, mathematical truth is completely random, patternless, and incomprehensible. Therefore, these truths can neither be compressed into axioms nor can they be deduced from any principles simpler than they are. Worst,

Chaitin says that David Hilbert (the founder of a purely axiomatic method) was completely wrong.

Chaitin concludes that some mathematical statements are true for no reason, they are true only by accident. Consequently, there can be no “theory of everything” in mathematics. In place of Hilbert’s axiomatic method, Chaitin substitutes Algorithmic Information Theory (AIT). This turns off the life support system for Hilbert’s formalism as far as logic is concern; but the ghost of Hilbert’s formalism lives on in the artificial programming language of computing. This ghost also haunts some aspects of anthropology.

Anthropology meets Chaos

Though the integration problem introduced above and anthropology fit comfortably in the same problem-solving matrix, most conventional anthropologists, and many nonprofessionals, would have difficulty fitting incomputable numbers, randomness, incompleteness and inconsistency into the picture. It will be evident from what is to follow that a problem of the complexity, dynamics, and magnitude of the integration problem requires chaos mathematics like that applied to Haken’s (1978) phase physics. Anthropology’s need to deal with the problem is most apparent in examples where researchers lacking the necessary mathematical tools avoid dealing with the problems of complexity, randomness and chaos.

Anita Jacobson-Widding (1979) had the problem of integration compounded by the introduction of chaos when she confronted the cognitive thought of peoples of the lower Congo. Her argument uses three general questions to attack the view of “structuralist”: (a) Are there any coherent cultural systems in which a third, indeterminate value is systematically recognized? (b) If so, what importance has the recognition of a third, indeterminate value in the cognitive world view and as regards coping with problems of everyday life in such a culture? (c) Is it possible to combine a high status of rational, two-value logic with the recognition and systematic utilization of a third, indeterminate and therefore irrational factor within the same cultural system?

She uses her observations of Congo culture to support a yes answer to the first question and an argument involving “taboo” to describe the importance of the indeterminate value in coping with everyday life.

The way that she contrasts Congolese and Europeans, though a trivial and accepted practice among conventional anthropologists, is of special interest in the integration problem context here:

> *“….The European scientist, administrator, etc. may also experience the dynamic potential of the indeterminate value in his everyday life, but he does not give explicit recognition to it. He rather tends to classify it as soon as possible or to sweep it under the carpet.*
>
> *The Congolese are as conscious as the Europeans of the necessity to eliminate indeterminate values in those situations in which rational definitions of concepts are at stake, principally in the judicial process. White and black pigments are here kept in readiness to be applied to the forehead of the winner and loser, respectively, whereas red pigment is banned from places where judicial processes are carried out….*(p. 370)

Here Jacobson-Widding describes certain aspects of randomness, but keeps it under tight control by placing it neatly in a third category. Her argument opposes dyadic reasoning with triadic, with the indeterminate category of the triad taking a clearly inferior, but “necessary” role. She compares the third category with the number zero, to explain the strange behavior of indeterminacy.

Ironically, this orderly, insulated, anthropological view of the world (as late as 1979!) mirrors the spread of ancient Hellenic culture by Alexander the Great, who stopped at India and never made it to China. What would have happened to Hellenic culture had he made it to China, will always be a matter of speculation: what happened to anthropology when confronted by Information Technology and chaos at home; and controlled chaos in the Indian and Chinese cultures; is now becoming a matter of record. Due to their internal integration problems, (see Teresi 2002) anthropology came with too little, too late.

By the end of the 1930s, philosophers and Meta mathematicians Russell & Whitehead, had been joined by Gödel and Tarski. Together they had made the law of the excluded middle a thing of the past for Western philosophy. Logician Reichenbach (1947) (1965) had already shown that a triadic logic using an indeterminate category was essential for dealing with the idiosyncrasies of quantum mechanics and had developed a calculus for it. By the middle sixties, dyadic logic had virtually no status among logicians, and pure mathematics was about to lead the mature sciences into chaos.

Anthropologist should have gotten there first, because India and China had already confronted them with cognitive patterns that would easily defy the relatively well-behaved number zero; chaos patterns that merited Chaitin's Super Omega numbers. Most anthropologists were from cultures with a handicap, because Western logic and language both break down when confronted by chaos. Mathematician Ian Stewart (1990), who has been most influential in developing the vocabulary of chaos, skillfully illustrates the problem.

Stewart defines chaos as; "the ability of even simple equations to generate motion so complex, so sensitive to measurement, that it *appears* random." He contrasts his definition with three dictionary definitions, 1) the disordered formless matter supposed to have existed before the ordered universe. 2) Complete disorder, utter confusion. 3)(Math.) Stochastic behavior occurring in a deterministic system." With biting wit, Stewart points out that deprived of its status and its jargon, the mathematical definition amounts to "lawless behavior governed by law".

Fortunately, for the world in general and general systems in particular, both India and China, two mathematically sophisticated cultures, have, for millennia, dealt quite comfortably with chaos. Stewart noted that Hindus ascribe to chaos a more subtle role than mere formless confusion. He described a trinity of three gods, Brahma, the god of creation, Vishnu, the god of order and protection, and Shiva the god of chaos. Study of the attributes of Shiva alone requires understanding complexity at a very high level. The trinity reveals that Hindus have explored complexity as well as the underlying unity of order and disorder.

Predicting and Calculating

The Chinese also developed a trinity. Like the Indians, the ability to understand the unity of opposites has given Chinese philosophy a distinct advantage over Western philosophy when dealing with chaos. Mathematics plays a key role in the Chinese approach.

The same year that Jacobson-Widding published her studies of Congolese triadic reasoning, Da Liu (1979) published an introduction to the formulas of Shao Yung a mathematician and philosopher who died in 1077 A.D. Instead of one, indeterminate, dynamic, category, to contain the irrational concepts that are intolerable in higher status dyadic categories, Shao Yung's system has sixty-four categories that employ chaos in reaching decisions.

According to Liu, the Chinese character Suan means both to “predict” and to “calculate” and numerology is the mathematics of Chinese metaphysics. Shao Yung, was a master at both. His methods differed significantly from those of his European counterparts. For example, though Shao Yung’s *Plum Blossom Numerology* answered the problems that Hans Reichenbach (1938) treated in *Experience and Prediction*, Chinese solutions to philosophical problems resemble more the intuitive areas that Reichenbach reserves for psychology than they do the formal, more axiomatic, solutions favored by most Western philosophers. Nevertheless, the strict Chinese rules of reason combined with conscious reliance on experience and intuition places the Chinese system almost precisely in the middle, between the formalism of philosophical logic and the intuitive knowledge characteristic of psychology.

Da Liu uses two formulae to apply numbers and calculation to both experience and prediction. The first formula models the observer’s perception of the conditions existing at the moment of prediction. The observer uses this formula to focus personal observations and intuitive concepts. The second formula relates the problem to the *I Ching* (*Book of Changes*). *I Ching* deals with the interpretation of the sixty-four hexagrams that act as the primary categories for Chinese reasoning.

Most important, Chinese reasoning is pragmatic. It is not an exaggeration to say that the *I Ching* is *the* philosophical touchstone against which all Chinese thought is measured. Its structure and the way that it is employed combines with the above discussion of chaos to make the *I Ching* a Western academician’s worst nightmare—especially if the academician is a philosopher, an anthropologist, or a psychologist. Far more elaborate than Western truth tables, the *I Ching* not only tolerates, dyads, triads, indeterminate categories, randomness and chaos: it employs all of them—simultaneously.

If the academician is so egotistical as to not look further than his/her own discoveries, the *I Ching* can act as a mirror. Some examples: German philosopher and mathematician Leibniz, who invented a binary system, saw the *mirror image* of his binary system in the arrangements of the *I Ching*. Aristotelians might find true and false in the Yin and Yang of the *I Ching*. Conversely, some followers of Hegel claim that the *I Ching* was the inspiration behind the creation of his triadic system of logic.

Enthusiasts of binary logic and computer programming could mistake the same Yin and Yang for their pattern of reasoning. Reichenbach and Jacobson-Widding could see their third (“indeterminate”) category multiplied by sixty-two. Chaos people might see their catastrophic transition in the moving line of an *I Ching* prediction. Mathematical worshipers of fractals can find their recursive functions patterning all of reality in *I Ching* models, everything from the cosmos to the quantum. Physicist, geneticists, neuro physiologists and color vision specialists can see their favorite integrative patterns in the hexagrams.

This does not mean “love at first sight” by everyone who becomes aware of the power of the *I Ching*. The concept of evil turning into good, good into evil is enough to justify extreme suspicion for anyone viewing the *I Ching* from either a religious or a judicial perspective. Wilhelm (1960) (who attributed the same dynamic quality to the *I Ching* triads as Jacobson Widding attributed to the Congolese triads) noted that all of the early Jesuit scholars who concerned themselves with the Book of Changes were either declared to be insane or heretic. The question has been raised in many forms and in many contexts. Is the *I Ching* a “theory of everything”, or does it simply function like the clouds on a summer day: where anybody can see practically anything, depending on their mood?

The answer is simple. Support for the answer is exceedingly complex. The simple answer, it is or it is not, depending upon one’s perspective. The Chinese visitor to Department X, in addition to being a behavioral scientist, is an authority on the *I* Ching.

From his perspective, the *I Ching* has evolved into the supreme meta-system that contains and controls and explains all meta-systems. For the visitor, no support is necessary, because his experiments and experience with the *I Ching* are sufficient. To the head of Department X, chaos is unacceptable in behavioral science and discussion therefore unnecessary.

Ironically, these events take place between two people who, according to the disciplines they represent, should be able to act as consultants in precisely the integration problem they create. If we avoid the term “cultural differences” (a broad, general, category that says very little and explains less) this becomes an extreme case for any consultant in integration problems. Clearly, Department X serves as an example of irreconcilable differences combined with radically different perspectives—in other words, global integration problems in microcosm. Multiple variations of these events take place every day, in all countries, all groups involving all cultures, it would require no training and very little knowledge to predict the occurrence or the courses of such events.

Though somewhat rare in traditional institutions in Scandinavia, the boorish behavior of the head of Department X would surprise few in his own department and relatively few outside of it. Nevertheless, attributing such behavior to an individual personality is another trap for behavioral scientists: “Personality”, like “cultural differences”, is also a word that tends to obscure more than it reveals and generate more heat than light. Both words tend to be answers to the question “why?” these events occurred rather than “How?” they occurred.

In the information context, some distinctions between the answers to the three fundamental questions “what”, “how” and “when” are quite helpful. Whereas answers to the “objective” questions what and how can each be shared with others: answers to the more subjective “why” are strictly personal.

More specifically, answers to “How?” questions in a General Systems framework suggests a complex, behavioral science, solution and (or resolution!) to the integration problem; a solution where chaos and Information Technology are applied, simultaneously, to the bio behavioral roots of the integration problem. Answers to the first “How?” question must focus on how Chaitin’s meta-mathematical mirror influences the integration of Mindscapes and multiple perspectives into a general system. This example demonstrates the substitution of a “*how*” question for the very complex, deeply intuitive, “*why*” question:½

> *Why go through the exceedingly difficult operations necessary to construct an integrated general system when it would be much simpler to be eclectic?*

This is a very tricky, difficult and complex question. Its answer is fundamental to application of general systems.

Holes in Wholes

Anthropologist and futurist Magoroh Maruyama (1980) and mathematician Harold Linstone (1999) are both scholars of administrative science and both work as consultants. Maruyama’s knowledge in architecture and mathematics give his mindscapes formulations a radically different perspective from that of more conventional anthropologists and Harold Linstone’s ability to substitute calculation for conventional reasoning sets his multiple perspective formulations apart from many industrial consultants.

Each offers unique and creative contributions to resolution of integration problems. Their work is especially important in the present context, because Japanese Maruyama

and American Linstone also represent East and West striving to solve two important aspects of the integration problem. Maruyama's mindscapes deal with irreconcilable differences that occur due to epistemological and cultural barriers to mutualistic thinking. Linstone employs multiple perspectives to improve executive performance.

Either the differences separating major paradigms or the virtually infinite number of potential perspectives defining viewpoints can be a virtual blockade to integration. And the two often occur in concert. Though related, neither can be reduced to the other. So a solution to the integration problem must deal with both problems simultaneously.

As one might suspect, to reduce the conceptual distance and avoid friction between Maruyama's and Linstone's pragmatic approaches and at the same time achieve an elegant, fractal, resolution (and/or solution) to the integration problem is both complex and subtle. To make matters worst, taking a peek into Chaitin's meta-mathematics mirror destroys all subtlety by raising a question as whether it is even necessary to close the distance. It helps that Maruyama's mindscapes seem to support both the position suggested by Chaitin's mirror and Linstone's multiple perspectives. But things are made more complicated, by the fact; though Maruyama's mindscapes may be essential to Linstone's multiple perspectives, whether Chaitin's Meta mathematical mirror is of any consequence to a particular perspective depends entirely upon the circumstances.

Meta-mathematical Psychology

To contemporary psychology as a whole, Maruyama's, Chaitin's and Linstone's views together do not constitute a system. Depending on the paradigm, the combination constitutes a complex of paradoxes that range from the fuzzy to the bizarre. Most psychologists would experience fuzziness. For applied psychologists the fuzziness arises when Chaitin's meta-mathematical mirror focuses on abstractions too far in the background to be included as part of either their professional images or their paradigms. Some holistic specialty's paradigms, like Gestalt psychologists', have bizarre images in Chaitin's meta-mathematical mirror due to either logical paradoxes or conflicts between mathematical facts and psychological tenets.

Whereas ignoring each individually or all combined might be the most comfortable strategy for most specialized paradigms, this strategy is not available to mathematical psychologists. Nevertheless, mathematical psychologists still react to the constellation of Maruyama's mindscapes, Linstone's multiple perspectives and Chaitin's meta mathematical mirror as either a very troubling, *hopefully* temporary distortion, or a complex riddle. It is, however, quite apparent that colleagues in other psychological specialties will not, and in most cases can not, use Algorithmic Information Theory (AIT) as a mirror. It is also quite apparent that contemporary psychology needs its own mirror. And meta-mathematics must be included in its construction.

In view of the logical paradoxes, divisions of labor, and paradigmatic conflicts within contemporary psychology, one can easily anticipate a number of problems with such a mirror. The most difficult of the problems that directly influence integration fall in three fundamental categories, 1) problems with units, 2) problems with perspectives and 3)problems with dominance. Each problem will *seem to* introduce serious distortions when the paradigms view themselves in Chaitin's mirror.

Behavioral analysis exemplifies paradigms with a unit problem that subjects them to Russell's paradox. More specifically, even if they were successful in integrating all of their own units, irreconcilable differences prevent them from integrating themselves with other paradigms. Their problem is analogous to that of Russell's barber, who is given strict orders to shave everyone who does not shave himself. The barber is faced with a paradox when the question arises as to who shaves the barber. He breaks the rule if he shaves himself. He breaks the rule if he doesn't. Russell's solution to this class of problems is *the theory of types*. Stated simply, one does not include one's self

in the rule system. In addition to escaping his paradox, Russell also justifies the use and construction of meta-systems like meta-mathematics.

Chaitin's "mirror" is an appropriate metaphor because one can not view one's self either from the plane of the mirror or from any focus point within the mirror. Also, everything that is reflected by a mirror is not "real" but an image of a reality—a reality void of substance. The mirror is therefore a good analogy both for the theory of types solution to Russell's paradox and for Information Technology's virtual reality. Some psychological paradigms have therapists analyzed by other therapists. There are also strict rules regarding the complex subject of transference. Both are attempts to avoid the pragmatic problems raised by Russell's paradox. Neither attempt will stand up under the scrutiny of a determined logician. Behavioral analysis avoids Russell's paradox by assuming a perspective outside of the system under investigation. Thus behaviorists avoid the paradox, but their strategy leads to severe integration problems with other paradigms.

Psychology's classical case of irreconcilable differences is the conflict between analytical schools and holistic paradigms. Gestalt psychology exemplifies holistic paradigms and, according to Chaitin's mirror, it is an example of paradigms that have a perspective problem. Gestalt psychology with a perspective problem represents a bizarre image to psychologists, because Gestalt psychologists have devised ingenious ways of problem solving, ways dependent primarily upon choosing a proper perspective. Nevertheless, Gestalt psychology has a tenet that is as close to a logo as an experimental science dare come, an *aesthetically* elegant concise statement,

> *"The whole is more than the sum of its parts."*

True, Gestalt psychology can avoid integration problems with units by avoiding units altogether. The question that other paradigms ask is, what "parts" have the qualities described by the Gestalt tenet?—certainly not the units of experimental psychology.

None suggest that the excellent research done by Gestalt psychologists be cancelled by the paradoxes, integration problems and epistemological conflicts generated by this short tenet. Yet, The analytical schools object stringently on epistemological grounds. They can garner strong support from both logicians and mathematicians who agree: of course, "The whole is more than the sum of its parts" is nonsense to both to meta mathematicians, and all other mathematicians who are familiar with the Dedekind cut—an algorithm that proves the exact opposite. Of particular interest is the fact that the Dedekind cut made the ordering of real numbers more perspicuous in 1872 when, like Chaitin's Omega numbers today, rational numbers incompletely filled in the holes between numbers. See Kleene (1971).

Mathematicians are joined by logicians. Still, logicians have a bit of trouble countering the Gestalt tenet because they are handicapped by one of the oldest paradoxes in Western culture—Zeno's paradox. Named after an ancient Greek scholar, Zeno's paradox presents the problem as a footrace between the hero, Achilles, and a tortoise. The tortoise is given a head start and the paradox occurs because it is logically impossible for Achilles to close the distance. To cover a hundred meters Achilles must first run fifty meters, and before that twenty-five and before that twelve and a half…. So even if some logicians might find the Gestalt position both bizarre and in error, those who have studied Zeno's paradox must be more cautious with their criticism.

Pragmatist and experimental researchers in quantum physics, chemistry, astronomy, behaviorists, engineers and manufacturers of clocks and puzzle might all object on empirical grounds; where detractors can cite volumes of references extolling the successes of units formulated in less radical terms. It can be argued that when the results of an analysis are to be applied to construct as synthesis, the Gestalt definition's disadvantages far outweigh its advantages.

For example, if three units (a), (b), and (c) are the result of an analysis of the whole, abc. Eight triad arrangements are immediately possible. There are even more possibilities if all of the combinations and permutations are calculated. Consequently, the whole is considerably less than the sum of its parts; like many chemical compounds where each arrangement of elements has unique properties. In these and many other cases, the advantages of defining parts in a way that is consistent with the laws of logic and mathematics are quite apparent. Too, relational data bases make use of this permutable aspect of units, and card games are controlled by rules that make mathematics of combinations and permutations very useful. Combinatorial game theory has applied the same principles to GO endgames. See Berlekamp & Wolfe (1994).

There are also psychological advantages. One example is distinguishing between being innovative and creative. Rearrangements of elements discovered in analysis of abc to produce variations like cba or acb can be defined as “innovative”. Introducing a new element like (d) to yield combinations like abd or dba can be defined as creative. In biochemistry and micro genetics, the difference between the genetic materials DNA and RNA are based upon such a distinction. In addition to defining the “identity” of any living organism, mutations can be defined using this same class of distinctions.

Nevertheless, there is powerful intuitive, psychological, support for the Gestalt position. Gestalt psychologists are not seriously concern about logical paradoxes. After all, many real world barbers not only shave themselves, but cut their own hair. And anyone betting on a logical paradox preventing a top athlete from closing the gap on a turtle might as well consider his/her bet a donation.

Department X case study made it more than apparent that even among behavioral scientists logic is more apt to be applied to rationalizing behavior rather than to behaving rationally. The potential and/or opportunity to optimize as judged by logical and mathematical standards are seldom realized. For example, despite general availability of powerful Information Technology aids, most humans, (among them many psychologists) are very poor both at calculating and analyzing the consequence of numbers yielded by calculation.

Chaitin’s Omega numbers show that the mathematical world is subject to the same psychological laws as the rest of the population. The human mind is so addicted to continuity that it invents things to fill up an ever increasing number of holes. There are many more examples of discovered holes forcing human minds into a state of denial. When telescopes extend human senses upward into outer space the mind is confronted with the ice cold facts that the universe consists of more holes than wholes. When electron microscopes and powerful accelerators in quantum laboratories extend the humans senses down into the micro universe, the mind is confronted by the same holes in wholes phenomena. Discovery of Omega numbers suggest that in every science except some parts of behavioral science; that there are more holes the wholes is an undeniable fact.

Thus if human senses as extended by science are to be believed, there is no way of not including the holes among the parts. Since logic can not make a continuum and mathematics can not avoid the holes in formal systems, biophysics and open systems results yield strange parts indeed, especially when the mind is focused on itself *as a living system*. In the human mind the sharp clear boundaries so familiar to carpenters and brick layers, and readily quantified by engineers, are replaced by raw emotional feels, boundary-less images, and fuzzy qualities readily identified by psychologist and psychiatrists. Among analysts, careers are advanced by discovering and creating units and divisions—basically destructive processes. On the other hand Gestalt psychologists have been fascinated by the blended qualities and continuity of a whole without the divisions.

Consequently 20th Century psychology was neither a mental science, like mathematics nor an aesthetic experience like music, and it needed to be both. The technical institutes for behavioral engineers and the cognitive school designers never combined to design a school of psychological architecture. For 20th Century psychology, integration was a problem under consideration and a concept. Brunswik (1955) had developed a viable conceptual system for it, several concrete intentions of integration programs for the contemporary psychology developed. A possible reason they were not successful was that psychology had focused primarily on analysis and had not developed any reliable systems for synthesis. Unlike chemistry, physics and engineering, psychology could not reliably reconstruct by synthesis what it destroyed by analysis. And without an analogue to architectural design, 20th Century psychology was housed in ugly, primitive, quasi natural, mental edifices analogous to caves, skin tents and grass huts. Despite many fractious paradigmatic conflicts, a solid groundwork was laid for integration in the 21st Century.

Eliminating Psychology's "Fifth Postulate"

21st Century psychology's integration problem is difficult to describe because it forces contemporary knowledge to the boarders of credibility. Given, a logic full of paradoxes, a mathematics that generates numbers that can not compute: it has to incorporate a mathematics of discontinuity and chaos. Then consider behavioral analysts (who prefer to exclude cognitive approaches) and include them along with the conglomerate of cognitive psychologists dedicated to a poorly organized revolt against behaviorism's dominance. Psychology must also include the Gestalt holist—who have a tenet that excludes behavioral analysts and most experimental approaches. Add to the list the psychoanalytic clinicians who feel that emotions should have highest priority. Somewhat begrudgingly, psychologists must admit some bio-physicists who have become impatient with psychology's progress and have initiated mathematically based reformulations of behavioral science. Psychology is not permitted to ignore either ethologists who support or the ethologists who oppose an important role for learning theory. Psychology must somehow integrate an anthropology divided between futurists, physical anthropologists and those of the "how quaint the natives" schools. To integrate, 21st Century psychology must total all of the above, and then ask the question what conceptual framework could possibly accommodate such a conflicting collage of paradoxes, contradictions, conflicts, perspectives, paradigms and confusion? The answer is General Systems.

Enter, The Strategic Gene

The next question to answer is what, if anything, could possibly integrate such a diversity of agenda and viewpoints into a coherent system that makes sense? The only answer is "GAMES". "GAMES" is spelled with capital letters to distinguish this concept from both common usage and the carefully formulated mathematical definitions in Rapoport's (1970 a, b) *N-Person Game Theory*. In the present context **GAME** occurs when one or more *individuals* make up rules for "PLAY".

Here, "PLAY" is not necessarily an activity; it is a *private state of raw feels*. PLAY's raw feels may or may *not* be associated with a behavior that can be seen or localized with the help of contemporary biopsychological methods. Because they are often *experienced only by the individual*, the raw feels associated with PLAY are often not associated with any specific word or language symbol. Consequently common language does not distinguish the raw feels of play from other emotions. PLAY's raw feels are often a mixture of spontaneous, positive and negative experiences, much of them in the twilight zone between the conscious and the unconscious. They can be either more general or more specific than other emotions. In any event, PLAY's raw feels tend to be generated by the sum total of an organism's bio system, and are so

complicated that neither the most powerful and most sophisticated contemporary computers, nor our most advanced theories are capable of dealing with the complexity. Nevertheless, raw feels are an integral part of human existence.

Psychoanalysts have given different names to raw feels. Beginning with Freud's "Id" and "subconscious", psychoanalytic paradigms have attempted to deal directly with raw feels; develop a language for them; and give raw feels a far more dominant position than do experimental paradigms. Most psychoanalytic oriented approaches concentrated primarily on the qualitative aspects of raw feels. Berne's "child" and Jung's "collective unconscious" are probably descriptions of these raw feels from different perspectives. On the other hand, biological psychology, psycho physics and behaviorism focus primarily on bio activities that are concomitant with raw feels: because bio activities are more easily quantified and controlled.

PLAY is essential to the survival because it is often the only affective and effective associative process by which large brain organisms make essential connections between raw feels and niche space (the part of the physical environment that supports an organism). GAMES permit analysis and definitions of optimization for PLAY's raw feels. There are significant differences between the various definitions of "game" and the definition GAME. In common usage "game" is associated with pleasure and leisure, even when the participants are professionals. On the other hand, mathematical psychologist Anatol Rapoport (1970 a) formulates a technical definition where he clarifies the differences between zero-sum games, (games where there is a winner and a loser); negative sum games, (where everybody is a loser); and positive sum games (where there are no losers). Also of interest, Rapoport (1970 b) distinguishes between fights, games and debates. All definitions and classifications converge in GAMES where the human mind and gene strategy are inextricably bound to niche space.

Gene strategy, MIND, and Niche space

Like Rapoport, German molecular geneticists Eigen & Winkler (1993) exclude raw feels from their formal definition of Nature's LIFE/DEATH GAME. They use bead games to illustrate how *the principles of nature govern chance,* and to organize the relevant variables. The micro geneticists demonstrate how interaction between chance and rules underlie everything that happens in the universe. According to Eigen & Winkler,

> *The rules of the game channel the chance decisions of the dice and thereby determine the behavior patterns of different populations: indifferent drifting, stable balance, unstable growth, or catastrophic decline.* Pg 30.

Eigen & Winkler use games to express, simply, the most complex of all conceivable processes, viz how living systems convert randomness into order and how this is related to population growth rates. In contrast to individuals who experience knowledge as raw feels, Eigen & Winkler equate knowledge of the rules of the game (and *only the rules* of the game) to "understanding". In the present context, Eigen & Winkler's knowledge of the rules THE LIFE/GAME is both sufficient and necessary to answer the public question, "how?" But raw feels are necessary and sufficient to answer the private question "why?" Psychology has been roughly divided into "hard minded", those who like natural scientists specialize in "how?" questions; and "tender minded", those who like humanists specialize in answering "why?" questions. It will be shown below that the gene strategy is that of a generalist who specializes in adapting to changing environments. GAME is therefore formulated to focus at the interfaces between the raw feels of PLAY and the rules of Eigen & Winkler's LIFE/DEATH GAME. The term "universal principles" that apply to natural science "how?" questions do not necessarily apply to psychological "why?" questions.

In general, games as “universal” principles and rules of games as the basis for understanding might (due to their popular associations) appear simplistic rather than simple were it not for the work of German phase physicist Hermann Haken (1978). Haken formulated a mathematical theory of non equilibrium phase transitions that deals with self-organization of systems and includes the discoveries by Eigen & Winkler. Called “Synergetics”, Haken’s system is a multidisciplinary, integrated, mathematical approach to systems that range from the completely deterministic; through the stochastic; finally to and chaos itself.

Defining chaos proves to be as difficult for micro geneticists and psychologists as it is for mathematicians and physicists. Stewart (1989) defines chaos as; “the ability of even simple equations to generate motion so complex, so sensitive to measurement, that it *appears* random.” He contrasts his definition with three dictionary definitions, 1) the disordered formless matter supposed to have existed before the ordered universe, 2) Complete disorder, utter confusion, and 3) (Math.) Stochastic behavior occurring in a deterministic system.” With biting wit, Stewart points out that deprived of its status and its jargon, the mathematical definition of chaos amounts to “lawless behavior governed by law”. Fortunately, it is their discovery of the gene’s non hierarchical strategy of integration rather than Haken’s complex mathematics that makes Eigen & Winkler’s approach to genes playing games the main focus of a general systems inquiry. In a conceptual framework with genes and raw feels, chaos emerges as a plausible consequence of principles of nature governing chance.

This permits the intuitive power that GAMES inherit from PLAY: and PLAY permits general systems to gain a great deal more from Eigen & Winkler’s complex extension of the game analogy than can be gotten from either strictly axiomatic methods or more conventional game analogies. For example, James Lovelock (1990) argues in favor of a world whose material state is determined by the activities of their neighbors. He suggests that unless changing the environment were included as part of the game, evolution would be a game like cricket or baseball—one which the rules forbad environmental change. Environmental changes (especially those connected with Ice Ages) are Stephen Oppenheimer’s (2003) primary focus for his synthesis of DNA studies to track ancient migrations of humans and humanoids from Africa to the peopling of the world. Geophysicists would add earthquakes. Microbiologists would add viruses and bacteria. Ethologists concentrate on relationships between population, behavior and physical space. Eigen & Winkler’s book *Laws of the Game* (the critical bridge) integrates essential aspects of the various approaches by suggesting that genes are playing a game that strongly resembles an oriental game: a game the Japanese and Western cultures call GO and the Chinese call wei-chi. By choosing wei-chi, Eigen & Winkler enjoy the advantages of a constant environment while activities of neighbors, chance and necessity are all present and accounted for.

The differences between Japanese and Chinese approaches to the rules and strategies of GO and wei-chi, though insignificant for players and micro genetic applications, proved critical to discovering the strategies of the genes. Chinese invented the game upon which the analogy is built and their reasoning (developed over three millennia) is the closest analogue contemporary societies have produced to mirror gene adaptive strategy applied to the Life/Death Game. Whereas Western logical reasoning minimizes the role of raw feels, Eastern reasoning (this includes India, Japan, Malaysia and Korea) have gained impressive control of cognitive and physiological processes by applying raw feels. Mid 20th Century behavioral psychology began making inroads to similar controls with limited but encouraging success. See Miller (1971). There has been a steady advance; many of them by military researchers, since then. As a rule, Western natural and biological sciences have striven to achieve a perspective at the interfaces between cultures, and therefore beyond the biases and conflicts considered obstacles to objectivity. Genetics has been a notable exception to this rule, an exception that until the discovery of DNA made pseudo scientific heredity

debates out of what were actually fights over racial, geographic and/or cultural dominance.

Morals, Strategy and Information Technology

Laws of the Game judiciously avoided the cultural debate; as Eigen & Winkler's concept of genes playing games added micro genetics' "strategic gene" to biologist Wilson's "altruistic gene" and biologist Dawkin's "selfish gene". The two evolutionary biologists describe genes in moral terms: micro geneticists attribute tactics and strategies to it. Though not ascribing any intelligence to the gene itself, economist Charles Murray & behavioral scientists Richard J. Hernstein (1994) wrote *The Bell Curve* that attributed differences in economics, race and social status to hereditary intelligence. In direct contrast, economist Hernando De Soto' s (2000) *The Mystery of Capital* attributed the "bell curve" to property laws. Moral genes injected, by analogy, into the ongoing economic, religious and political debates tend to amplify all of the divisive and polarizing aspects of fights, games and debates while adding little to knowledge of genes themselves. See Caplan (1978), Dawkins (1982) and Murray & Hernstein (1994). Of course the ensuing conflicts between phenotypes and paradigms are clearly counter productive to solving integration problems. Conversely, Eigen & Winkler's strategic gene reveals ingenious information based solutions to integration problems, solutions that can be readily accessed by means of Information Technology.

The gene defines information for living systems and uses this information to select, connect, integrate and synchronize every aspect of life and death on this planet. The research reviewed below suggests that Eigen & Winkler's strategic gene is the most advanced life form on this planet. Consequently, understanding the gene's tactics and strategy is essential, not only for behavioral science, but for every aspect of human knowledge—including physics, biology, logic and mathematics. Any similarities and/or differences between the strategies of Homo sapiens and gene strategies in the Life Death Game must define the word "CRITICAL". The consequences of applying a paradox filled logic, and a mathematics that includes numbers that we can not calculate must be investigated. Most important for general systems, we must understand the complex relationships between the gene and the human mind.

The Necessary Unity

Anthropologist Bateson (1979) defines mind as "the pattern that connects" and suggests a "unity between Mind and ecology". Following his lead we define the strategic "MIND" of the gene as "the pattern that selects, connects, integrates and synchronizes life on this planet. We escape problems with Russell's paradox by adding MIND to GAME and PLAY, thus raising the general systems definitions and rules above the levels of analysis of the definitions and rules of the included specialties. A new meta-system permits us to do this without making any modifications to the rules and/or definitions of the specialties we employ for integration. A similar tactic is used to deal with Bateson's definition which includes the word "pattern". Here a general systems definition of "GESTALT" helps to avoid psychology's problems between holistic patterns characteristic of mind, behavioral units and Zeno's paradox: still Gestalt psychology's tenet becomes both an obstruction and a nuisance.

GAMES joins mathematics in support of a decision to let Gestalt's psychology's tenet ("a whole is greater than the sum of its parts") go the way of Euclid's 5th postulate in Riemannian geometry. Strict mathematical definitions of the terms, "sum" "part" and "greater than" definitely do not favor the Gestalt tenet. Two common western toys[1] and two common Chinese toys make the objections concrete. Point to a common picture

[1] Sports, toys, any artifact necessary for play are considered part of a GAME.

puzzle and ask, what more is needed to complete the puzzle, what more than all of its parts? Not another part? Another example, combinations and permutations of the Danish Lego units, can generate many different toys. The Chinese shapes game, Tangram, is the most startling example. A square is cut into seven “parts” (simple geometric shapes; squares, triangles, parallelograms) that can be arranged to generate hundreds of complete, unbroken shapes. Wei-chi, the world’s oldest and most sophisticated strategic game (our analogy for Eigen & Winkler’s Life/Death Game) is the second Chinese example.

The situation here is analogous to that Einstein faced with his general theory of relativity, and the decision is also analogous. When Einstein discovered that by changing two postulates Riemann gave him a geometry that permitted more accurate predictions than the classical Euclidian geometry, he used Riemann geometry. Chinese philosophy offers general systems solutions to mathematical psychology’s integration problems advantages that are even greater than Riemann geometry offered to Einstein, but also for a higher price. For scrapping the Gestalt tenet, mathematical psychology gets: a well tested solution to integration problems; a pattern of reasoning almost identical to that of the gene; the logic that created the game upon which Eigen & Winkler’s Life/Death game is based; and a prototype pattern that selects, connects, integrates, and synchronizes. The price (which may seem exorbitant to some) is, alienating the classical Gestalt paradigm and adopting a pattern of reasoning that is virtually incomprehensible to most psychologists and most people who have been educated in Western cultures. Debatable in some contexts, removing a primary obstacle to integration is worth almost any price when integration with the analytical paradigms is in focus. The advantages are immediate.

The Chinese Gestalt

Continuity is the primary advantage that Gestalt psychology has over its analytic rivals, be they experimental, clinical or behavioral. Continuity is also the primary characteristic that separates the qualitative continuity experience while using an analogue clock from the discontinuous, quantitative feeling of a digital. Continuity was also the reason early Gestalt psychologists went so far as to invent a pseudo topology in an attempt to achieve the holistic success of open sets geometry while avoiding conventional mathematics’ stringent rules. There is, however, reason to believe that continuity is merely a useful psychological illusion, even for mathematicians.

For example, Chaitin’s discovery of Omega numbers is neither the first nor the last, only the most recent frustration for mathematics’ quest for an absolute continuity, an existence completely without holes. Experimental sciences have fared no better. Mechanical extension of our senses upward into the cosmos or downward among quantum particles, whether with lenses, mirrors or Information Technology, the answer is always the same—more space than matter, more holes than substance. Boxed in by the conceptual frameworks of Western analytical languages, mathematics, and philosophy; behavioral scientists are still repeatedly forced to consider whether continuity is only a mental artifact. The Chinese have a Gestalt concept that provides us with an intriguing answer.

The Chinese call their Gestalt “taiji” (sometimes spelled tai chi or tai-ch’i), which translates roughly “Grand Ultimate”. The Chinese took over three millennia to develop the pattern that strongly resembles morphogenesis, Nature’s own genetic algorithm. Information Technology based comparisons between: the Grand Ultimate, DNA, meta-mathematics and Gestalt psychology, reveal fundamental principles of continuity, integration and natural open systems. In contrast to logic inherited from Greece, which has had difficulties supporting modifications demanded by the many multi cultural discoveries in mathematics (see Teresi 2002) Chinese philosophy absorbs even radical mathematical concepts with relative ease. The same can be said of Chinese

philosophy's ability to support and, if necessary, to incorporate or emulate alien philosophies.

In addition to having a powerful mathematical base, the secret to the Chinese system of integration and synthesis lies in an organic way of defining wholes and parts. Western Hellenic heritage dictates a mechanistic, either/or, exclusive, definition of "parts". The Grand Ultimate permits organic, both/and, inclusive, definitions. For example, Western logic has nothing analogous to the Chinese Yin/Yang polarities; where despite being opposites, Yin contains some elements of Yang and Yang contains some elements of Yin. Though Western logic forbids such mixed polarities they are the basis of Chinese reasoning. And equally important, biology, especially genetics, is replete with examples analogous to Chinese Yin/Yang pairs. It is the mixed polarities of Yin/Yang sets that create a raw feel illusion of a whole that is greater than the sum of its parts. The differences become critical when information is used to integrate *organic* "parts" of organic wholes with *mechanical* "parts" of mechanical wholes as is the case in cybernetics. Mathematics is also essential.

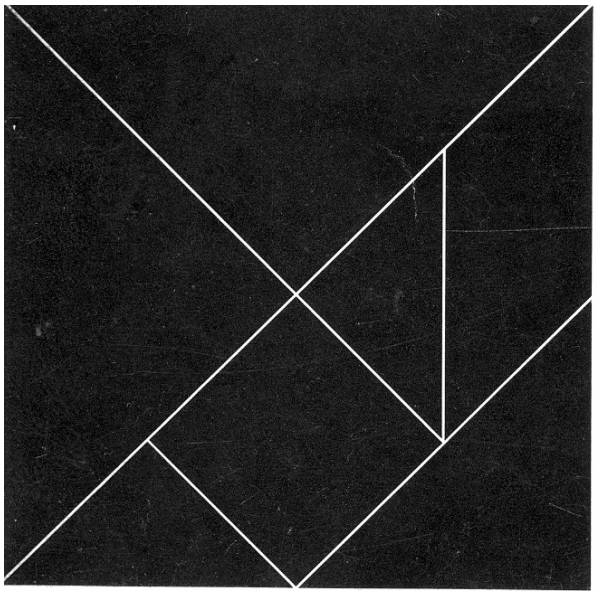
Qualitative and Quantitative Integration

Despite some linguistic interfaces where Chinese *I Ching* reasoning and Western logic are completely incompatible, mathematics permits not only an integration, but a continuity between the two cultures. Chinese mathematician Z.D. Sung (1934) showed how even complex wave equation are readily modeled by complex *I Ching* lattices. Another Chinese mathematician, Jou, Tsung Hwa (1983) provides the necessary links between *I Ching* reasoning, Western thought, and The Grand Ultimate. Mathematics succeeds where logic fails because the *I Ching* functions more like an advanced Gestalt psychology than it does any Western philosophy. The fundamental, pragmatic differences between the Chinese Yin/Yang Gestalt and Western reasoning are dramatically illustrated by comparing the consequences of their respective approaches to architecture and the calendar.

Architecture by its very nature incorporates: the functional, the aesthetic, the qualitative and the quantitative; along with cultural and personal biases- all inextricably linked to the niche space. To Chinese architect Lawrence G. Liu (1989), continuity is the primary focus; continuity is the chief difference between Chinese and Western architecture. Liu's discussion of Chinese organization of space is a classic example of how Chinese reasoning permits continuity from microcosm to macrocosm, a continuity that would be exceedingly difficult within Western cultural and logical frameworks.

When, by analogy, one extends the comparison of traditional architectural forms to living forms, the General Systems framework naturally encompasses both bio dynamics and psychology. However, with the dynamics, comes the fascinating but exceedingly complex mathematics of symmetry. See Stewart & Golubitsky (1992). Symmetry introduces definition problems and difficult concepts like "shared symmetry" and "broken symmetry". However, two simple games, one Chinese one Western, permit us to make the necessary psychological comparisons while avoiding a quagmire of specialized mathematical and technical complexity.

Figure 1:
Chinese Tangram Game. Two triangles form a triangle for the left side of the square and three triangles, a square and a parallelogram together form a triangle for the right side of the square.



According to Joost Elffers (1978), the Chinese name of the Tangram game is called *ch'i chae pan* (Seven-Board of Cunning): because it represents the custom of threading a needle with seven eyes, on the seventh day, of the seventh month; which is supposed to bring good luck. Both analysis and synthesis are brought into play as the player constructs a familiar, easily recognized object from seven simple geometric shapes. Here Seven-Board of Cunning is used to illustrate the Gestalt aspect of Chinese reason.

Pushing the Tangram pieces in Figure 1 together will produce a black square with an unbroken surface showing what appears to be indisputable continuity. By separating the pieces and thus exposing the edges of the geometric figures comprising the square the continuity is broken. Measurement of the triangle forming the top half of the square and the triangle forming the bottom half can be used to prove mathematical symmetry: but, though the two triangles equally divide the square, they are obviously different. Five rhetorical questions reveal relevant Gestalt qualities of the Tangram game:

- Is the whole equal to the sum of its parts?
- Does equal necessarily mean identical.
- If the geometric figures are to be integrated into the square form in Figure 1, are not quality and quantity shown to be of equal importance?
- Given the triangle forming the lower right side of the square is qualitatively the same as the triangle forming the lower half of the square, is not what mathematicians call quantity simply a fundamental and universal quality?
- Would rotating the figure or changing the order in which the parts were assembled be of any practical significance?

Psychologically, all of these questions are trick questions, like asking unwary undergraduate anatomy students to "describe the histology of the pupil". The wise but unwary will describe the cells in the iris. Those using common sense would call the

pupil a “hole”, but a professional would refer to its function by calling the pupil an “opening” to the eye. In physics and experimental psychology there are no such things as “holes”, there is only space-time, a fundamental entity with exceedingly complex, yet measurable, qualities. In Figure 1, the white surface represents space-time, a single, indivisible entity. The black surface represents matter-energy. With the black surface classified as Yang[2] and the white surface classified as Yin, Figure 1 is a Gestalt where space-time divides and defines the parts of a continuous whole. Western Gestalt psychology would have great difficulty achieving such continuity between what they would classify as the figure (matter-energy) and ground (space-time).

In contrast to their rhetorical importance to psychology, micro genetically the five questions above can be applied directly to the geometry of the DNA and RNA, where the answers may be of the utmost importance.

Twenty questions, a popular Western parlor game, illustrates the analytical qualities typical of Western mathematics, Information Technology and experimental psychology. Player A thinks of an object and challenges Player B to guess the name of the object. Player B is permitted to ask a maximum twenty questions to help him/her guess the correct answer. A simple algorithm; halving, helps Player B to optimize performance. Applied with good success in some systems of speed mathematics (see Cutler & McShane, 2002) halving is simply dividing by two. Applied to twenty questions, if B asks questions that effectively divide all remaining categories in half A, would have to have more than 1,048,576 (2^{20}) of Player B’s categories to win the game. Player B’s strategy reveals relevant strategies that *dominate* Western analytical thinking.

In mathematics, halving (executed with precision) will by definition generate symmetrical, quantitatively equal, sets. The whole is guaranteed to be precisely equal to the sum of its parts. And though not identical, the parts generated for one side will be mirror images of analogous parts for the other side. Of course neither perfect symmetry nor absolute equality is encountered in living systems. Even if they were as perfect as mathematical numbers, problems with “holes” similar to those encountered in the Tangram Gestalt still occur. Chaitin’s Omega numbers must have some effect on geometry and, consequently, topology. This raises two fundamental questions;

- Do the holes in mathematics have interesting qualities like space-time, or are mathematics’ holes linked to randomness in ways that make nonsense of all pretences of mathematical continuity?

- Can, as Chaitin suggests, experiment overcome the mathematical difficulties raised by Information Technology’s entrance into philosophy and metaphysics?

These are the kinds of questions that meta-systems are constructed to answer. If, as Chaitin says, meta-mathematics must employ experiment to answer its questions, mathematical psychology’s meta-system has a dual problem, because mathematical psychology’s meta system must answer both the relevance of such questions for mathematics and the consequences of the answers for psychology. Thus mathematical psychology’s answer to the two questions is formulated in terms of a third question, can the Chinese Gestalt function as a meta-system for mathematical psychology?

Reformulated into Chaitin’s mirror metaphor and edited to include both Eigen & Winkler’s Life/Death Game and the Chinese Gestalt, the question reads, Can taiji’s proven mirroring powers be extended to the “strategic gene”? Insights into the answers

[2] This representation would cause some cognitive dissonance among Yin/Yang purist who would use black paper to represent the Yin (space-time) polarity and white ink to represent the Yang (matter-energy).

to this question and many of the questions posed above can be gleaned from the Chinese application of taiji to their calendar.

Taiji a Chinese General System

Taiji's function is analogous to the role we give general systems. The primary role of a general system is to integrate any number of specialized systems into a seamless whole while, if possible, allowing each system to maintain its own identity. It would be difficult, however, to find a behavioral science equivalent example to the Chinese's application of taiji to integrate multiple aspects of the Chinese calendar.

At the most basic levels of survival, calendars are crucial for determining: when crops must be planted; what time of month women's fertile periods occur; periods of intense climatic changes; migration of important animals in the food chain; movements of tides, as well as religious holidays. In addition, embedded its calendar is a culture's knowledge and approach to space-time, the single most important determinant of behavior of all life forms. In addition, time is the psychological component of space-time, and as such, holds the key to synchronizing behavioral and environmental patterns. See Dockens (1996). Consequently, the integration between the Chinese calendar and other aspects of a culture may serve as a valuable behavioral science prototype.

To develop calendars, each culture's reasoning pattern must be integrated with the mathematics of astronomy, in order to achieve synchronization with both the cosmos and the local environment. The more complex the culture, the more dependent it is on time and timing. In ecological systems-after Nature selects and connects-synchronization is a vital step in a dynamic pattern of integration. Information supplied by genes play a decisive role in synchronization of plant/animal ecologies. Consequently comparisons between the Chinese and the Western calendars reveal essential information about their culture's respective approaches to an area of vital importance to Life/Death Game strategies.

The lack of connectivity that is characteristic of Western psychological research also characterizes the Western approach to constructing a calendar. The mathematics and astronomy connected to the calendar's construction are highly respected and have improved to the point where scientific speculation has extended beyond the galaxies where it includes the whole universe and possible multiple universes. Celebration of New Year is a quasi religious, quasi superstitious, activity involving parties and drinking. And astrology (that correlates positions of constellations at birth with personalities and daily lives of individuals) is considered to be either deep mysticism or pure superstition. To many researchers (probably most) any attempt at integrating such diverse expectations, assumptions, demands and perspectives would seem at best optimistic—at worst ludicrous.

Yet the Gregorian calendar continues to serve its multiple purposes. Like Western logic and its paradoxes, mathematics with its Omega numbers, and a notoriously fragmented behavioral science, everything continues as usual, the discontinuity barely noticed. The Chinese counterpart is almost the exact opposite.

In contrast to the great deal of specialization associated with development of Western calendars, Chinese mathematics, astronomy, astrology, psychology and politics were all closely linked and carefully integrated. A Chinese can impress aliens with a good approximation of the date of month using only the phase of the moon. This boasts well for the technical success of the lunar solar integration, but even this impressive astronomical accomplishment by an ancient culture is surpassed by continuity between the calendar and culture. More impressive still, is the way by which this integration is accomplished.

Fugue on the factors of the number twelve

W.C.C. Hu's (1991) *Chinese New Year* describes problems identical to those faced by the Greeks and Romans. In both cases the solution had to combine in a single system the lunar year of 12 cycles (or phases) of the moon (totaling about 354 days) with a solar year (totaling about 365 days). The Chinese solved the problem by meticulously calculating a year according to a solar formula and fitting a lunar calendar. Though their calculations led to similar results, the Chinese calendar had to be different from Western calendars because in China, astronomy, astrology and meteorology were closely linked to politics. Hu says:

> *"The astronomers were regarded as the interpreters of the celestial signs. Exploiting the resonances between the natural and political worlds, they read the destiny of the empire in the heavens by observing the stars, the course of the five planets and their transits through the twenty-eight stations (Hsiu) of the moon etc." (pg. 19)*

The result is an integrated lunar-solar calendar where three New Years are observed and celebrated, one for the people, one for the politicians and one for the farmers. Resembling more a behavioral general system than the basis for chronology, the Chinese calendar suggests how Western mathematical psychology can apply mathematics as an aid to "understanding" the Chinese Gestalt—up to and including the Grand Ultimate. We can start by thinking of Chinese reasoning as a fugue on the factors of the number 12 (2, 3, 4, and 6), and we can think of 12 itself as the Grand Ultimate (taiji).

The Chinese give each of the *twelve* months of the year the name of a different animal, but, not just any animal. Similar to Western astrology, the Chinese supplied each animal with a personality, a life's philosophy, a strategy and a legendary history. In addition, each animal is assigned a year and one of the *four* seasons (winter, spring, summer and autumn); a direction (North, East, South and West) and *two* hours of each day. Finally, each animal is connected to *I Ching* reasoning and the Grand Ultimate by a Yin/Yang designation and an assignment to one of the *four* elements (Water, Wood, Fire and Metal).

Five Powers (Elements)

Of special interest here is the fact that there are five powers (elements) and none of the seasons were assigned the fifth element, Earth. Lau (1980) says the Chinese sages reasoned that Earth (interpreted here as ecology) is symbolically composed of the other four elements. This reason seems consistent with the way that the element Earth is used in Shao Yung's I Ching numerology. It would also be rational to view the calendar as "Earth", since the calendar is composed of the four seasons. is See Liu (1967). If, as Lau says, the Earth element is composed of the other four elements then Earth would have to be some form of integration or compound, perhaps a mini taiji. Using the *I Ching* reasoning as a mirror, a Western philosopher might assume that the sages' decision was based on consideration of a variation of a Chinese version of Russell's paradox (discussed above), or some rule concerning simplicity (like Ockham's law of parsimony). A Western mathematician might suggest that perhaps a fifth element disrupted the celestial rhythm of the Chinese calendar's fugue by introducing the asymmetry of an odd number among all of the even numbers being generated by integration of solar and lunar elements in the Chinese calendar.

Though all of the above explanations may have some validity, they underestimate both the complexity of the problem and the integrative abilities of the Chinese sages. Chinese historian Hu (1991) describes in detail how the number five is the central number in a magic where the sum total is fifteen in any direction.

Table 1:
The magic square defining significant and critical relationships integrated in the Chinese calendar and the taiji principle.

6	**1**	**8**
7	***5***	**3**
2	**9**	**4**

The Chinese associate this magic square and categories of five with equations of changing seasons, five directions on the compass, interpretations of the *I Ching* and Taiji. The numbers fifty, forty-nine, seven, five and three all represent important systems that must be integrated into the calendar and the culture. Chinese mathematician Sung (1934) gives a thorough diagrammatic description of more advanced mathematical functions and their relationships to the *I Ching*; and Chinese mathematician Jou, Tsung Hwa (1983) has published tables and diagrams that show the mathematical connections by which the taiji (Jou uses the tai-chi spelling) principle not only connects but integrates the diverse systems that comprise the Chinese culture.

How taiji inextricably links the five elements (Wu-Hsing) to all of the component systems is of special interest because the principles governing the five powers supply the underlying dynamic for interrelated systems. According to Hwa, the five elements are related to each other according to four major principles; mutual creation, mutual closeness, mutual destruction, and mutual fear. Consequently, conflict, mutualism, affinities, and compatibilities are contained in the theory of five elements. Relevant to behavioral science, Chinese historian Fung Yu-lan (1983) cites the *Kuan-tzu* and describes punishment and reward as “the harmonizers of the four seasons”. Thus the Chinese have used taiji to link the elements to the seasons and the seasons to reward and punishment.

Half of a “Theory of Everything”
Added to the discussion above, the way that Chinese and Western cultures are mirrored in their respective calendars is incorporated into an integration prototype for an *applied mathematical psychology*. Calendars demonstrate dramatically that synchronization with a changing ecology is more a process than a goal. Calendars focus on the qualities of ecology that numbers can describe in concert with other aspects of a culture, abstract qualities like time and synchrony. For behavioral science, calendars also demonstrate the constraints cultures and ecology place on mathematics and visa versa.

Like their calendar, the products of Western analytical logic are specialized and fragmented to the point that the unified whole, so desirable to the psyche, is virtually impossible. Consequently the ultimate conclusions reflected in the Western meta system are plagued by holes, discontinuities, random distortions, chaos and numbers that can not be computed. It would be unwise, however, not to see the advantages in discontinuity. The power and utility of Western analysis comes from its facility in isolating functional units that can control and alter patterns, and perhaps change the very course of Nature. Western medical sciences and micro genetics research are examples.

Like their calendar, the products of the Chinese *I Ching* are generalized, and integrated to the point that the unified whole, so desirable to the psyche, is virtually a seamless web. Consequently the ultimate conclusions reflected in the Grand Ultimate (taiji) are characterized by smoothness, continuities, aesthetic forms and whole number concepts. The power and utility of The Grand Ultimate comes from its facility in integrating functional units that can harmonize with; alter patterns, and perhaps conform to Nature. Chinese medical sciences and holistic procedures are examples.

From the perspective of general systems integration, the two cultures and their calendars can serve as a prototype of the cultural integration problem. The solutions to the mathematical problems encountered while constructing a calendar are literally dictated by cosmology. So, the Chinese and Western calendars are pretty much in agreement as far as days, months and years are concerned. Though the Chinese calendar has the added advantage of being synchronized with the phases of the moon, each calendar functions reasonably well in respect to empirical predictions. Most important, the calendar was the first mathematics mediated interaction between Homo sapiens, genes, and their global environment.

Behavioral science can learn three valuable lessons from that interaction, because calendars make the relationships between mathematics, integration, and Nature's modus operandi clear and unmistakable. First, the link between natural events and mathematics practically guaranteed agreement between Chinese numbers and Western numbers, but the calendars constructed around the numbers differ considerably. Second, Nature's laws governing climates and seasons define what is global, what is local as well as the differences between global and local. Finally, Eigen & Winkler's *Laws of the Game* suggest that though considerably more subtle than the brash laws governing calendars, Nature's laws governing behavior are part of the same modus operandi.

Eigen & Winkler view the genes as engaged in a life and death game; a game played *on* and played *for* a niche space; a game that resembles the Chinese game—wei-chi. The mathematics of population demographics are determined, more or less, by the laws of the game, and behavior is constrained, and to a large degree controlled, by these laws. According to the authors, the mathematics describing these laws can be simulated by bead games, but the "understanding" of these laws by physical and biological sciences is limited to the "rules" of the game. With the exception of the limits to understanding, all of the above is just as applicable to behavioral science as it is to physical and biological sciences. This highly significant difference is apparent in the calendar example.

Whereas physical and biological science specialties have focused on the calendar's measurable astronomical and geographic facts and ignored (not with impunity!) individual reactions, cultural variables, and folklore, 21st Century behavioral science is extending this understanding to include the psychological aspects of the gene's fundamental adaptive tactics and strategies of survival. An individual might see calendars as clues to the collective psychology of a single culture. Nevertheless, laws of demographics combine with the fact that calendars occurred as geographically isolated events, in some cases, and as interactions between cultures in others, to suggest that behavioral researchers erase most of the boundaries between anthropology and applied mathematical psychology.

Based on the historical and present states of Chinese and Western calendars, a constellation of mathematical psychology and anthropology suggest that despite agreement as to specific numbers and dates, irreconcilable epistemological differences prevent integrating the Chinese calendar into the Western system. On the other hand, the Chinese use the Gregorian calendar *concurrent with the Chinese calendar*. Specifically, though Theodora Lau (2000) can "integrate" Chinese and Western Horoscopes (East/West), there are serious epistemological barriers that complicate

analogous integration (West/East)—even in informal cases like Horoscopes. Maruyama (1980) has demonstrated that mathematics and mathematical arguments may be of little or no help in the face of cultural resistance. The simple fact of an asymmetrical cultural acceptance for calendars supplies equitable support for Maruyama's views on mathematics and agreement. However, generalizing from calendars to cultural integration and from cosmology to micro genetics requires a general behavioral science foundation. Introduction of the number zero into Western reasoning systems is a prime example.

Divisions by Zero

Division by the number zero is invalid, but that did not prevent zero from amplifying serious cultural divisions. Fraught with problems of taboo and misunderstanding from the start (see Teresi, 2002), and finally proven indispensable, the number zero still was the source of logical and conceptual difficulties in anthropology as late as 1979. The case example is a three way comparison between Western European, Congo and Chinese reasoning.

Common sense arithmetic attributes zero either to a null set with no numbers or uses it as a very non dynamic place holder. Cultural anthropologist Jacobson-Widding (1979), whose basic argument is described above, applied the number zero to a "dynamic" *intermediate*, "red", value in the Congolese three valued logic. The Chinese apply zero to an equally dynamic but *extreme* value "Yang". As one of the dyads in information theory, zero is both definitive and dynamic indeed. Finally, the role of zero in defining imaginary numbers in the complex number system is the use most appealing to the applied mathematical psychology system for which this paper is the epistemological foundation. These are all valid uses of the number zero; nevertheless, the uses supply basis for quite different interpretations.

The differences can be attributed to the sophistication of the underlying scale. See Stevens (1951). Anthropologist Jacobson-Widding's use implies a nominal scale where the number is used as the name of a category, while mathematician Hwa focuses on the fact that zero is the origin. Once again, zero amplifies the differences rather than facilitating either an integration or convergence of the two views. Psychologically the arguments supporting any of these positions are seen as being more like *rationalizing* than they are *rational*.

Even when there is irrefutable proof of the superiority of one mathematically based system over the other, force of habit can triumph. The case of the British Imperial measurement system and the Système Internationale d'Unités is a prototype example of cultures refusing to adopt a system that is superior on rational grounds and can be rationalized both pragmatically and scientifically. There can be serious consequences. Despite the universal acceptance of Système Internationale d'Unités by the scientific community, a space experiment failed due to a mix up in units.

Stated succinctly, the conclusion is that numbers and mathematics by no means guarantee either agreement or integration. Neither does a mirror. Mirrors, however, have subtle, psychological, properties that permit mirrors to exert a powerful influence, without requiring either agreement or integration. Nevertheless, there are laws governing the construction of mirrors, even if they are only conceptual mirrors—like meta-systems.

The comparison of Western and Chinese calendars shows how taiji can be an exceedingly accommodating meta-system. A simple substitution of Eigen & Winkler's strategic gene for the cosmos sets the stage for an analogy between the Chinese calendar and mathematical psychology. Analogous to the respective calendars, the Chinese meta-system can accommodate the Western, but not visa versa. As the movements of the planets dictated certain identical facts and features for both

calendars, the tactics, strategy and structures of the gene will generate corresponding facts for the corresponding meta-systems.

A Subtle Elegant Complexity

Subtle elegant complexity is the strategic gene's immediate contribution to both general systems and mathematical psychology, but, at a price. Speaking through taiji, the living information system requires subtle, but significant, modification to practically many aspects of both mathematical psychology and general systems.

Before the birth of Information Technology, theoretical biologist Ludwig von Bertalanffy's (1968) *General Systems Theory* linked mathematics and computer science. Physicists von Bertalanffy defined a system as *closed* "if no material enters or leaves it and *open* "if there is import and export of material." While accepting the "open" and "closed" definitions in principle, micro genetics supplies all living things with a code that places severe and very specific limits and constraints on what may or may not enter a "living" system. Allergies, blood types and criteria for organ transplants are the most notable examples. Absolute categories "open" and "closed", like other examples of tertium non datur, are seldom supported in the world of the strategic gene. In Eigen & Winkler's new language of genetics a living system open/close opponent categories may be redefined as being "open more or less" or "closed more or less". The "mirror" meta-system can treat Open/Closed as Yin/Yang and define a spectrum between them.

James Grier Miller's (1965) (1971) multilevel descriptions of living systems can also be translated into the strategic gene's information system. In the strategic game formulation, DNA/RNA strings not only define "living systems" and "dead systems", they can (as in the case of viruses and fetuses determine) "more or less", life and death. Structure defines function and structure is the basis of function. To a strategic gene, a *genotype* is merely a prototype, to be put to a test as a phenotype. Those that survive are modified and reentered in the gene's Life/Death game for niche space, those that do not find themselves on evolution's scrap heap. The strategic gene seems to be experimenting with everything, including how it modifies successful prototypes. Cloning seems to be the tactic of choice for some simple types and sexual reproduction for the more complex. Cloning and sexual reproduction represent extremes on what reveals itself again and again as a spectrum of techniques, tactics and strategies. Spectrum is a key word in a language describing the strategic gene. The language is forced to cover everything from phylum, through species, to identical, individual identity; the gene has an impeccable information system that is capable of defining each an organism in relationship to itself and/or multiple relationships to all others.

Eigen & Winkler's strategic gene has a special affinity for Rapoport's approach to game theory. Using its code as a blueprint and proteins as building tools, the gene produces the genotypes (sexually or asexually, depending on the species) that become phenotypes; phenotypes are thrown—like expensive dice—into the Life/Death game, where they react with an often radically changing environment. The phenotypes are the gene's working "prototypes". Einstein (who would not accept quantum physics because his god did not play dice) would abhor mathematical psychology's strategic gene whose strategy is identical to that of a casino owner; a casino owner who can afford to always play fair because there is precious little chance of the house losing. Each individual of every generation is both a cast of the gene's dice and a player in the Life/Death game. Imperiously impartial, the house is not particularly worried either about going broke or which of his customers wins or loses the available niche space. Casino owners, games and genes do not employ determinism in any strict sense, but *determinism more or less*.

Wei-ch'i is an excellent analogy because skillful players make use of patterns that Japanese players call *josekis*. Josekis, as tactics, do in wei-ch'i what the gene does in the Life/Death Game. Both employ Rapoport's optimal strategy (TIT FOR TAT) that never attacks first, but severely punishes any attacker, then forgives him/her. The process is "repeated as needed". See Axelrod (1984). The result of this strategy, it permits skillful players to turn what most people experience as a zero-sum (win/lose) game into a positive sum (win/win) game. The strategic gene creates difficulties for mathematical psychologists by extending pragmatic applied studies into the barely explored area of positive sum games. There is the consequence, however, that Russell's theory of types and its relationship to hierarchal formulations encounter severe difficulties with both positive sum games and competition regulated by hypercycles.

Psycho linguistics, pioneered by Noam Chompsky, is the discipline most challenged by the strategic gene; because Information Technology was developed during World War II and the Cold War, primarily to be applied to coded language problems. Consequently, computers were originally developed to extend a long history where code braking was simply the first step to discovering enemy tactics; tactics the first step to discovering enemy strategy. See Kahn (1996). Consequently, the force of the strategic gene's subtle, primarily feminine, elegance brings evolution's integrative reasoning to an area where language and biological research traditionally focused on the numerous, but over rated influence of the male hormone testosterone.

Without the genetic code, it was understandable that behavioral researchers would (when not applying mathematics to language) downplay, or completely overlooked the strategic gene's more subtle methods and concentrate on the spread of language by the military strategies of colonial armies: Latin by Roman legions; Greek by Alexander's phalanxes; English by the British square, Moorish cavalry, Napoleon's canon, German tanks, etc., etc., etc…. However, micro genetics has led to radical changes in the way we view human evolution. Luigi Luca Cavalli-Sforza (2001) recounts, in *Genes, Peoples and Languages*, how cultural archeology, genetics and linguistics have be joined by cultural anthropology, demography, economy, and sociology, seem to all be converging toward creating a common story of human evolution. Consequently, the 21st Century version of human evolution is envisioned as a multidisciplinary account that, with the help of micro genetics, extends much further into the past than linguistic accounts of recorded history. See also Cavalli-Sforza, L., Menozzi, P. & Piazza, A**.** (1994.

That this convergence, this synthesis, this multidisciplinary effort includes economy and does not include any form of psychology is understandable in the contexts of the discussion. Instead of converging toward any unified story (or point!) conventional psychology was in the process of diverging from everything, including itself. The strategic gene formulation in a general systems conceptual framework suggests modifications to the story of evolution: the end of the modified story includes a planet populated by "nice" genes.

Digitized Casino Morality

Political scientist Robert Axelrod's (1984) computer simulation of competing moral strategies and Rapoport's formulation of the winning strategy combine to give an Information Technology based prediction of a planet populated by "personally empowered, nice", genes. Applied mathematical psychology, in combination with the above modification of Chaitin's mirror, permits an extension of Axelrod's results to employ Cold War Information Technology to the discovery and prediction of Eigen & Winkler's gene's strategies and tactics. The strategic gene seems to be doing essentially the same thing that Axelrod was doing, but with considerably greater

sophistication. Fortunately for mathematical psychology and Homo sapiens, it appears that the results will be analogous.

Like Axelrod, the gene has arranged a tournament open to all strategists. Neither the *Axelrod phenotype* nor Nature has any vested interest in who wins the tournament, or by which means—only in the results. There are, however, some significant differences between the Axelrod phenotype's tournament and the competition arranged by Nature. In Nature's tournament, every living thing (all genes, plants, viruses and animals) has been entered in the Life/Death game tournament since the first life form appeared on our planet. After entering the playing environment, genes rarely leave Nature's Life/Death tournament, alive. Finally, everything about the Life/Death game, *even the time limit*, is more or less determined. Yet, any player can be eliminated by random processes that can vary in size an severity from the quantum physics of radiation; through defects in micro genetic coding; to the astrophysics of exploding and colliding stars.

Morphogenesis appears to be the prevailing pattern for Homo sapiens; and variations of Rapoport's TIT FOR TAT (a strategy so simple even viruses can master it, but so subtle it defeats the most sophisticated mathematical models!) seems to be on the way to a triumph in the Homo sapiens class. Where the "bad" guys/dolls are not eliminating each other from the tournament, they are succumbing to superior "nice" strategies. Casualties among the exclusively nice will be higher than among the "intermediates" (like TIT FOR TAT); but *their population numbers* will probably outlive the bad. And the net result will be an integration of the "nice".

As encouraging as the above scenario may have sounded for "nice" gene populations, phenotypes are not included in the immortality that is so highly probable for nice genes. Axelrod's and Nature's definition of *"bad" is striking first*. Revenge by "intermediate" friends and family members all but insures the demise of the "bad", but is little consolation for a victim of a lethal first strike. The plight of phenotypes is best exemplified by a virus attack against a Homo sapiens; this pits the most efficient simple life structure against the most efficient complex life structure; DNA against RNA; a naked micro genetic structure against a complex system that includes a brain. Contemporary AIDS and SAS epidemics are prime examples. There is no guarantee that either the attacking virus or the infected Homo sapiens will survive the encounters. Yet, Axelrod's and Nature's tournament results still tend to agree. "Nice" viruses that are not lethal to their hosts will probably survive longer than "bad" viruses that kill hosts.

Nevertheless, wise phenotypes are those that survive by superior tactics and strategies, whether inherited or acquired. Only successful phenotypes will survive to represent the gene. Chance has a role to play, but fortuitous events, whether positive or negative, may only delay a real test of a phenotype's adaptive strategy. The ancient question as to the superiority of simple micro-genetic structures (like viruses) over complex organisms with both brains and micro-genetic structures, (like humans) is still an unanswered question. Consequently, winning merely the Homo sapiens division of the Life/Death tournament by no means insures survival of a gene, or long life for a phenotype. The Life/Death tournament is held in a truly open system. Nature runs its tournament as if it were a morality casino: a morality casino Axelrod that has merely digitized.

Chance and Necessity; "More or Less"

When we add psychological raw feels (unconscious thoughts that are felt rather than articulated) to Chaitin's incomputable numbers, conventional languages and epistemologies crash; they are confronted by an irrefutable reasoning inherent to ancient genetic codes. Laws become mere rules expounded by magistrates; and

commandments shouted by stalwarts of conventional moralities offer no achievable alternatives to strict conformity to the laws of the game. Science fares no better.

Translating from the language of the genes to other languages, the expression *determined more or less* can not accurately be translated “determined”. Not quite absolute; but nearly so; when defined genetically, “determined” always has a probability function, a probability function that may rarely (yet all too often to be excluded!) be attached to a catastrophe. Consequently, conditions described as genetically “determined” may produce results that are diametrically opposed to predictions made by “rational” but conventional methods.

Attempting to place moral values on events that are not absolute, but “determined more or less” tends to play havoc with moral and/or philosophical systems—if the values insist on certainty. Typically, in forced choice situations, where conventional language usually expresses alternatives in terms of “either or”, the gene usually substitutes options that are better expressed with “both and”. All too often, genetic problems present organisms and researches with a complete spectrum of options.

In general the biological world of the genome and its genetic code is a world dominated by laws of information. There are clear and obvious differences between information, as employed by genetic DNA/RNA systems and information as defined by 101010 computer systems (though discovery of the former has been heavily dependent on developments in the latter).

Computers and robots use a mechanical code to *express* a comparatively rigid form of information, IT-*information*; information that requires no living organism for execution. On the other hand, living organisms (viruses, plants humans, etc.) and cyborgs use genetic code to *generate* a dynamic quite flexible information, *G-information*; information that is generated by living organisms and requires either the same system or another living organism for its execution. It is important to emphasize, however, that IT-information is a G-information artifact! Consequently, though IT-information does not actually inherit anything directly from G-information; it nevertheless shares significant characteristics with its creators.

Confusion concerning differences between IT-information and G-information are frequent sources of difficulty both for theoreticians and applied workers. Growing interdependence between the two kinds of information adds to the complexity by demanding that behavioral scientists understand both kinds of information as well as possible and probable interactions between them. Also, distinctions become blurred as the two definitions merge in advanced applications of artificial intelligence; and when an increasing number of emerging technologies use Information Technology to transform Homo sapiens, and other species, into cyborgs. Here too, failing to differentiate the two types of information can lead to serious consequences.

The picture is further complicated by the fact that two types of living systems patterns (inextricably linked to a changing environment and to each other) produce two types of G—Information, one structural the other procedural. The first, DNA and RNA, are *generative patterns*. Generative patterns are structural patterns. In contact with the proper living environment, (mammal’s DNA in a womb, virus RNA in a cell for) these structures induce the environment to produce one or more living organism that conform to a plan specified by the genetic code. DNA/RNA codes force us to view information as structures that are not merely plans, but executors; they are the very foundation of organic structure and function.

The second pattern, the *evolutionary pattern*, is a process pattern that seems to be an invariant developmental pattern for all of Earth’s living organisms. Phylogeny, morphogenesis, learning and cognition, advanced human thought, all adhere to the evolutionary pattern.

Nearly symmetrical forms and/or opponent pairs are characteristics of the generative structures. Opponent processes are characteristic of evolutionary patterns. Called a synchron and synchronicity respectively, the generative structure and the evolutionary patterns are believed to be the basis of the fractal like, psychological, organization of both conscious and unconscious events. See Dockens III (1996). Chinese philosophers were the first to describe the complex relationships between the generative structures and the evolutionary pattern. Chinese scholars call the relational complex as expressed in living systems *Tao*. The generative structure, they call *Taiji*.

For Western European cultures, the effects of accepting the Taiji and the Tao's Eastern, natural, quasi feminine reality against formidable masculine linguistic obstacles can be likened to our acceptance of the mathematical concepts governing complex numbers and the number zero. Both zero and the imaginary unit ($i^2 = -1$) were at first accepted in an atmosphere of suspicion, mystery and skepticism when first introduced to the West. Of special psychological significance is the fact that a complex number consists of two parts, an imaginary unit and a real unit. Human thought also consist of two parts, one "imaginary"; the other "real". Psychologically, our complex reality, like complex numbers, is incomplete without the imaginary components.

By analogy, Taijiquan (the life/death combat application of the taiji principle) suggests the representation of complex numbers that comes closest to describing the phenomena involving the strategic gene is a stereographic projection called the Riemann sphere. See Hwa (1980). Time, mathematics, the harmony of opposites, omission of tertium non datum, all combine to make Taiji's dualities a western semanticist's nightmare—especially in psychological contexts. See Korzybski (1958).

The meta-system constructed here, specifically for the mathematical psychology of the strategic gene, consists solely of the two organic patterns—linked. It is a form without content. When the DNA/RNA content is added, G—information does to conventional concepts of psychology what Information Technology did to mathematics (Omega numbers); particles did to physics (quantum mechanics), DNA/RNA did for genetics (the genome) and what genetics is doing to behavioral science in general. The mirror has been constructed to guard against most paradigmatic distortions (analytical, inductive or synthetic biases) that might otherwise alter a phenotype's image of itself. Finally, the meta-systems mirror is constructed to withstand the extreme pressures that will be generated by advanced information systems that may be constructed in hyperspace. See Kaku (1995).

The crucial role of the amicable partnership between Chance and Necessity and the essential contribution of a meta-system and a language to support this role become most apparent during the events comprising morphogenesis. In addition to the strategic gene's fundamental tactics and global strategy, the direction of evolutionary processes and the mathematics crucial to their description, all come into sharp relief when morphogenesis is made the focus of applied behavioral science.

From selection of sperms and eggs within individuals, to the time of inception, morphogenesis is the epitome of how the strategic gene uses principles (common to Nature and games) to govern chance. Like in a marathon race, the frantic contest that selects among suitors and sperm for space in a womb with an egg are subject to chance at the same time that the process is already being brought under the control of strategic genes. Once the selection is made, and insemination complete, a strategic gene forms then takes over. What happens next is analogous to an *information orchestrated* piece somewhat different from anything the great Mozart composed, played and conducted.

The strategic gene's style is more like that of new world composers, a combination of the flexible melodies and bold rhythms like jazz composers Duke Ellington and George Gershwin, yet capable of velvet crescendos and abstract melodic changes like those

characteristic of Mexican composer Manuel Ponce. Strategic genes have inherited codes comprising the genotypes: these elements play like classical themes, rhythms, and melodies; some are relatively new, analogous to the music of French and Spanish Impressionists; some of them are as ancient as life itself.

Like Jazz composers, strategic genes construct contemporary themes that allow maximum freedom to competent phenotypes, who are the soloists in the genetic orchestra. As long as phenotype soloists do not seriously violate fundamental themes and rhythms they will survive as extensions of the genetic jazz line. Extended, its African roots make the jazz music analogy conform to 21st Century, DNA based, genetic trees (championed by Stephen Oppenheimer, 2003 and Luigi Luca Cavalli-Sforza, 2000) than do classical music analogies. Also, jazz is now suffering, as classical music did before. It is no longer dominant and should not be complacent about the probabilities of extinction. The music analogies are not, however, simply analogies. Musicians are people; phenotype expressions of genotypes.

A disquietingly complex, efficient and indifferent cognition is revealed to any phenotype who looks into the meta-system mirror constructed especially for reflecting the gene in the dramatic transformations comprising morphogenesis. In the mirror, what has been often interpreted as multiple cognitions, multiple personalities, and (in extreme cases) multiple worlds, is exposed as a single, information generated, process.

"Intelligent" Organic Polymers!

Conventional pre-genome notions of a "gene" can not carry the weight of this concept: the genome can. The more that is known about the concept "gene" and the chemical structures proposed to comprise it, the more the evidence favors DNA/RNA polymers as both the true organic strategists and the actual "players" in the Life/Death game. Experiment supports the genome as both the carrier of primal information and the expression of the most recent mutations and evolutionary advancements. Collectively the genome defines the species and the phylum; singularly the genome defines the individual. The genome retains all of the qualities and aspects that were attributed to the gene; the genotypes as well as the phenotypes. Still, the experimental distance between the physical chemistry of a polymer and the personalities, strategies and tactics of GO masters is vast.

Chaitin's Information Technology based epistemologies stipulate experimental foundations to support reasoning and analogies. Here we encounter an unusual situation where Eigen & Winkler's (1993) brilliant GO game analogy permits a sharing between three experimental disciplines: mathematics, biochemistry, physical aspects of cultural anthropology and experimental psychology. The analogy also supports much that is not experimental, but is still essential to behavioral science and genetics. Yet, sometimes it is important that the relationships between disciplines, experiments, reality and analogies are clearly delineated; and sometimes it is not.

One thing is clear. DNA and RNA based living forms are not analogies: they are realities. Survival is the strategic gene's only rigid stipulation. For jazz groups and orchestras to conform to real strategic gene criteria, every musician would have a complete copy of the music being played as well as all of the music that contributed to the music's development. The genome's modus vivendi dictates that solo phenotypes that synchronize the genotypes evolution with extant environments will extend the genotype: others will die. The genome thrives on diversity among its phenotypes. Information is shared to the point that every phenotype has a complete copy of the genotype, and every cell in a phenotype shares the DNA/RNA of that phenotype. Sharing and integrating genetic information permits phenotypes to meet opposition with sophisticated, appropriate strategies.

Few organizations come any where near approaching the quality of integration that the genome achieves by means of its sharing of information. The above characteristics also reveal the strategic genome as considerably more tolerant than almost any philosophical or scientific paradigm. This strategic gene conceptual framework's treatment of the Sir Karl Popper's philosophy can serve as a prototype example of paradigmatic tolerance.

Popper would suggest to the strategic genome that an inductive approach to science was far from ideal, because nothing can be proven to be true. Popper would, however, permit statements to be falsified. In the strategic genome context, Popper's assertions would be welcomed with enthusiasm by its genotype aspect but rejected as nonsense by its phenotype[3]. This follows naturally from the fact that the strategic genome uses phenotypes as environmental probes, multiple prototypes for producing information for construction of future genotypes and phenotypes. Those that do *not* survive are "falsified", but there is no assurance whatsoever that the surviving prototypes will continue to survive. On the other hand, frantically adapting phenotypes accept anything that is functioning as "true". This follows naturally from the nature of the phenotype for which "Chaos" alone would make Popper's theory of falsification a very dubious option. To the strategic gene, Popper is no more and no less than another phenotype probe.

The Genome Game Symbiosis

The extreme, high casualty, conflict between Homo sapiens and infectious viruses has been chosen as the *definitive prototypes* of genomes playing Nature's Life/Death game. To date, the most extreme case on record is the influenza pandemic of 1918. It infected billions and killed between twenty and forty million people. A kill rate of approximately 2.5% of those infected justifies labeling the relationship as a "Life/Death conflict"; and the billions infected without dying suggests "symbiosis". Eighty-six years, many Nobel prizes, and an Information Technology revolution later, the AIDS (ACQUIRED IMMUNE DEFICIENCY SYNDROME) virus threatens to eclipse the human casualty record. That no attempt is made to estimate virus casualties, though they are undoubtedly many powers of ten higher, is psychologically significant, but not nearly so significant as the difference in the strategic quality of play by Homo sapiens genomes at the unconscious, polymer level of the conflict as opposed to the tactics and strategies employed at the conscious, individual, and institutional levels. Both AIDS genomes and genomes of the many viruses that cause common colds are master players who boast consistent wins over Homo sapiens opponents.

Genome weapons are chemical, and at the cellular level (where "battle" is engaged) "suicide attacks" are the rule, rather than the exception. Technically speaking, there are no rules, only Nature's laws. Adapting swiftly to creative changes, chance, catastrophe, mass births and mass deaths (at the cellular level) are characteristic of the *actual*, genome vs. genome, Life/Death game. The patterns of engagement are too complex to describe as if they were stereotype.

Virus genomes masterfully exploit their relative information simplicity, in comparison to Homo sapiens. After a chemical entry, viruses insert their messages into the cell. Like a fertilized egg in a womb the virus genome induces Homo sapiens cells to produce viruses in geometric progressions that eventuate in vast numbers of viruses that overwhelm Homo sapiens' complex defense systems. AIDS is especially skillful in inducing the Homo sapiens defense system to produce replicas of the invading viruses. The Homo sapiens defense system responds with an integrated, multifaceted, chemical, defense/counterattack.

[3] Induction advocate Hans Reichenbach found the results of Sir Karl Raimund Popper's great work, *The Logic of Scientific Discovery* "completely untenable".

Mast cells function as an alarm system; histamines and cytokines alert blood vessels, and macrophages. Macrophages attack both damaged cells and invaders, using toxic chemicals. Blood vessels respond by permitting immune cells (lymphocytes and neutrophils) to move swiftly to the site of attack. Lymphocytes increase the effects of the immune system and neutrophils specialized in engulfing and destroying. Toward the end of the encounter platelets appear to repair the damaged sites. Vast numbers of Homo sapiens cells are and viruses are created, killed, and destroyed in the conflict.

Globally, daily, Homo sapiens genomes fight variations of this conflict for living space in Homo sapiens' bodies on many levels: chemical, cellular, systemic, individual and institutional. We are conscious of events that occur only on the last two levels, individual and institutional. Individual and institutional levels lack the integration, coordination, cooperation and effective strategies, tactics and counters of the unconscious aspects of the conflict. While our contemporary, human, collective, intelligence is, as international institutions, struggling mightily to *learn* adequate strategies and tactics against a formidable genome, the efforts of our ancient genomes are superior in every respect. This contrast between the degree of sophistication between the conscious activities of human brains and institutions and the unconscious activities of the Homo sapiens genome suggest a shocking (but inescapable!) conclusion.

The seat of Homo sapiens intelligence is not in the brain, it is in the genome. The brain is an organ of integration. Homo sapiens' organ of integration is fast evolving into an organ of thought, an organ that is of increasing assistance to the genome. But this development is, at present, far too primitive to match the strategies and tactics of our most dangerous and most lethal opponents—virus genomes.

Political scientist Robert Axelrod's game theory/Information Technology axis helps to predict the probable direction of our evolution and the probable outcome of the gnomic games. The exclusively "nice" (non aggressive), forgiving, genomes will, probably survive longer than the exclusively "non-nice" (aggressive), only to succumb to a nice/non-nice combination. Our genomes are driving us relentlessly toward a world populated by followers of Rapoport's TIT FOR TAT strategy which Axlerod describes as nice, retaliatory, forgiving, and clear. His reasoning:

> *"Its niceness prevents it from getting into unnecessary trouble. Its retaliation discourages the other side from persisting whenever defection is tried. Its forgiveness helps restore mutual cooperation. And its clarity makes it intelligible to the other player, thereby eliciting long-term cooperation.*
>
> Axelrod (1984)

The psychological consequences of the meta-system are presented in a sequel.

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