

Kenneth J. Hsü

In Search of a Common Language



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I took three projects with me to Berlin. Shortly after New Year, I completed the writing of a monograph on the geology of China. The possibility of being relieved of teaching and administrative duties at the institute made the chore easy. After May, I started the cooperative project with Abraham Lerman and Fred MacKenzie on the explosive evolution of skeletal fossil organisms. We had three ideas, and we might never have come to an agreement to identify the correct idea to develop a working hypothesis if we did not have the opportunity to discuss in depth the various aspects of the problem. We now understand each other and shall go back to our institutes to carry out the computations and modeling necessary for the formulation of the hypothesis. I concentrated most of my efforts during the year on my third project, taking advantage of the opportunity of an interdisciplinary association to engage in a search for a common language. The Berlin year will be a memorable experience. I greatly enjoyed the congenial atmosphere, and the help of the academic and non-academic staff, particularly that of the librarians, is much appreciated.

My search was inspired by Richard Feynman's book *The character of physical laws* (MIT Press, 1965), in which he lamented the dichotomy between physical sciences and humanities. We are all looking for beauty and truth, yet we speak different dialects even when we all write in English. The fundamental physical laws could be reduced to "a lot of electrons, protons, and neutrons." The truth in arts and history is described, however, by words such as harmony, beauty and hope. As noted by many, the present dichotomy is an ideological consequence of the belief in the dualism of body and mind, preached by Descartes and accepted as an axiom by scientists, artists, and theologians. Two years ago,

I stumbled onto Neoconfucianism, which teaches the unity of all things. The world is made of *qi*, Zhu Xi said, and interactions of *qi*, according to the principles of *yin* and *yang*, are the *li* of all things, cosmic, societal, and individual. What is this *qi*, and what is this *li*?

I gave my colloquium in February and spoke of *a search for a common language* in our intellectual pursuits. Scientists speak a mathematical language, with all its precision and lack of precision. Artists, philologists, historians may have to find a simple mathematical language to communicate their perception of beauty and truth to their colleagues in natural sciences. In my talk, I proposed that beauty consists of fractal geometry and that truth describes a strange attractor. Beauty and truth are the *li* of Neoconfucianism, and *qi* is a flux of particle interactions. Of course, none of the Fellows in the audience took me seriously. Joan Richard was, as I recall, the only philosopher who commented during the discussions, and she did not pull any punches in voicing her disapproval. Only Peter Stoltzenberg encouraged me with a verse from Erich Fried:

*Es ist Unsinn
sagt die Vernunft
Es ist was es ist
sagt die Liebe*

Perhaps Peter alone appreciated that Gretchen's song (Faust I) is an expression of a strange attractor:

*Meine Ruh ist hin
mein Herz ist schwer
ich finde sie nimmer
und nimmer mehr*

Strange attractor is a concept in the presently popular chaos theory. There have been numerous attempts to describe nature in terms of chaos and fractals. In my paper on Gaia ("Is Gaia endothermic?" *Geol. Mag.*, 129, 1992) I presented a hypothesis that the earth's climate has been functioning as a self-organizing system. Global temperatures have been regulated by a strange attractor, expressed by the equations

$$y_n = 1 - x_n(1 - x_n) \quad (1a)$$

$$X_{(n+1)} = Y_n \quad (1b)$$

I call those organisms whose biological functions cause directly or indirectly global warming the "heaters," and their percentage is indicated by x_n . Those organisms whose biological functions caused global cooling are the "air-conditioners," and their percentage is indicated by $(1 - x_n)$. The only pattern one sees in the climate history of the earth is the alternating dominance of the "heaters" and "air-conditioners," which regulated the global climate so that the ocean never completely froze, nor did it ever boil during the 4.5 billion years of the earth history.

Wise men of China recognized that patterned chaos, as expressed by eqs. (1), constitutes the fundamental laws of the universe. They are not only valid for the physics of the cosmos, or for harmony and justice in society, but are also essential for the sustenance of the health of an individual. In the words of daily-life experience, the laws are called *tao* by Taoists and *li* by Neoconfucianists. The laws of the cosmos are called *wu-li* (*li* of material things, or physics). The laws of physical health are called *shen-li* (*li* of life, or physiology). The laws of human relations are called *ren-li* (*li* of people, or ethics). The laws of society are called *fa-li* (*li* of the methods, or law).

The pattern of strange attractors was in fact recognized in Chinese pre-history, when the *I-Ching* was invented. It was said that the *yin* and *yang* are the primordial twin potencies that regulate the universe and that have bestowed power onto everything within space and time. *Yang* represents male, positive energy, producing light, warmth, and fullness. *Yin* is female, negative, the force of darkness, of cold, and of emptiness. The *yin* and *yang* manipulate heaven and earth, and they exert their power over the human beings and everything under the sun. The claim that *yin* and *yang* are the parts of the whole is given by such a definition, namely:

$$x_n (\text{yang}) + (1 - x_n) (\text{yin}) = 1 \quad (2)$$

Many of you will probably lose interests immediately when you see a mathematical equation, but the equation 2 is really very simple: it merely says that the sum of parts is whole. *Yang* and *yin* together make up 100%. When *yang* is 40%, for example, *yin* would be $(1 - 40\%)$, or 60%. The sum of 40% and 60% is 100% or one! The claim that *yin* and *yang* regulate all systems can be expressed mathematically by the two equations (eqs. 1) that generated the strange attractor. The variable y is the resultant interaction of *yang* and *yin*, and the resultant is reiterated as $x_{(n+1)}$ or the *yang* of the next generation, while the sum of the *yin* and *yang* always constitute a whole, or their sum remains unity. What is then the meaning of 1 in eqs. 1?

For those of you who still have a vague memory of your geometry lessons, the top graphic in Fig. 1 shows two straight lines, and the other four graphics show a parabola and a straight line. Now, the shape of a parabola depends upon the value of a dimensionless number I in the equation for parabola. The parabola is flat for a small I value, e.g. $I = 0.8$, and the parabola is more sharply accentuated for a large I value, e.g., $I = 3.1$ or 3.8 .

We see the three types of situations. When the value of I is less than 2.5, say $I = 0.8$, the pattern resulted from interactions is typically one of extinction. Take, for example, the case of prey and predators in a situation represented by a I value of 0.8: the reiterations cause the value of the resultant y or $x_{(n+1)}$ to become increasingly smaller, until it approaches null. In other words, the presence of a prey-population x in this particular instance can only support a predator population y which is smaller than x . The predators cause the population of the next generation of prey to decrease. In turn, the decrease of the prey population causes the decline of the predators. Finally, both the preys and the predators become extinct. During the year, we have listened to several talks in the institute that described reiterations causing extinction. The best example is the situation, described by Richard Law, of the decline of the fishing industry in the North Sea. Overfishing causes the fish stock to decline, and the decline causes the design of more effective fishing methods to cause more overfishing. The vicious circle repeats itself until both the fish stock and the fishing industry become extinct.

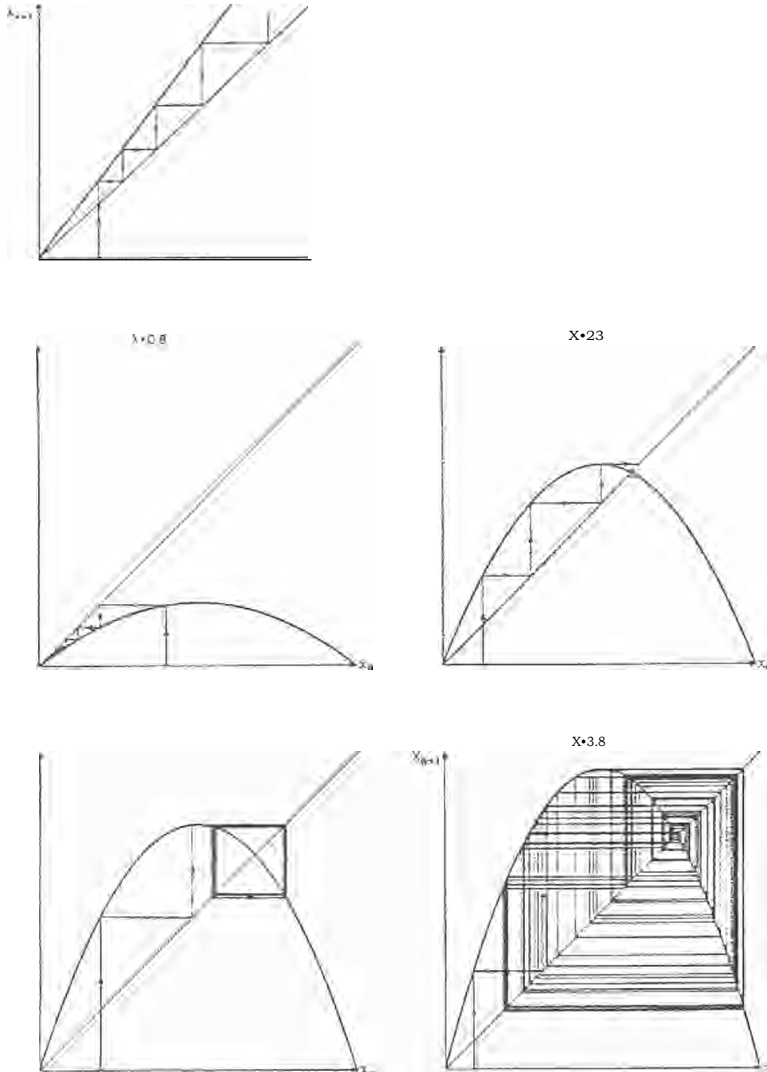


Fig. 1: Strange attractors in the chaos theory can be considered an expression of the interactions of *yin* and *yang* (see text for explanation).

When the value of λ is 2.5, after several reiterations, there is eventually a fixed point for the resultant y or $x_{(n+1)}$ toward which all interactions tend regardless of our choice of x .

We might take an example from the national-security policies, discussed by Kurt Spillmann. The *yang* x is the action, the strength, and the *yin* y is the reaction, the feedback mechanism. In the case of eye-for-eye competition, the increase is linear. When the Americans arm themselves, the Russians follow suit accordingly. The Americans catch up, and the Russians invest more. There would be a "spiral inflation" described by

$$Y_n = c x_n \quad (3a)$$

$$x_{(n+1)} = Y_n \quad (3b)$$

Of course, the arms race cannot go on forever. There would be disarmament talks. The Americans will, of course, still arm themselves, and the Russians will still follow suit. But when it is the Americans' turn to catch up, they will take into consideration that things do not go out of hand; their course of action is described not by equation (3a), but by equation (1a), with the value of λ being 2.5. Reiterate the arms race a few more times and one should find a fixed point where parity or a stable equilibrium is reached. This is, of course, the balance of power policy pursued by all national statesmen.

There is a strange attractor when the value of λ is greater than 2.5. This is the boy-meets-girl story in the world's great literature. My favorite is Somerset Maugham's *Of Human Bondage*: Philip met Mildred. She smiled at him, and he was enchanted. She went to the theater with him, and he was infatuated. She flirted with another man, and he was despondent. She came back to him, and he was more in love than ever. She ran away with his friend, and he was crushed. She had a baby and came to ask for help, and he was kind. She prostituted herself, and he was angry. Their bondage is a strange attractor, and we all have our bondages.

Strange attractors regulate everything in our chaotic society. There is the *yang*, the aggressive action, and there is *yin*, the negative feedback. In Malthus's theory of population, the *yang* is reproduction, and the *yin* includes wars and famines. The population of China did not increase exponentially during the last 2000 years, because the negative feedback mechanisms always managed to achieve some sort of dynamic balance. Then came the revolution of 1949, the population doubled during the decades of peace and better medical care and the official policy of one child per family had to be introduced as the negative feedback mechanism. Strange attractors regulates everything in nature. Gaia is the

strange attractor ensuring that the world's ocean never boiled nor froze solid. The same mechanism has been invoked to explain various natural phenomena. It seems to me, therefore, that the strange attractor, not the "Theory of Everything" of nuclear physicists, is the *li* of the traditional Chinese philosophers.

What then is *qi*? *Qi*, according to the Neoconfucianists, is everywhere on earth and in outer space: there is *qi* inside our body, there is *qi* manifested by the fortune of a nation, and *qi* is the elementary constituent of everything in the cosmos. However, in some instances at least, *qi* cannot be said to be "a lot of electrons, protons, and neutrons." We should recall that Feynman spoke in the 1960s, when we did not have quarks; nor did we then have a Theory of Everything.

Physicists use the expression "elementary particles" to designate the elementary constituents. We are building bigger and bigger colliders to find smaller and smaller elementary particles, and there seems to be no end in sight. Mesmerized by the Cartesian idea of the dualism of matter and spirit, the elementary particles must be a spatial entity which could be represented by a certain mass, charge, and spin. These elementary particles are thought to be the basic constituents of the electrons, protons, and neutrons.

Thanks to the recommendation of Helge Ritter, I read J.-P. Changeux's *Biology of Mind* (Oxford U. Press, 1986). There are more than material things in the working of mind: there is information to be transmitted and there are ideas to be entertained. Yet Changeux still recognized the two identities, material and spiritual, when he attempted "to destroy the barrier that separates the neural from the mental, and to construct a bridge to cross from one to another" (p. 168).

The pre-Ionian Greeks and the traditional Chinese philosophers see a unity of everything in action. I came to appreciate the meaning of the Neoconfucian *qi* during the course of my search for a physical theory of time. My friend Yuk L. Yung of Cal Tech asked me to solve the puzzle why one and the same Planck's constant should appear in all the fundamental equations in quantum mechanics: in photoelectricity, in X-ray emission, in de Broglie's equation, in the uncertainty principle, etc.

Planck's constant, as I was to realize, is not material. The constant is a product of energy and time, and this product acquires a special definition in physics and is called "action". My final answer to Yung was simple enough: One and the same Planck's constant appears in all those equations because the quantum actions represented by the constant are the elementary particles of the universe in space and in time, and I called those particles of quantum actions "chronons" (Hsü, "Are chronons elementary particles in space and in time?" *TAOS*, June, 1996). Later I

found out that two French physicists had come to the same conclusion, and they called the particle-action represented by Planck's constant *quantons* (Levy Blanc, J. M. and Balibar, E, *Quantics*, 1990). Listening to the seminar talk by my colleague Brigitte Falkenburg, I had the impression that the chronons or quantons could be synonyms for Leibniz's monads.

Qi is not purely material, but a dynamic, energetic entity. Photons in the photoelectric effect are, for example, inanimate quantum actions, but photons in photosynthesis give life to plants. What has been called vitality is thus not necessarily supernatural, but sequenced quantum actions or actions of *qi* in living organisms.

Restricting science to describing observable or experimentally falsifiable phenomena, the Neoconfucian *qi* has been dismissed as a metaphysical concept. Assuming that *qi* is an entity consisting of actions, *qi* can be considered as an information carrier. I used the word "chronons" to designate the elementary action which triggers an event. What is the chronon that triggers radioactive decay?

Current theories tell us that a helium nucleus, an electron, or a photon inside a nucleus jumps out of an energy-barrier to cause alpha, beta, or gamma decay; radioactive decay is spontaneous and one cannot predict why and when a nucleus will throw out a particle to cause decay. With the concept of chronons, I came to the conclusion that natural radioactivity is induced by *qi* or particle interactions. Beta decay could be, for example, the action of a neutrino on a neutron, also known as the neutrino-capture process (Hsi", 1996). An assumption of a nonfalsifiable vital force causing spontaneous decays seems to me a more metaphysical postulate than the chronon theory that *qi* (or a neutrino) acts as an information-carrier to induce radioactivity. An experiment is being initiated to correlate beta-decay rate to neutrino flux.

During the last decades, theoretical physicists have increasingly come to the realization that everything is not only material. Their "Theory of Everything" implies that everything can be interpreted in terms of "four kinds of interactions." The history of mankind also consists of "a lot of actions." Perhaps the vocabulary of science would include beauty and hope if those words could be described in terms of time and chance in particle interactions.

Of all the scientific disciplines, the "language-barrier" is greatest in medical science. There is no Chinese mathematics, no Chinese physics, no Chinese geology, no Chinese biology, even the Chinese philosophers find a kindred spirit in Spinoza. There is, however, Chinese medicine, which is practically incomprehensible to all but a few scientists of the Occident.

The barrier to understanding in today's medicine lies not only in the languages of daily life, which are translatable. The formidable barrier consists of a fundamental difference in scientific philosophy. The literature of medical science is phrased in terms of molecules, cells, virus, bacteria, antibodies, chemicals, etc., which are material. The 13,000 volumes of books on Chinese medicine are written in terms of "yin" and "yang," of "five elements," of "hot and cold," of "qi," of "harmony and vitality," etc. When a common language is found to describe both Neoconfucianism and modern science, the understanding should bring to all of us, *inter alias*, better health and a longer life. No person could wish for more. With the encouragement of my colleague Rudolf Rott, I have, therefore, proposed to the Rector of the Institute that the Board of Trustees consider a proposal to initiate an interdisciplinary study of the scientific merit of traditional Chinese medicine, particularly the physical principles of pulse-diagnosis.

In conclusion, I look back on a very wonderful year, having greatly broadened my horizon and having made many new friends. I am grateful to those who have made my journey to Berlin possible.