Needham's Question and China's Evolution - - Cases of Nonequilibrium Social Transition

Ping Chen

I. Prigogine Center in Studies of
Stetistical Mechanics and Complex Systems
University of Texas at Austin

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Abstract

Joseph Needham's question Why did capitalism emerge in the West and not in China is discussed along with the sources to form a centralized state and the mechanism for perpetuating the Chinese bureaucracy. The relationship between the stability and complexity of socio-ecological systems is also analyzed. The potential application of nonequilibrium thermodynamics and nonlinear dynamics to social evolution in China is introduced. A brief survey of historical and contemporary issues relating to the transition of agricultural structure in China and the recent crisis in economic and political reform is given.

I. Introduction: Needham's Question and Prigogine 's Theory

The history of Chinese civilization has many distinctive characteristics: the gigantic bureaucratic system of the long-lasting Centralized Chinese Empire, its hostile policy toward the merchant class, and its cyclic dynasties and peasant rebellio n. These characteristics are in sharp contrast to Western civilization with the fragmented feudal society, powerful Christian church, and strong middle class. Chinese history could serve as a counter-example of the Western route of historical evolution and as a touchstone for competing models in social sciences and philosophy of history.

During China's cultural revolution in the 1970s, I became interested in Needham's question, Why did science and capitalism emerge in Western Europe but not in Chinese, Indian, Islamic, or other civilizations ? [Needham 1954]. A parallel question, What are the sources of the stability and longevity of the centralized Chinese bureaucracy which has survived for more than two thousand years and continues to be a major obstacle to the development of a market economy and a modern society ? [Elvin 1973].

The attempt to answer Needham's question brought me to an unanticipated application of Ilya Prigogine's nonequilibrium thermodynamics to social phenomena when I read Prigogine's paper on the thermodynamics of evolution in the spring of 1973 [Prigogine et al 1972]. Prigogine classified thermodynamic systems into three categories: isolated systems, closed systems, and open systems. Nonequilibrium thermodynamics simply asserted that self-organization emerged only in open systems. It occurred to me that the degree of openness and adaptability to changing environment was the key to comprehending the diversity of civilizations in history [Chen 1979, 1988a].

A related perplexity is the relationship between stability and complexity. Chinese society was characterized by its self-sufficient economy and labor-intensive agriculture. Compared with the Western pluralistic society with its open economy and developed division of labor, traditional Chinese society was a rather simplistic, monolithic society with remarkable structural stability which had endured and cyclic turbulence overtime. As expected in theoretical biology, complexity seems to be related to stability according to the Darwinian doctrine: the fittest survives. However, both mathematical modelling and historical observation led me to an opposite conclusion - - that complexity implied instability rather than stability [Chen 1987]. From the viewpoint of nonequilibrium and nonlinear physics, instability not only implies the possibility of destroying an old order but also the opportunity of forming new structures.

In this paper, I will address historical and theoretical issues first, then discuss problems in China's reform and recent crisis.

II. Openness of the Economy and the Stability of Agriculture

Needham's question, asking why science and capitalism emerged in Western Europe but not in China, has puzzled many historians [Needham 1954; Wittfogel 1957; Wallerstein 1974; Braudel 1981; Jin & Liu 1984; Huang 1985].

Marxist-Maoist historians laid the blame for the stalemate of Chinese society on the brutal exploitation of the peasants by Chinese ruling class. But a quantitative investigation of land taxes in 16th century revealed that China's land tax rate was generally in a range of 1% to 10% which was much lower than taxes in medieval England and Japan [Huang 1974].

Rather it was institutional incapability that was responsible for China's backwardness [Needham & Huang 1974]. Weber emphasized the significance of culture. In his opinion, the development of capitalism in the West was driven by the Protestant zeal for accumulation of capital while China was at a standstill due to the Confucian tradition [Weber 1964]. So, we should ask What were the sources of conservative culture and institutions?

Elvin interpreted the stagnation of the Chinese economy after the Song dynasty (960-1279) as a high level equilibrium trap in development, since there was only quantitative growth, but qualitative still with no fundamental change in technology [Elvin 1973]. So the question became Why id a technological revolution not emerge to spring the trap in China? Perkins pointed out the importance of demographic factors in economic growth. He found that the growth rate of agricultural production was lower than the growth rate of population in the last four centuries [Perkins 1969]. However, it was difficult to determine whether the population factor played a positive or negative role in economic development. Boserup argued that a certain amount of population pressure was necessary to adopt new technology [Boserup 1965].

Although many factors might contribute to the emergence of capitalism and modern science in the West, openness of economy and society was a necessary condition for developing to the capitalism and modern technology [Chen 1979, 1988a]. According to Prigogine, the destruction of order and increase of entropy always occur in isolated systems; a static structure like a crystal may form in closed systems; self-organization and structural evolution can only develop in open systems where energy flow, matter flow, and information (entropy) flow exist. Nonlinearity and instability (positive feedback) play critical roles in forming dissipative structures [Prigogine et al 1972; Nicolis and Prigogine 1977]. Prigogine's idea sheds the light on social transition.

There was an astonishing contrast between the openness of the Western economy and the closeness of Chinese society. Encouraging foreign trade and protecting city business was the traditional policy of European countries in the middle ages. But the Chinese government had controlled city commerce since the 8th century B.C. and tightly had carried out a closed-door policy in the Ming and Qing dynasties (14th-19th centuries A.D.) until Western gunboats opened the closed door of China'. Even the patterns of war in the West and the East were different. Europeans often fought to control vital trade routes, while the Chinese struggled to acquire arable land.

Chaunu once observed a paradoxical phenomenon in history that could not be explained by the theories of Malthus or Weber:

> "The European wastes space. Even at the demographic lowpoint of the beginning of the 15th century, Europe lacked space. . . . But if Europe lacks space, China lacks men. . . " [Wallerstein 1974].

The question was Why did China keep a closed-door policy under the pressure of increasing population while Western countries had being seeking to expand territorially under the banner of an open-door policy since the 15th century? We should identify the framework that shaped the different civilizations in Europe and China [Chen 1979, 1988a].

Braudel developed a three-level model of human civilizations: the material life, the market economy and the world system [Braudel 1981]. We have generalized his model into a pyramid of human society (see Fig. 1). In the bottom level, material life includes

environment (geography, climate, and resources), population, and resource. Traditionally, the study of political economy is only concerned with the middle level of market economy. A more general view should also consider the subsistence economy as well [P. Huang 1985]. Braudel strongly argued that material civilization determined the basic structure of economy. Anthropologists emphasized that environment played a fundamental role in shaping the culture and social institution [Harris 1980]. We agree with Harris that the lower level may have a fundamental impact to the levels above, but we should remember that the interplay among the three levels is also important in history, since development is a dynamic and irreversible process.

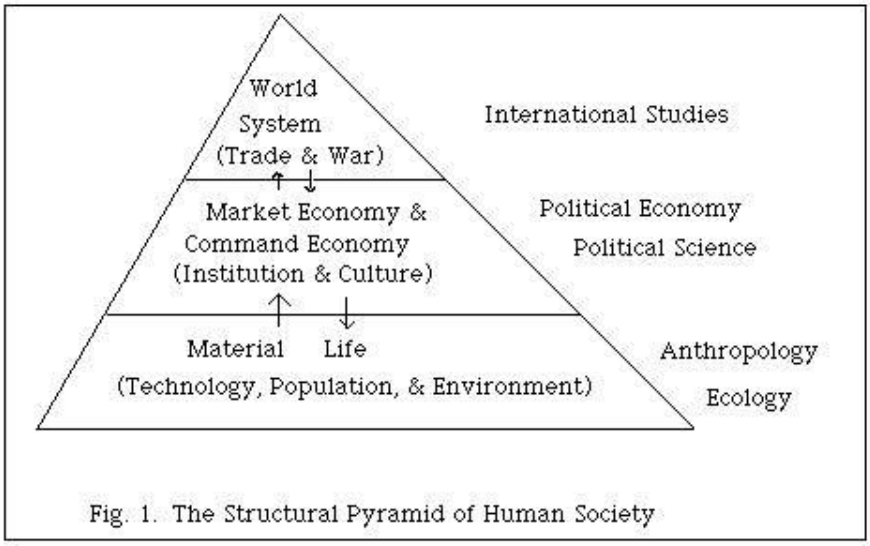

Fig. 1. The Structural Pyramid of Human Society

We note the dissimilarity in environments that resulted in significant differences in economic structure and political behavior. Western civilization arose around the Mediterranean Sea, which serves as the main trade route between the East and the West. China is basically an inland country, and most areas are not accessible to the sea. More than 50% of the Europe continent is plains while 90% of China proper is mountainous. Developing transportation and division of labor was, therefore, much easier for the Europeans than for the Chinese. Lacking development of transportation and division of labor has been a key factor to foster a self-sufficient economy in China since its early stages.

Environment was a strong influence in determining the pattern of agriculture that in turn shaped the original institutions and culture of civilizations. European agriculture consists of mixed crops and livestock farming [Rubenstein & Bacon 1983]. Dairy products and meat are the main staples in the Western food structure. However, Chinese agriculture consists of a simple structure of intensive farming since grain and vegetables are the main foods for the majority of Chinese people.

Presumably, the principal motivation for European expansion in the 16th century was the need for land rather than the call of religion. The Black Death may also have stimulated the development of labor-saving technology in Europe. Nevertheless, the land-conserving intensive farming developed in China only led to population crises and cyclic peasant wars. Similarly, socialism may have emerged in Eastern Europe and China, because the inland countries could not compete with the coastal areas. The modern market economy first

prospered in island countries and coastal areas such as Italy, the Netherlands, and England in the West, and Japan in the East because their transportation costs were low.

The resource efficiency of labor-intensive agriculture and the labor efficiency of capital-intensive technology characterize the Chinese and Western civilizations respectively. They are complementary ways of adapting to the natural environment. Economists often speak about the efficiency of allocating resources in market economy without specifying the high resource cost of industrialization. The efficiency of energy use in a traditional societies was actually higher than it is in modern societies because the food web of the former is much simpler than the latter. As Chaunu put it: "The emphasis on cattle in Europe led to the extensive use of animal muscular power as an engine of production. Rice is far more fruitful in calories per acre but far more demanding of manpower [Wallerstein 1974]."

One interesting aspect is the importance of the spice trade in the Western economy. Europeans needed spice, which was imported from Indonesia and India, to preserve meat. Therefore certain oriental products like spice become basic goods in Western material life [Thompson 1928]. Westerners went west seeking new routes to India because the Turks had blocked the traditional trade route through mid-Asia and Arabia in mid-15th century. The economic need to import crucial products and political pressure to protect vital trade routes became constant motives for open-door diplomacy and colonial policy in Western history. The Chinese never felt the critical need for foreign trade as a material necessity. The bulk of Chinese foreign trade imported luxury goods for the upper class. The primary concern of Chinese rulers was national security - - defence of the country from the menace of Nomads in the Northwest and pirates from the sea. This orientation was responsible in past for closed-door diplomacy and the self-sufficient policy.

Geographic determinism, cultural determinism, and economic determinism address Needham's question from different angles. We may integrate competing uni-causal views into a united dynamic model of dissipative structure. The interactions between external environment and internal structure led to different civilizations in East and West. These interactions compose a multi-dimensional dynamic process that includes geography, climate, demography, technology, economy, culture, and social institution. No single variable can determine the multi-fold evolutionary course. And social evolution is not an "inevitable" deterministic process. The emergence of capitalism and science must be rare events in history whose survival probability could be as small as those of life at the dawn of history.

III. Historical Bifurcations Caused by Fluctuations in the Environment

In analyzing the adaptability of technology and the degree of cultural rigidity in social evolution, the pattern of agriculture emerges as crucial in shaping cultures and institutions. The pastoral nomadism in the Middle-East and central Asia is an unstable form of agriculture, while intensive farming in China and India is a very stable one. The mixed crop and livestock farming in Europe is a flexible and adaptive metastable structure [Chen 1979, 1988a; Rubenstein & Bacon 1983].

The difference in the food and agricultural structures of the East and West may resolve one paradox in history. Although the populations of the two empires were roughly of the same magnitudes, there were far fewer Roman soldiers than soldiers in the Chinese Han Europe. The scale of Chinese peasant wars in Middle Ages was comparable to those of world wars in industrialized society. The technical possibility of storing grain from intensive

agriculture made possible the logistic support possible to maintain a standing army of many millions of soldiers in China, while the Roman army had difficulty storing enough meat and dairy food for even hundreds of thousands of men in a mixed agriculture [Chen 1979, 1988a]. Grain production and storage were the very foundation of China's unity, which was achieved by means of military control and bureaucratic centralization [Chi 1936]. In this regard, we could say intensive farming together with hydraulic engineering was a technology that supported centralization while mixed farming with natural irrigation was a technology that led to division of labor. The characteristics of the dominating technology shaped the orientation of institutions and culture.

According to Schrodinger, it is the metastable state or aperiodic solid that may be the very foundation of living structures [Schrodinger 1944]. From the view of nonequilibrium physics, aperiodic solids and metastable states must exist in a nonlinear open system. An analog between dynamical stability and social structure is shown in Fig. 2. Only systems with the proper degree of openness and appropriate stability have the chance to evolve to the complex form and advanced stage of life and civilization.

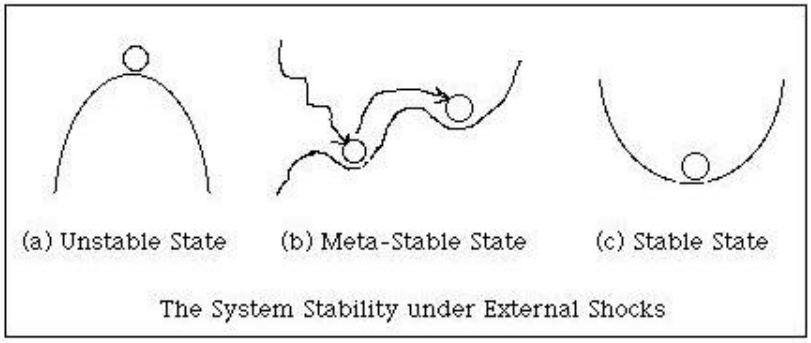

Fig. 2.

The historic course of social evolution is neither purely deterministic nor totally random. The development of China's intensive farming is a typical case of order through fluctuations in history.

Until the Shang dynasty (16th-11th centuries B.C.), archaeological records show that Chinese agriculture was mixed agriculture with a large share of animal husbandry. The dramatic social transition of the Spring and Autumn period (770-476 B.C.) occurred at almost the same time Greek civilization was flourishing. The population grew rapidly and land became a scarce resource. The manor system based on extensive farming collapsed and the landlord system based on intensive farming emerged during this period. This period also marked the very beginning of the chronic dynastic cycles, which brought more than two thousand years of civil wars and peasant rebellions.

Chinese Marxist historians regard the Spring and Autumn period as a revolution in a slave society that resulted in a feudal society according to Stalin's five-stage scenario [Mao 1967]. So-called historical materialism asserts that historical development should follow a deterministic sequence - - such as primitive communal, slave, feudal, capitalist, and then

socialist society [Stalin 1940]. But the Needham question makes it difficult for the Maxist historians to explain the Chinese history.

We submit that the dissimilarity between Chinese and Western civilizations is simply due to a bifurcation in agriculture caused by climate fluctuation. According to the meteorologist Zhu, China had a subtropical climate during the Yin dynasty (14th -11th centuries B.C.). The climate became very cold in Zhou dynasty (11th-8th centuries B.C.) and warm again in the Spring and Autumn period (8th-5th centuries B.C.) [Zhu 1979]. A possible scenario of social evolution in China between the 14th and the 5th centuries B.C. is this: mixed crops and livestock farming was prevalent in the warm period of Yin. Animal husbandry was almost destroyed by cold weather in Zhou, and only such cold-resistant crops as wheat and millet survived the cold wave. When climate became warm again, the yields of crops increased and population grew. However, the northeastern plains of China not large enough to support a dense population with mixed crops and livestock. So the transition from extensive farming and mixed agriculture to intensive farming to produce more grain to support an ever denser population became an irreversible trend in Chinese history.

Another event in 1453 caused a second major bifurcation in world history: Constantinople fell to the Turks and the eastern Mediterranean was closed to western Europe. European sailors were forced to search for a new route from West to East. This effort led to the discovery of the New World and the development of a world market that made way for industrial revolution and capitalism [Cooper 1985].

The bifurcated tree of world civilization is illustrated in Fig. 3 . Here we see again the role of the deterministic mechanism of natural environment and social structure and the stochastic "events" in changing climate, technology, and political landscape.

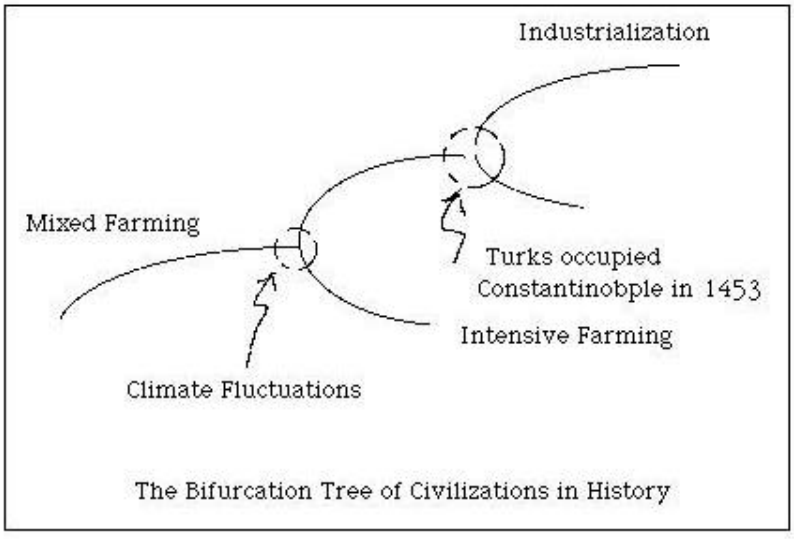

Fig. 3.

IV. The Darwinian Dilemma Concerning Complexity and Stability and Cultural Factors in Learning and Competition

A question related to Needham's problem is the unique stability and longevity of the centralized Chinese Empire, which survived for more than 2100 years. Even the present

People's Republic has inherited many imperial traditions from the past. In Western history, the Byzantine Empire lasted about 1100 years (from 330 A.D. to 1453 A.D.), and the Roman Empire existed for only 500 years (from 27 B.C. to 476 A.D.). Other Western empires in premodern history collapsed even faster than the Romans. Decentralization and cultural diversity are the main features of European civilization. In contrast, China has been a united country under a centralized bureaucratic government since 221 B.C. The origin of the state and the mechanism of stability has been a puzzle in the political sciences. In previous section, we addressed the issue from the technical characteristics of the agricultural structure. Now we will discuss the problem of the origin of division of labor by analyzing community complexity.

A parallel dilemma was recognized in theoretical ecology regarding the relationship between stability and complexity. There was a belief among biologists that increased web complexity would cause increased stability when studying the evolution of species communities. However, mathematical simulations have shown an opposite conclusion. For instance, the stability of a two-coexistent-species system is less stable than a single one [May 1974]. Many theoretical biologists doubted the models were realistic enough to reflect the nature of living systems. We believe that May's discovery was correct because the reverse correlation between stability and complexity could be justified from experience in human history. For example, a Chinese village with its simpler order would recover much more easily from a power failure or military attack than New York City would.

It is realized that culture plays an important role in the origin of capitalism and sciences [Weber 1930]. M. Kikuchi is aware of differences in the degree of "individualism" existing in the Eastern and Western nations [Kikuchi 1981]. We developed biological models including the cultural factor, which has been emphasized by psychologists but overlooked by economists [Hogarth & Reder 1987].

Some economists and evolutionary biologists justify their optimization theory of living behavior by assuming the selfish nature of human being or even the gene [Dawkins 1976]. However, empirical investigation cannot determine whether a living being is selfish or altruistic. We suggest a sociopsychological indicator to measure collectivistic, or risk-averse, behavior and individualistic, or adventure-loving, behavior; these are characteristics that can be observed [see Fig. 4]. Varying this behavioral parameter, we may have a wide spectrum of degrees of "individualism" in diversified behaviors or cultures, from social to solitary animals, or from conservative to progressive cultures. Then we introduce the cultural behavioral factor into the information-diffusion process and the learning competition model. The learning ability of species with different cultural orientations in exploring new resources or technology leads to revealing information for understanding the origin of division of labor and differentiation of society [Chen 1987].

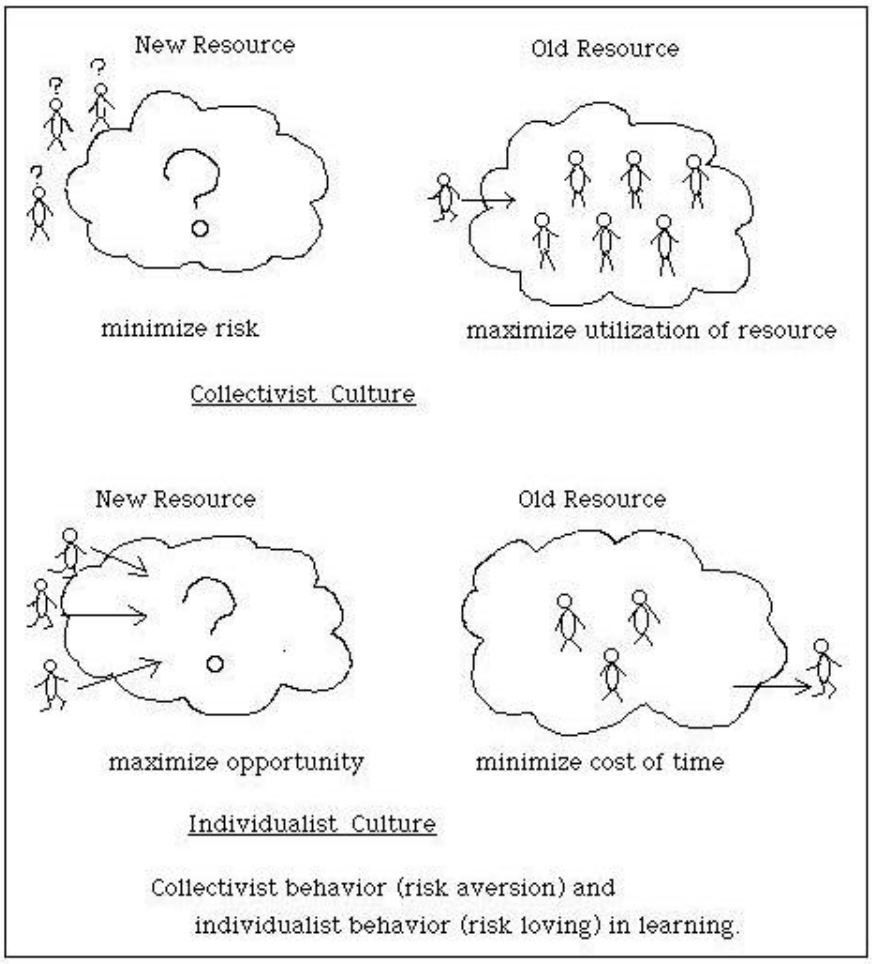

Fig. 4.

It is shown in the model that a progressive species needs a larger subsistence space than a conservative one in order to maintain the same population size. This is why some aggressive species with low population density need larger subsistence space. Chaunu observed the puzzling difference between European and Chinese behavior. In section II, we explained it by technological argument. Here we examine the issue from the view of cultural behavior in learning. Obviously, Western ranchers and merchants were more adventurous than Chinese peasants and bureaucrats.

Another interesting result is the stability of culture in a fluctuating environment. It has been found that a conservative culture is more stable than a progressive one. This is especially true when some survival threshold population size obtains and resources are limited. But when new information comes, a conservative species is less inclined to absorb new technology than in a progressive species.

The most interesting investigation is of the competitiveness between two species with different learning behavior in exploring new resources. It has been shown that two conservative species cannot coexist. When they compete for the same resource or same idea, such as arable land or a dominating ideology, the only possible result is that one

replaces the other. It is the story of cyclic dynasties in history, which repeatedly occurred in traditional monolithic societies such as those in Oriental countries. Therefore division of labor cannot emerge in a conservative culture.

If two species have equal learning ability, then two progressive species coexist, but the conservative species will replace the progressive one. So, the only strategy for progressive species in competition is to improve their learning ability. If we consider capitalism as an adventure loving culture, then we may reach a conclusion similar to Schumpeter's - - that innovation is vital for capitalism when competing with socialism [Schumpeter 1950]. Once innovations cease, capitalism will lose in the competition for existing resources. If their learning abilities are not equal, there is variety of possibilities for competing species, so we could have a diversified world. Another interesting result of the model is that a mixed society of conservative and progressive species is more stable than a mixture of two progressive species. This reminds us of a common phenomenon in western political systems.

Studying the stability against a fluctuating environment reveals that a monolithic society is more stable than a pluralistic one, although a pluralistic society enjoys more social wealth than does a monolithic society. There is a trade-off between stability and flexibility, or, security and development, which sheds some light on the differences between Occidental and Oriental cultures. Regarding the origin of division of labor in history, division of labor certainly has its benefits and costs. The cost of industrialization is a greater risk of instability. That is the price we have paid for modernization.

The "time arrow in history"has been perceived in different ways in different civilizations. Indian Buddhism had a cyclic view of history. Christians believed in a better life in the future, while Confucism and Taoism believed the past life was better. The Chinese orientation toward conservative culture can be understood by considering the deteriorating environment of intensive farming. Based on this discussion, we may discuss the evolutionary tree of social history [Fig. 5]. Clearly, it consists of a two-way traffic moving towards simplicity or complexity, depending on the environment and the structure of the system. Development is a multilinear process toward a diversified world, not a fated convergence toward communism or capitalism.

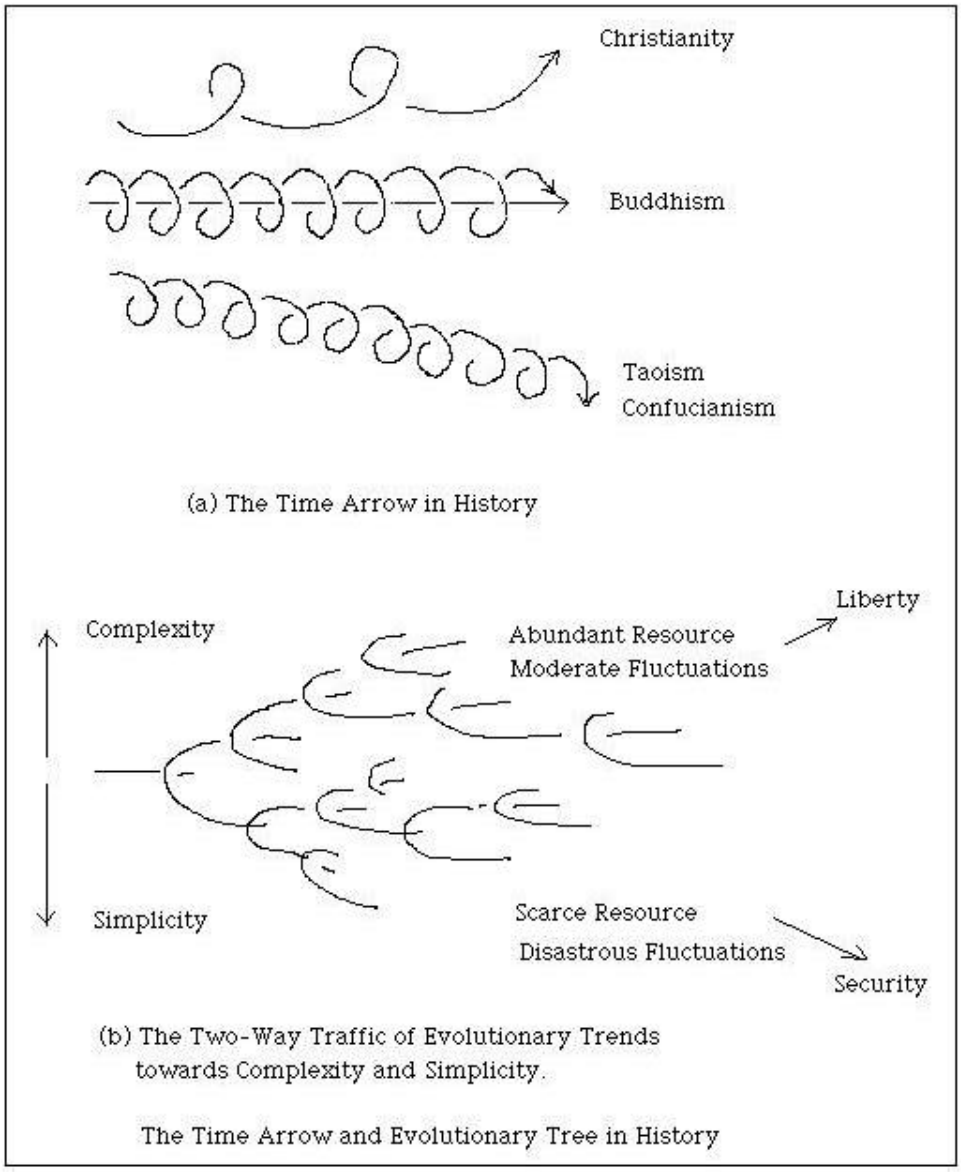

Fig. 5.

We might speculate about why capitalism emerged in the West and not in the East. Disasters and wars occurred much frequently in China than in Europe and were much severe [Chen 1979]. Environmental fluctuation in China is too large to maintain a complex structure. We may reverse Mao's evaluation of the role of the Chinese peasant wars and the bureaucratic system since Chin dynasty in the second century B.C. The transition from mixed agriculture to intensive farming, which was parallel to the transition from manor system to landlord system, was a devolution from complexity to simplicity in a deteriorating ecological environment [Chen 1979, 1988a]. Contrary to the Marxist hypothesis that China's "capitalist seeds" could develop into full-blown capitalism without Western influences, we concluded that China had no chance to rediscover science and capitalism

unless she contacted the outside world. This is our starting point for observing China's reform in the last decade.

V. Some Observations on China's Reform and the Beijing Crisis

China's reform raises serious challenges to mainstream economics. China is a vast country with great geographical, structural, and economic disequilibrium. Its evolution from a traditional society to an industrial society cannot be comprehended by both Marxist economics and classical equilibrium theory [Chen 1988b]. However, the emergence of newly developed evolutionary dynamics and nonlinear economics sheds light on the studies of economic fluctuation, dynamic bifurcation, complex behavior, and structural changes that are critical issues in China as well as in the changing world economy.

In a brief discussion, I make the following observations about China's economic and political reform. I expect stimulating responses from readers.

(1) The Origin of Socialism and the Cost of Capitalism

Poor environment, difficult transportation, and scarce means of subsistence form the soil of self-sufficient agriculture in traditional China and of the rationing economy in communist China.

The present socialist system emerged in poor countries during two world wars. Socialism has demonstrated its resource-saving efficiency to achieve the national independence and military security at a high cost of low living standard and low social mobility.

The socialist system is not an advanced stage that follows industrial capitalism but a complementary way to achieve industrialization in inland areas or poor countries, because a centralized government can mobilize national resources to rapidly improve infrastructure and human resources at an early stage to develop capital-intensive industry. But a socialist economy has difficulty competing with advanced countries in the world market.

The capitalist system has proved that its time-saving efficiency and greater human liberty achieve long-lasting economic growth and mass consumption [Berger 1986] at a cost of high consumption of energy and natural resources.

A successful market economy needs many essential conditions: an open world economy, accessible transportation, appropriate technology, a balanced education system, fair institutions, and strong leadership in management and administration. To establish or improve these necessary conditions for the market economy, it may take decades of persistent effort and reasonable policy ; the necessary conditions cannot be achieved by overnight revolution. Nor will one-time surgery achieve a so-called market equilibrium in a country that lacks the basic infrastructure and requisite institutions for a market economy.

A tenable reform in socialist countries must consists of a deliberate mixed economy that includes a market economy for consumer goods, planning high technology, and rationing of scarce basic goods. A naive program of wholesale westernization is doomed to fail.

(2) Volatile Interactions between the International Environment and Domestic Balance

China has a long tradition of regionalism due to the great discrepancy between its natural endowment and economic development [Mao 1967]. The commodity economy in the

coastal provinces is more developed than it is in the inland area. In the past, the formidable fighting forces that were the military power of centralized China consisted of poor peasants from the harsh environment of the inland area; and the grain supply and financial support came from the economically wealthy Southeast [Chi 1936]. The cyclic policy swing in modern Chinese history from closed-door to open-door policy, from pro-Russian to pro-Western diplomacy, from conservative to liberal government, and from rationing to the market economy are highly dependent on the power balance between political factions in the inland area and coastal provinces. Generally speaking, the international environment determines which group will have the upper hand in internal conflicts. Military hard-liners who represent the interests of the inland area often win the political struggle when a foreign menace becomes a major challenge to the nation or when the country is torn by protracted civil war. Mercantile soft-liners who embody the interests of coastal provinces may emerge as the dominating force during a peaceful time of international environment combined with domestic prosperity. Therefore, keeping China's door open is the critical prerequisite for the advancement of any kind of reform in China. It is naive to address China's affairs from a purely ideological or political standpoint; it will be helpful to analyze China's evolution in a multidimensional framework.

The twists and turns of political reform are heavily influenced by interactions with the international environment. China's economic reform gained the momentum from the thaw in the cold war. China's economic reform also put strong pressure on the Soviets ruling class to end their expansionist policy. However, the emergence of Polish solidarity and Hungarian opposition parties alarmed the aging Chinese hard-liners who feared the loss of communist power. Detente in Sino-Soviet relations relieved Chinese leaders of the fear of Russian invasion, enabling them to withdraw troops from the Sino-Soviet border to suppress the student movement. No one could have predicted recent Beijing tragedy since instability and uncertainty always exist in open systems. However, I still believe that instability means not only risk but also opportunity.

(3) The Ecological and Economic Sources of Cultural and Political Orientation

Socialist ideology is a product of the traditional values of a subsistence economy and the war-time experience of military discipline. The socialist demand for equality is rooted in subsistence economic conditions [Wang & Bai 1985]. Only when the material life of the majority of the people is much improved, can the demand for liberty prevail over the demand for security. In another words, in a capitalist democracy equal opportunity is the demand of middle class, while in a socialist democracy equal distribution is the cry of poor people. Thus the protest made by the Chinese students' pro-democracy movement against official corruption is more closely related to traditional egalitarianism and intellectual protest than to bourgeoisie liberalism. Even in Western societies, the new knowledge class is a major antagonist of capitalism [Berger 1986].

Western democracy, where the majority rules in a multiparty system, is more successful in countries with relatively homogeneous economies and cultures and less successful in extremely heterogeneous countries. A balanced demand for personal liberty and equality is essential to achieve a mixed economy and pluralistic politics. I do not believe the Chinese people could afford to adopt Western institutions in total because of their high communication and operation costs.

(4) The Predicament of Rational Sequence in China's Reform, Which Should Come First: Economic Reform or Political Reform?

More precisely, the question is whether the old bureaucracy controls the command economy can be transformed into an institution that regulates the market economy. If yes, then, how? A related problem is what will give the bureaucrats an interest in carrying out the institutional reform?

History has witnessed the absurdity and hardship of the so-called proletariat dictatorship both in Stalin's Russia and in Mao's China. But it maybe wrong to compare the status of socialist bureaucrats with the privilege of feudal aristocrats. There is an inherent contradiction in socialist morality [Kornai 1980]. Under the communist system, private property is a sin and its guardians should not be honored. Therefore, the economic interests and material benefits of the ruling class are not legally protected by institutions and are highly vulnerable to political challengers. This is why internal conflicts within the ruling party in socialist countries are much fiercer than those in capitalistic countries. Limited choices and scarce resources intensify the political struggle in socialist societies.

I doubt the present form of party dictatorship in socialist countries can last very long. During the peaceful international environment and stable economic growth, personal loyalty and party discipline will inevitably decay and collapse. While governing by ideology and seniority will be gradually replaced by governing by law and education. I think it will be much easier to resolve the political deadlock by economic and procedural means.

Providing economic incentives and educational opportunities should be a necessary condition for transforming party officials into business managers or public servants. Giving up the dream of distribution equality in exchange for a greater degree of political freedom and economic opportunity is a deal worth serious experiment in the reform of China.

According to the theory of nonequilibrium thermodynamics in social evolution, neither economic nor political reform should go ahead of the other. A calculated interplay may catch the chance to proceed with a reform program when technological breakthroughs and educational progress make the institutional transition feasible. The leader of China's reform or prodemocracy movement should always keep watching the changing international climate to decide whether it is the time to advance or compromise.

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Captions

Fig. 1.The structural pyramid of human society.

Fig. 2. System stability under external shocks. (a) Unstable state, (b) Metastable state, (c) Stable state.

Fig. 3.The bifurcation tree of civilizations in history.

Fig. 4.Collectivist behavior and individualist behavior in learning.

Fig. 5. The time arrow in history and the two-way traffic of evolutionary trends toward complexity and simplicity.