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SCIENCE, TECHNOLOGY AND THE IDEOLOGICAL DEBATES IN CHINA

Until late 19th Century, science and technology were an integral part of the wider Chinese culture. Science and technology did not enjoy a particularly high status until then. Scientific theories were derived from the reigning cosmology and its branches, and technology was the domain of craftmen. But with the introduction of modern science and technology in China, that subject became a sphere of highly self-conscious activity. Modern science was introduced to China by Christian missionaries from the West; it represented an entirely new framework of knowledge which made truth-claims which were alien to Chinese cosmologies. Modern technology came to China in the form of weapons; the Chinese initially accepted them merely as useful artifacts. But when the Chinese attempted to produce these weapons by themselves, they quickly realized that such artifacts were the end-products of a comprehensive industrial system and that system, in its turn, was organicaly linked to the system of knowledge called "science" and a system of politics called "demogracy". And the Chinese thinkers further arrived at the belief that these two systems were also inseperably linked.

The uneasy feeling that China needed to have an alien system of knowledge, values, and social and political organization in order to acquire the artifacts which had become indispensable if China was to defend itself militarily against the Western, power started the first major ideological debate over science and technology. For a time, some thinkers put forward the proposition that China should continue with "Chinese learning" (Zhongxue) for cultivating "the substance" (ti) i.e. values, ethics, social and political organization; "Western learning" (Xixue), i.e., science

and technology, should be promoted only "for use" (Yong). That would be having the best of both worlds and thereby China would, naturally, emerge as a civilization superior to the West. The proposition gradually fell by the wayside largely because the Chinese "substance" itself came increasingly under fire around the turn of this Century. A new generation of thinkers outside the Chinese government bureaucracy began to identify Confucian values and the social and political organization based on these values as the major cause of Chinese humiliation at the hands of the foreigners.

By 1920, Chinese intellectuals after much debate, arrived at the conclusion that only "Mr. Science" (Sai Xiansheng) and "Mr. Democracy" (De Xiansheng) could lead China towards a bright future. China needed a political revolution to invite "Mr. Democracy" and it needed a commensurate change in the system of education to make "Mr. Science" feel comfortable and prosper. The debate seemed to have come to an end with this formulation. But a small voice kept on asking: If we invite these foreign "gentlemen" (Xiansheng) to run China, what happens to our "national essence" (guocni)? In other words, would China become a faint carbon-copy of the West devoid of anything uniquely Chinese?

It is perhaps in response to this voice that the Chinese Nationalist Party (Guomindang or KMT as it was known) gradually adopted a variant of the "Chinese learning for substance and Western learning for use" (Zhongxue weiti, Xixne Wei yong) formulation. Because of continuous warfare in China for the next two decades, nothing much came of it; there was no intellectual debate either. But since 1950, the Nationalist Party has made this formulation the basis of its policies on the island of Taiwan. The uneasy

truce between "substance" and "use" has not, however, generated any debate in Taiwan although, with the passage of time, "use" is increasingly determining the shape of the "substance". It is, perhaps, the tight ideological control by the Nationalist Party which accounts for the absence of a debate on this issue.

The same troubled voice produced another response from the rapidly growing Chinese Communist Party. As Marxist-Leninist revolutionaries, the Chinese Communists outright rejected the Confucion Chinese "substance". But they also rejected "Mr. Democracy" who came from the "bourgeois imperialist" West. They would accept "Mr. Science" only in tandem with an entirely different Marxist "substance". But the peculiarities of the Chinese situation – a huge mass of peasantry, little or no industrial proletariat, total isolation from the industrialized world and, above all, a strong sense of uniqueness – made some Marxists, particularly Mao Zedong, doubt the desirability of adopting the Marxist-Leninist social system as it had been developed in the Soviet Union. Mao Zedong was well-versed in the Chinese claims; he could readily see that the Confucian "substance" was responsible for China's "backwardness" in the field of science and technology. But he could also sense that a social system of the Soviet type would also produce science and technology which were inappropriate for China. If China was to build a new Marxist social system based on the social characteristics of the Chinese situation, it would also need to create a new "proletarian" science and technology system to go with it. This system too would build on the long tradition of technology created and murdered by the Chinese peasants and craftsmen; Marxist philosphy would "sum up" the experience of Chinese peasants, and later on industrial workers, in the form of new "proletarian" scientific theories. Mao

put forward two formulations for this process: "Class-struggle, the struggle for production, and scientific experimentation", and "Practice-theory-practice".

Such reasoning has been presented here as a "debate" going on in the mind of one person, Mao Zedong. This is because only Mao's writings (particularly the two essays "On Contradiction" and "On Practice") on this subject have survived from the period when the Chinese Communists were virtually cut off from the rest of the world in remote "border areas" of China. In any case, during the 1930s and 1940s, the Chinese Communists were fighting for their very survival; they must have had very little time for such fundamental debates.

The Chinese Communist Party came to power in October 1949. It was committed to attaining for China the status of a Great Power both in military and economic terms and therefore was enthusiastic and determined to cultivate an advanced state of development in the fields of science and technology. At the same time, it was also committed to fulfil its socialist objective of turning "feudal" China into an egalitarian and participative society. If the Chinese Communist Party was committed to science as "one of man's weapon in his fight for freedom", it also carried the equally strong conviction that Marxism, particularly dialectical materialism, provided a scientific framework within which the natural sciences as well as the social sciences could be placed in a unified manner. But differing interpretations of both Marxist theory and necessary practice among the Party leaders gave rise to severe "two-line struggles" over the policies in almost all sectors – ideology, politics, economy, defence, culture, and science and technology — in China. In these "two-line struggles", there were two main ideological issues insofar as the relationship of Marxist philosophy to the natural sciences

was concerned. One issue concerned the interpretation of the "practice-theory-practice" principle of epistemology; the other was about the guidance of Marxist philosophy over science and technology. This essay, intended to be a companion to the one entitled "Science Policy in the People's Republic of China" presents an overview of the ideological debates that have taken place on these two main themes in the People's Republic of China.

Practice-Theory-Practice

An important ideological issue involved in the after math of acrimonious debates, concerned the "correct" interpretation of the "practice-theory practice" principle of development of knowledge, put forward by Karl Marx, developed by Vladimir Lenin and reformulated by Mao Zedong. Since the implications drawn from this epistemology had direct relevance to science and technology policy, the principle was interpreted differently by different Party and government leaders to suit different policy preferences. At times, the principle was sought to be literally interpreted in order to yield a set of prescriptions for science and technology policy. But even literal interpretation meant quoting the grand masters selectively; both sides in the debate could – and did – play the game.

Such an inflexible, literal interpretation became the reigning doctrine during the most radical phases of the last three decades in China. It held that the activity of production or "practice" ultimately governed the development of scientific theories throughout the history of humankind. The origin and development of all branches of knowledge,

from the very beginning of mankind, were determined by the practice of "social production" ("teslimt" according to Marx). Scientific knowledge, thus, arose from "practice" in the "struggle for production" and this production experience was then elevated to "theory" as well as subjected to verification, again in practice. This view strongly emphasized the contributions of the "labouring masses" over invention of an individual genius and the overriding importance of class struggle for transforming the "bourgeois idealist" worldview of the scientists into a "proletarian materialist" view and the theory influencing the development of science and technology. Though such a rigid framework based on the "practice-theory-practice" principle was most dominant during the period when Mao Zedong was the supreme leader of China, and particularly during the decade of the Great Proletarian Cultural Revolution (1966-1976), at other times the same principle was differently interpreted. Often, it got only lip-service.

The first major ideological debate on the science-production and theory-practice relationship took place at the beginning of 1958 when China switched over to a new approach to economic development known as "development through mass mobilization"; the thinking which led to this approach has been outlined in the companion essay. This was the Great Leap forward. The changed approach to economic development was justified and explained in terms of a comprehensive Marxist-Leninist ideology as interpreted by Mao Zedong. "Practice-creates-theory" and "production-creates-science" became the dominant theoretical themes of the period. An important Rehmin Ribao (People's Daily the Chinese Communist Party's mouthpiece) editorial on the history of science and technology explained how most

of the important inventions in history, whether in China of any other country, came "from the oppressed classes, from among those in lower social positions, younger in age, less learned, in bad circumstances, and those who even suffered setbacks and discrimination".[1] Another article on the same subject also spoke of major innovations made by ordinary persons: "Those who dare to defy old theories, create new ones, and open new roads for science and technology are not always well-known personalities in the field of science. They are often practitioners and working innovators.....".[2] Taking the debate to a higher, ideological level, a Hongqi (Red Flag, the Party's theoretical journal) article in 1958 called what is internationally practised as "bourgeois science" and "pseudo-science"; and it predicted that this science would be eventually replaced by "genuine science" by the proletariat.[3] Such practice-determined-theory viewpoint was repeated in many articles of this period.[4] This interpretation of the "practice-theory-practice" formulation posited a new superior "proletarian science" based on Marxism-Leninism-Mao Zedong Thought and downgraded the "bourgeois science" of the West.

With the failure of the Great Leap Forward experiment, Chinese intellectuals as well as scientists, technologists and other experts regained their pre-eminence in policy matters. The new liberalized political atmosphere during the years of "readjustment" beginning in 1961 went with a radically different interpretation of the "practice-theory-practice" principle of epistemology. Because of what had happened during ths Great Leap Forward and the failure of the policies of that period, the epistemology of science was widely debated in the Chinese press during the early 1960s. The new interpretation of the Marxist philosphy of science and technology now defended the "relative"

independence of "theory" and the ability of "theory" to predict and even to guide "practice". One author stated that in world history scientific theories did not rise spontaneously from the practice of production and he pointed out the important role of experiments, abstractions, and hypotheses in the process of the formation of scientific theories.[5] Another author described scientific experiment as a "special form of social practice" which began approximately in the sixteenth and the seventeenth centuries in Europe, and subsequently underwent a comparatively systematic and relatively independent development. Clothed in quotations from Marx, Engels (his book Dialectics of Nature, a great favourite of all Marxist theoreticians of science) and Mao (On Practice) his major work on epistemology which comprehensively discusses the "practice-theory-principle" of epistemology, the author specially emphasized the important role of "theory" in the further development of "practice".[6] An interesting critique of this article, also supported with quotations from Engels and Mao, argued that the development of science was determined by production from the beginning of human history and that scientific experiment was a kind of social practice that had been present since antiquity. Its author attacked the "theory-before-practice" viewpoint.[7] Such a debate shows that while the dominant Marxist view during this period underscored the important role of "theory" in the further development of "practice", alternative interpretations of the "practice-theory-practice" principle were also allowed free expression. Obviously, the Party leaders of that time – Mao Zedong had then retired to the "second echelon" — felt that the principle was not so unambiguous as to justify only one set of interpretations. Or, perhaps, they were confident enough about their preferred interpretation and did not feel threatened

by alternative ones. In any case, Mao Zedong was still a power to reckon with and the views close to his own could not simply be blacked out.

As already stated, the view that "practice" is the determining factor of "theory" was aggressively propagated during the decade of the Great Proletarian Cultural Revolution. This Revolution was a political or ideological revolution but more fundamentally, it sought to revolutrinize the very thinking of all Chinese. Not surprisingly, the Marxist epistemology as a whole and that of science in particular was repeatedly brought up as the touchstone in all discussions of history of science and technology not only in China but in the whole world. The wisdom of the "labouring masses" as the motive force of scientific and technological advance became a central theme as was the case during the Great Leap Forward. The professional and mass media in China repeatedly reminded the people that progress in science and technology was not produced in ivory towers but generated and developed by the "broad masses of working people" on the basis of their activities in production practice in workshops and fields.[8] The viewpoint that theory is primarily deductive and it develops according to its own autonomous inner laws was attacked as "bourgeois" defence of the "class nature of ideas;" the "bourgeoisie", it was said, always denied intelligence of the non-expert masses, and confined their role to merely working out in practice, of designs formulated by the experts. It was on this interpretation of the "practice-theory-practice" principle of epistemology that the policies of "mass science" and "open-door" scientific research were based during the Great Proletarian Cultural Revolution. "Mass science" meant treating the 'struggle for production" of the workers and peasants as a series of gigantic scientific experiments and "open door" meant scientists and technologists going out of the laboratories to engage in actual production and also inviting workers and

peasants into the laboratories to do research. The argument was also employed to attack "basic" or "pure" scientific research, professionalism in science and technology; no "genuine science" was possible unless the scientists went to farms and factories to "learn from the masses . They had to experience the practice of production and then to "sum up" this experience into generalized "scientific theory". Practice-theory-practice, literally interpreted, also became a weapon for attacking those intellectuals who in philosphical discussions believed in the possibility of separating conceptual reasoning from immediate reference to the perceptual.

So much for philosophy enunciated from on-high. On the ground, scientists and technicians remained totally unconvinced. Moreover, while the workers and peasants did bring up numerous interesting innovations, "science" as such did not show any progress. In any case, the political/ideological balance of forces within the Party extinguished the interpretation, and rehabilitated the experts. With the restoration of the importance of expertise beginning 1972, "theory" once again gained its "relative autonomy". One major article on this subject published even after the change of "line" explained that while several branches of science e.g. thermodynamics, botany, zoology, genetics, plant-physiology etc., did develop directly from the needs of production in workshops and farms, other branches such as quantum mechanics, particle physics, the theory of relativity and so forth did not follow that path in history. Many important discoveries in the natural sciences were made principally through "observation, analysis, abstraction, and scientific experimentation"; they had nothing to do with the "direct needs of production".

Citing an example from the field of mathematics, the author, a leading Party official, pointed out that when calculus was invented about 3000 years ago, it did not have any application whatsoever in the concrete production practices of the time; but it had now become an "essential" mathematical tool for solving problems of production. Therefore, "theory" could also give rise to further development of "practice".[9] It should be noted that this article was published not in a Party paper or journal but a newspaper devoted to literature and culture.

Such an interpretation was a reheated version of the "bourgeois" viewpoint put forward during the period of "readjustment" after the abandonment of the Great Leap Forward. The Marxist purists immediately sensed danger and the redoubled their advocacy of the dominant role of "practice" in developing "theory". This interpretation of the history and philosphy of science became an integral part of the "anti-lin anti-confucius" campaign of 1973-74. Beginning 1973, many articles illustrating this "law" appeared in Hongqi, the Party's theoretical journal.[10] One such article sharply repudiated the view which "one-sidedly exaggerated" the role of "abstract thinking and logical inference" in mathematics. It refuted the contention obviously in the article cited above, that discoveries in calculus had "nothing to do with" the "needs of production" and proceeded to argue why the emergence of calculus in the seventeenth century was not a "matter of coincidence" but was dictated by the needs of production practice".[11] Beginning 1974, such a viewpoint was propagated even through China's professional science journals. Many such articles appeared in Scientia Sinica, the prestigious journal of the Chinese Academy of Sciences. The general refrain of these articles was that all knowledge, including

scientific knowledge, orginated in practice and arose from among the masses; many inventions and innovations were made by the "oppressed classes" who were low in social position and not by the high-class literati; all creations and innovations in science and technology resulted from the working people's repeated practice and continuous "summing-up" and "improvement" of their "findings" in class-struggle, the struggle for production and scientific experimentation.[12] These articles make delightful reading since they tell us little-known facts about very many, famous inventors in world history. The Chinese Communist Party, it seemed, had mounted a large effort to study the history of science and technology.

An interesting theme in the debate of this period was about scientific developments in ancient China. A major research project produced examples from Chinese history which "proved" that many inventors and scientists in ancient China came from among the working people.[12A] Why then did science and technology not develop rapidly in China? The answer, according to the Party historians, was that the Confucian School (Rnjia) and the "Legalist School" (Fajia) played diametrically opposite roles in promoting the development of science and technology in ancient China. The Confucian scholar-officials deliberately suppressed the growth of science and technology. The "Legalist", however, did everything to promote both but for that reason they were thrown out of power by the Confucians. The Confucians, it was argued, despised practice, preached idealist apriorism and the theory of "innate genius" (tiancai); they prevented to a great extent the further developments of knowledge of science among the "working masses". Their outlook on nature denied the objective realities of nature; hence they saw no

necessity for knowing its objective laws. It is thus the ruling Confucian class in China which blocked the advance of the natural sciences just as it occured in modern Europe because the ruling class in Europe at the time was keen on promoting production.[12B] In contrast, the "Legalist" School in China recognized that nature was an objective reality and its motion followed definite laws. The "Legalists" had a materialist outlook towards the theory of knowledge according to which "practice" was the essential way to gain knowledge. The "Legalists" believed in the dictum "subdue the will of Heaven and make use of it" (futian, yongzhi) as opposed to the Confucians who were held to be hostile to innovation because they held the "reactionary" ideological view based on the theory that "everything is decided by Heaven". Naturally, the "Legalists" grew economically and militarily powerful through the promotion of science and technology.[12C] This ideological debate over the merits of the Confucians and the "Legalists" in the development of science and technology in China was not settled through scholarly argument. It was a part of the wider political debate going on at that time and it was "settled in the political arena" like other ideological debates. Those who supported the "Legalist" position simply lost power and the debate came to an end.

Those who wanted a flexible interpretation of Marxist-Leninist philosophy as applied to science in order to modernize China rapidly, did not give up their view. The Outline Report on the Work of the Academy of Sciences, a key policy document formulated in 1975 to modernize the science and technology sector of China's economy made a brave attempt against heavy odds, to reverse the Cultural Revolution policies in science and

technology. It sought to justify the new policy thrust through the alternative interpretation of the "practice-theory-practice" principle. It paid ritual obescience to the classical Marxist-Leninst-Engelian view that science originated from the practice of production. But it then proceeded to argue that science and technology belonged to the "base" and not to the "superstructure". Science and technology, in fact, could be called "productive forces" which must go ahead in advance of production and push production forward.[13] Once science and technology could be included among forces of production, there was no question of their being either "bourgeois" or "proletarian". Science was science. It was the "relations of production" which determined whether science and technology were needed for "bourgeois" or "proletarian" purposes.

Even this modified restatement of the alternative position offended the ideological purity and policy preferences of the Party leaders who supported the philosophy of the Cultural Revolution. Little wonder then that they attacked the Outline Report, and aggressively defended their interpretation of the "practice-theory-practice" principle of epistemology. Quotations from Frederick Engels' Dialectics of Nature (e.g. "the emergence and development of science were decided by production right from the beginning" and "if society has a technical need, that helps science forward more than ten universities") were thrown at the ideological opponents to "prove" that all science derived from production practice. Those who viewed "theory" as a dominant factor in the further development of "practice" in the "practice-theory-practice formulation were labelled as "totally ignorant" of how theories of the natural sciences were "generated"; their knowledge of the history of science, the Maoists declared, was "close to zero".[14] Once again, a specific

information of Marxist ideology was used as a weapon to challenge the autonomy of research in science and technology and the "expert" claims of scientists and technologists.

Such attacks finally came to an end with the death of Mao Zedong. As observed earlier, the debate was "settled" not at the intellectual but political level. The new political "line" was put at a premium. With it, the ideological "line" unambiguously began to support the concomitant interpretation of the "practice-theory practice" principle of epistemology. As mentioned previously, this interpretation underscores the "relative" independence of theory in development and the ability of theory to predict and even guide practice. (In actual practice, "relative" independence becomes total independence.) The alternative orthodox Marxist-Leninist-Engelian is now labelled as "one-sided" and "narrow" in seeking to substitute "class struggle" and "production struggle" for the entire "social practice". What is more, the earlier interpretation supported by Mao himself is now condemned as "theoretically erroneous" and "contrary" to Marxism-Leninism-Mao Zedong Thought![15] Mao has become not only anti-Marx but anti-Mao as well.

So long as they call themselves Marxist-Leninist, the present leaders of the Chinese Communist Party can not totally abandon the classical formulation that "in the ultimate analysis" theory derives from practice. But the imperatives of speeding up modernization has always made them look for ways to legitimize the importance of the theoretically oriented experts. One way to do this was to make exceptions to the classical position "under certain circumstances". The latest device is to affirm the classical Marxist position but to distinguish

between the "earlier periods" of the development of science and technology in human history and the "modern" period; in the former, science depended on the needs of the society but "many modern technological developments in the past few decades were, in fact, the result of application of pre-existing laws" i.e. theory.[16]

DIALECTICAL MATERIALISM AND CHINESE SCIENCE

During the era of "struggle between two lines" in China i.e., the Great Leap Forward and the Great Proletarian Cultural Revolution, the guidance of Marxist philosophy, particularly of dialectical materialism over science and technology was aggresively stressed. It was held that Marxism incorporated the natural sciences and that the guidance of Marxist philosophy in the field of science and technology was absolutely essential. The holders of such a view were the most radical elements of the Chinese Communist Party who have now earned the label of the "Gang of Four". Their interpretation of the "practice-theory-practice" principle of epistemology was of a piece with their strong insistence on Marxist philosophy which lead : science and technology.

During the early years of the Communist Party-rule regime, political control and ideological indoctrination of the scientists and the technologists were relatively mild. Scientists were to be eventually converted to a socialist worldview, but this conversion, it was expected, could take place naturally in the course of their work, as a result of research into the materialist basis of the objective world. It was believed that since

Marxism was a scientific doctrine, the scientists would accept it of their own volition. A scientist was expected to accept and imbibe dialectical materialism through the data of science and on his own.[17] On the relationship between science and ideology, the formulation that the natural sciences had no "class character" was accepted and propagated. It meant that though every scientist may have his or her own political viewpoint, the natural sciences as such had no "class character".[18] This was a view adopted by the Communist Party of the Soviet Union as well for most purposes, except in the field of biology where Lysenko put forward a theory which may be said to have had a "proletarian character".

Because of relatively mild political control in the arena science and technology, the intrusion of ideology in the domain of scientists and engineers was almost non-existent. The only exception was genetics. Following the Soviet example, the "Mendal-Morgan laws" of heredity were rejected by the followers of the Michurian-Lysenko school of genetics in China. Both Mendal and Morgan were condemned by some Chinese geneticists as "reactionary idealists" who had been imbued with "bourgeois thought". A special edition of the Kexue Tongbao (Science Reporter), organ of the Chinese Academy of Science, urged the Chinese scientists to overthrow the "Mendal-Morgan faction" in the field of genetics. Obviously, not all Chinese geneticists were in agreement with the official "line"; some continued to express their criticism of the Michurian-Lysenko theories. However, they began to be labelled as being the victims of "doctrinaism". So, publication of anything critical of Lysenko stopped for a time.[20] By 1958, the Michurian-Lysenko School had become just as discredited in China as it was in the Soviet

Union at that time.[21]

With the change of the "General-Line" during the Great Leap Forward, the "line" on science, too, underwent a sea-change. Ideological indoctrination of the scientists now became a high priority. But, even in these years (1958-1960), the overwhelming emphasis ordained by the Chinese Communist Party was on implementing its epistimological view that it was social production that led to the growth of science; it did not insist on dialectical materialism "guiding" science. However, with the abandonment of the Great Leap Forward by 1960 the ideological indoctrination campaigns aimed at scientists and technologists i.e. to make them "red" also came to an end. The initial post-Leap years (1961-1963) were marked by a reduction of the influence of Marxist ideology in scientific work.

As has been explained in the accompanying essay on science policy, by the beginning of 1965, Mao Zedong had became extremely concerned about the deterioration in his own Party's thinking. This led him to launch the Great Proletarian Cultural Revolution. With it, Marxist ideology once again became all important. Scientists were now urged to study the philosophical thought of Marx, Lenin, Engels and above all Mao Zedong to improve the method of scientific research and to use dialectical materialism as a "weapon" to explore nature.[22] Mao Zedong advocated that "destruction" had to precede "construction". Hence a campaign was launched to discredit Western theories in science. Even the thinking of Newton was described as "incomplete" because he had lived before Marx and was therefore ignorant of dialectical materialism.[23] An interesting report, showing how the Party's ideological slogans could effect science and technology, appeared

in July 1965. In it a factory worker wrote a letter to the workers' newspaper, Gongren Ribao (Workers' Daily) in which he spoke about one of his colleagues who in the revolutionary spirit of "breaking down superstitions" and "daring to think and daring to act", attempted to invent a perpetual-motion machine. When told that there had never been such a machine invented by anyone in the world, the worker was reported to have said that he would make one now. The letter was referred to Professor Qian Xuesen, the world famous Chinese nuclear physicist and the "father" of the Chinese nuclear for his comments. In his reply, Qian explained that, however great the revolutionary zeal of the worker, things could not be done contrary to the "objective laws of nature". A machine with perpetual motion was not possible because it was in direct contradiction to the laws of thermodynamics.[24]

Scientists with high prestige could boldly contradict "line" for some time. But as the Great Proletarian Cultural Revolution really got under way, writing on scientific and technological matters in the Chinese media began to apply the method of dialectical materialism to the solution of scientific problems. Dialectical materialism was repeatedly brought up in all discussions on science. Scientists were repeatedly exhorted to adopt dialectical materialism and the thought of Mao Zedong in the place of their own "metaphysical" approaches in research. The "indispensability" of guidance by dialectical materialism over the natural sciences became the theme of a number of articles.[25] In one such article, Li Siguang, China's eminent geologist, urged his colleagues to establish the "proletarian" world outlook of doing work according to the principle of dialectical materialism, to use "Mao Zedong Thought" as a "mighty weapon" in the struggle against the "reactionary" viewpoints in the

natural sciences, and to eliminate "idealistic" and "metaphysical" thinking in scientific research. Citing the example of researches in the field of geology, Li sought to show how the dialectical-materialist approach had led to the discovery of huge mineral deposits in China in areas earlier downgraded as "useless" according to traditional, "metaphysical" geological theories.[26] Li Signang was right about the actual discovery of mineral deposits but his claim about dialectical materialism did not convince geologists elsewhere. Anyhow, such claims were made for many other branches of science, particularly medicine. It should be noted that the ideological "debate" — it was only a one-sided debate in which the opposing viewpoint was presented only for refutation — was conducted only in Party journals and newspapers since all professional journals on science and technology had suspended publication after 1966.

By the anti-Lin anti-Confucius campaign of 1973-1974, the ideological debate on the relationship of science to dialectical materialism was elevated to the level of philosophy. References to the application of the principles of dialectical materialism and to the principle of "one divides into two" began to appear even in highly theoretical papers in science journals which had resumed publication. The scientific literature of this period shows concerted attempts to interpret biological, chemical, and physical phenomena according to the concepts of dialectical materialism.[27] One such paper on the recovery, utilization and treatment of waste-water containing phenol, stated that all substances in the objective world behaved according to the principle of "one divides into two" and that the terms "waste" and "treasure" were "relative" and "under certain conditions" interchangeable. For example, phenol, if

simply discharged into the environment as a "waste" product, was an extremely harmful substance, while if it was recovered and properly utilized, it became a "treasure" of great value.[28] Another article, based on the understanding gained from studying Engels' Dialectics of Nature, traced the history of chemical theory from the time of the atomic theory of Democritus to modern times in terms of the "struggle between materialist and idealist interpretations of chemistry". He pointed out that idealistic theories such as "vitalism" had disrupted the progress of science whereas materialist theories had propelled chemistry forward.[29] A similar approach could be seen at work in a paper which dealt with a number of genetic problems from the standpoint of Mao Zedong's dictum that "in studying a problem we must shun subjectivity, one-sidedness and superficiality". Its author observed that the science of genetics was infused with many "idealist" and "metaphysical" concepts (viz., "single genes produce single characteristics," "the gene is not divisible," "the process of mutation cannot be controlled", etc.) because, for the most part, the science developed in capitalist countries. Applying Mao Zedong Thought to the problems of heredity and of functions within the cell, he wrote quoting Mao, from the standpoint of materialist dialectics; "External causes are the conditions of change and the internal causes are the basis of change;..... external causes become operative through internal causes". On this basis, the author believed that environment and heredity must be regarded as different things and that "phenotype" should be clearly distinguished from "genotype". In dealing with the relationship between the nucleus and the cytoplasm, the same author referred to Mao's statement: "Of two contradictory aspects, one must be principal and the

other secondary. The principal aspect is the one playing the leading role in the contradiction". Thus, he argued the nucleus which contained the chief genetic materials must be considered the principal aspect, playing the leading role in the cell. But he also pointed out that, in line with materialist dialectics, the principal and the non-principal aspects could be transformed into each other. This is what he believed to be true of the relationship between the nucleus and the cytoplasm.[30] The above is a typical example of how dialectical materialism and particularly its interpretation by Mao Zedong in terms of "contradictions", "unity of opposites" etc., was applied to reinterpret established scientific theories. There were numerous others.

The ideological "line" of Marxist theory "guiding" science and technology found its boldest expression in the "open door science" campaign of 1976. That campaign made the role of Marxist philosophy to "command" natural science as a "major issue" in the "struggle between the two lines" in the scientific and technological fields.[31] The literature which accompanied the campaign pointed out how the application of dialectical-materialist viewpoint had demolished many "idealist" and "metaphysical" viewpoints in the natural sciences. For example, in his Anti-Duhring, Frederick Engels had criticized Duhring's anti-Marxist viewpoints in cosmogony, physics, chemistry and biology. Similarly Lenin in his Materialism and Empirio-Criticism had opposed Boglanou's "revisionist line" and had made "deep-going researches" into the new discoveries of natural science and the "crisis of physics" and had presented a thorough critique of Marxism.[32] It was by applying materialist dialectics and on the basis of the principle that "everything divides into two" that Mao Zedong had generalized the achievements in the study

of basic particles in nuclear physics and advanced the thesis that the so-called "basic particles" were also infinitely divisible. Mao had thereby pointed out the direction for the study of physics in future.[33] Therefore, without the "guiding role" of Marxism, "no progress" in the natural sciences was possible. Even pre-Marxist "bourgeois" natural scientists were said to have applied the "dialectical-materialist" viewpoint — without, of course, being conscious of it — in the course of their scientific research. Thus, Newton had been able to discover the three major laws of classical mechanics and the law of universal gravitation because he had "stuck to spontaneous materialism" and had "recognized the objectivity of matter". Similarly, Kant was also able to put forward the "nebular theory" because, the interpretation went, "he had a definite materialist and dialectical thought" and "proceeded from the contradictory motion of the planet itself".[34] Since in the "open door science" campaign, workers and peasants were "invited in" to the laboratories, it was thought that they would naturally internalize such a "prelanian" approach and help to convert the professional scientist and technologists. They would actually apply such theories and come out with actual results which would convince the scientists and engineers about the validity of the dialectical materialist method.

The death of Mao Zedong changed everything. The entire "General Line" was thrown overboard. Professional scientists and technologist regained their prestige and more importantly, their power. With that the "indispensibility" of Marxist theory in scientific and technological developments began to be called a "ridiculous thesis". It was stupid to say that "Marxist philosophy is the most fundamental theory of natural science" and even more stupid to openly advocate "replacing" natural science with Marxist

philosophy.[35]

Obviously, as the guardians of Marxism-Leninism, the leaders of the Chinese Communist Party are not asking the scientists to forget about Marxist philosophy. It is still to "guide" scientific research.[36] But, using Marxism as a "guide" to scientific work is not the same as replacing basic theories of natural science by Marxist philosophy which is what was allegedly done during the Great Proletarian Cultural Revolution. (As a matter of fact, the allegation is untrue, but it is a part of a political not intellectual debate.) The Party asks the scientists to become "conscious materialists and dialecticians" and to adopt "dialectical thinking" as a methodology of scientific research.[37] The Cultural Revolution "line" asked for exactly the same in slightly different language, but now there is a change of emphasis. It is said that scientists must understand that the achievements of modern natural science provide a "scientific basis" for the philosophy of dialectical materialism and that dialectical materialism is the "philosophical basis" of modern natural science. They must also realize that applied sciences provide a definite technical and practical basis for the basic sciences, and that the basic sciences in turn become the basic theories of applied sciences. Consequently, the basic theories of the natural sciences cannot be "replaced" by Marxist philosophy as was allegedly advocated in the Cultural Revolution years.[38] Evidently, this is a lot of play on words. The professional scientists and technologists in China know it to be so and the conclusion they derive from this "debate" is that they can safely ignore this "ideological debate" and get on with their jobs.

The foregoing analysis shows that the heaviest emphasis on the Marxist-Leninist philosophy leading the natural sciences came during the Great Proletarian Cultural Revolution. The

interpretation which sought to explain the development of all scientific progress solely through economic reasons and which minimized the role of individual creativity in advancing scientific knowledge was a throw-back to the Soviet views on the history of science of the 1920s and the 1930s.[39] For example, in a paper presented to the Second International Congress of the History of Science held in London in 1931, Boxis Hessen, the Soviet delegate, had presented a Marxist treatment of social and economic factors as the main elements in scientific and technological development. Hessen not only attributed the development of science during the European Industrial Revolution to the needs of the "rising bourgeoisie", he related the most abstract propositions of Newton's Principia to the needs of the early capitalist society of its author's time.[40] Such views enjoyed a certain normative acceptance in the Soviet Union but were rejected after Stalin's death. Since 1952, Hessen's views have been described as being characterized by "a certain primitivism" in explaining the links between the socioeconomic conditions and the development of science.[41] The present Chinese leadership also subscribes to the viewpoint on the history of science which is close to that currently held in the Soviet Union.

As in the Soviet Union of Stalin's time, during the Great Proletarian Cultural Revolution in China, too, the guidance of Marxist philosophy over science and technology was taken as a precondition of its development. But China did not experience the "Lysenko phenomenon" and its attendant repression of alternative theories in the sciences. During the Stalinist era in the Soviet Union, scientific theories such as Einstein's Theory of Relativity, Cybernetics, the Mendel-Morgan laws of heredity and many other advances in science were vehemently denounced. The "natural dia s' who controlled scientific thought in many fields of sc

opposed these on ideological grounds.[42] The study of genetics according to the Morgan-Mendel theory, for instance, was discredited by the Lysenko school of genetics on philosophical-ideological grounds. Lysenko believed in inheritance of acquired characteristics, as opposed to the genetics of fixed characteristics based on the ideas of Morgan and Mendel which held that acquired characteristics could not be inherited. It was from dialectical materialism that Lysenko's school drew its important principle; it argued that since all matter was in a flux, there could be no stable heredity characteristics and so no constant variety of crops.[43]

The initial Soviet attitude towards cybernetics was also one of hostility based on ideology. It was criticized as a "pseudo-science" serving contemporary capitalism and offending the fundamental tenet of materialist dialectics which held that thought, the highest form of the motion of matter, could not be ascribed to lower forms of motion of matter, particularly mechanical matter, since consciousness and cognition, by definition, were properties of man alone; as highly organized matter and could not be the properties of lower forms of motion such as machines.[44] The death of Stalin led to Soviet science becoming more autonomous and the attitude towards cybernetics, genetics and other theories in science also changed.[45] If dialectical materialism influences the thinking of Soviet scientists today in any way, it is surely only in the sense of defining their positions as "cognitive realists".[46]

Although the guidance of Marxist philosophy over the natural sciences was aggressively emphasized during the Great Proletarian Cultural Revolution decade in China, nothing comparable to the Stalinist repression of alternative natural science theories and of scientists esponsing such theories ever took place in China. According to a recent report, the Morganist and the Michurianist schools of genetics have for long co-existed in China, though the former had become a

repeated target of criticism and its followers had no opportunity to answer back.[47] But, according to some other reports, the leaders of the Cultural Revolution allegedly described Darwin's Theory of Evolution, Einstein's Theory of Relativity, Morgan's genetics, and cybernetics as "bourgeois metaphysical" theories serving the U.S. "imperialists" and the Soviet "revisionists" to sabotage revolution.[48] They also allegedly attempted to "negate" the Theory of Relativity, the laws of thermodynamics and Newton's laws of motion.[49] A project to determine the sex of babies in the embryonic stage was also allegedly condemned by them as "not treating boys and girls on an equal footing".[50] Whatever the truth behind these allegations, on balance, it is clear that the Chinese Communist Party leaders have avoided situations comparable to the Stalinist repression of the natural sciences.

Despite all the highly visible "debate" and despite the support given by some professional scientists, there is little evidence of sustained application of the philosophical formulations of dialectical materialism in actual scientific research in China on a wide scale. It appears that dialectical materialism exerted little or no influence on the actual growth of the natural sciences during the Great Proletarian Cultural Revolution decade in China. For the most part, it was either utilized by many scientists and technologists as a way of paying tribute to the reigning Party philosophy or used as a post hoc attempt to provide ideological legitimacy for ideas developed independently of ideology. However, the same is not true so far as the social sciences were concerned. The penetration of ideology into the methodology and the content of research during the Great Proletarian Cultural Revolution was much more noticeable in the social sciences than in the natural sciences when disciplines such as anthropology, sociology and psychology were virtually abandoned. Once again, under the current regime of Deng

Xiaoping, these disciplines have been revived.

What summation do we make of the ideological debates in China as they concerned science and technology? It is easy to dismiss them as the fevered imagination of romantic revolutioniaries like Mao Zedong. They can also be seen as a short episode in the history of science and technology like "German Science" under the National Socialists (Nazis), an episode which was overtaken by the "rationialist" thrust of universal science which recognizes no ideological, national or cultural alternatives. But it would be a mistake to do that. It is important to remember that such debates were not "settled" on the intellectual plane but in the political arena. It was no "paradigm shift" a la Kuhn which left such alternative theories and approaches behind. Actually, these alternative theories were attempting a "paradigm shift"; the attempt did not succeed.

In surveying the debate in China on issues relating to science and technology, several special features of the debate stand out. A reference has already been made to the fact that neither alternative theories nor the theorists themselves were totally suppressed — though they were subjected to much criticism. Secondly, and this fact has gone unnoticed, the professional scientists of high intellectual standing who supported the alternative paradigm did so more on the basis of "Mao Zedong Thought" than by drawing on the theories of Marx, Engels, Lenin and Stalin; they took up the Chinese element rather than the "ideological" element out of Mao's interpretation of Marxism. The third feature is that unlike scientists and technologists elsewhere in the world, the Chinese scientists and technologists have always taken an active interest in the history and philosophy of science and technology in China. Fourthly, in Chinese history, technology has always been propelled forward by its practitioners in the course of production; the "theorists" only provided the broad cosmology. In China, the

generation of scientific theories was a lower order of intellectual activity. Thus, while the ideological re-interpretation of the history of science and technology in Europe by Chinese Party theorists may have been so much nonsense, the right conclusion were drawn about the development of science and technology in China. Fifthly, certain practices in China like acupunctural anaesthesia, continental exploration of oil, folk observations of meteorological phenomena, earthquake prediction etc., "worked" and these desperately called for alternative theoretical explanations because the conventional scientific theories had none to offer. And lastly, it is to be noted that modern scientific theories and poised for a paradigm shift in two areas: sub-atomic particles and theoretical biology. The Chinese theories offered very interesting alternatives in precisely these two areas. These special characterstics of the debate in China suggest that the debate will be carried forward and it will make a contribution to the debate on "alternative sciences" which has just begun in the West.

FOOTNOTES

1. "Science is No Mystery", Renmin Ribao Peking, China May 22, 1958, editorial, New China News Agency (NCNA), May 22, 1958, in Survey of China Mainland Press (SCMP), Hongkong, No.1780, May 28, 1958, pp.41-43.

2. Wang Shihao, "on the Promotion of New and Different Things", Renmin Ribao, July 16, 1958.

3. Jiang Ke, "Science and Superstition", Hongqui, Peking, China, No.13, 1958, pp.21-24.

4. See Gan Ziyu, "Why the Labouring Masses are the Most Intelligent", Renmin Ribao, June 10, 1958, Yang Kuangbao, "Practice is the Fountain-head of Science", Rehmin Ribao, Nov. 10, 1958.

5. He Zuoxiu, "The Roles of Experiments, Abstractions, and Hypotheses in Scientific Research", Hongqi, No.11, 1961, in Selections from China Mainland Magazines (SCMM), Hongkong, No.266, June 19, 1961, pp.13-24.

6. Gong Yuzhi, "On Scientific Experiment", Hongqi, No.1, 1965, In SCMM, No.454, Feb.1, 1965, pp.1-14.

7. Mao Yisheng, "Knowledge and Experience of Scientific Experiment", Xin Jianshe, Peking, China, Nos.11-12, 1965, in Supplement to SCMM, No.5, March 8, 1966, pp. 22-33.

8. "Poor and Lower-Middle Peasants are Masters of Agricultural Science and Technique", NCNA, December 22, 1968, in SCMP, No.4327, December 30, 1968, pp.16-19.

9. Zhou Peiyuan, "Some views on Educational Revolution in the Science Faculties of Universities", Guangming Ribao, Canton, China, October 6, 1972, in SCMP, No.5238, October 19, 1972, pp. 112-22. According to recent information, an "acute struggle" took place at that time over the publication of this article. Se Zhou Peiyuan, "What is the Intention of the 'Gang of Four'

in Obstructing Research on Basic Theories?", Renmin Ribao, January 13, 1977, in Survey of People's Republic of China Press (SPRCP), No.6268, January 27, 1977, pp.134-39.

10. See for instance, Xiao Tong, "The Development of Man's knowledge of the Universe", Hongqi, No.7, 1973, in SCMM, No.757, July 30, 1973, pp. 123-34 and Chen Yansheng, "The Struggle between Materialism and Idealism as seen from the Theory of Evolution", Hongqi, No.12, 1973 in SCMM, No.766, December 27, 1973, pp.80-90. Such articles have now been denounced as "anti-Party" and "anti-Marxist trash". See Ke Weiran, "Expose and Criticize Yao Wenyuan's Crimes of Using Hongqi to Sabotage Scientific and Technological work", Hongqi, No.4, 1978, in Translations from Hongqi, Joint Publications Research Service (JPRS), Washington D.C. USA, No.71314, June 19, 1978, pp.127-33.

11. Shu Li, "How did the Theory of Calculus Evolve", Hongqi, No.1, 1973, in SCMM, No.746, February 6, 1973, pp. 79-87.

12. See, for instance, Shi Qun, "Science Originates in Practice, Science Arises from Among the Masses — The Bankruptcy of the Idealist Theory of 'Innate Genius' as evidenced in the Historical Records of China's Development in Science and Technology", Scientia Sinica, Peking, China, pp.609-13.

12A. Li Zhun, "The Struggle between Confucian and Legalist Schools and Scientific and Technological Development in Ancient China", Scientia Sinica, Vol.17, No.6, December 1974, pp.709-716.

12B. Luo Jiazhang, "The Struggle between the Confucian and Legalist Schools and Natural Science in Ancient China", Scientia Sinica, Vol.18, No.1, Jan-Feb.1975.

12C. Li Zhun, "The Struggle between Confucian and Legalist Schools and Scientific and Technological Development in ancient China", op.cit.

13. "Outline Report on the Work of the Academy of Sciences", Chinese Law and Government, USA, Vol.12, No.1-2, 1979, pp.104-33.

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16. Qian Sanqiang, et.al., "A Brief Account of Scientific and Technological Development", Hongqi, No.15, 1980, in China Report: Red Flag, JPRS: 76563, October 7, 1980, pp.46-62.

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20. Richard P. Suttmeir, Research and Revolution: Science Policy and Societal Change in China, Lexington, Lexington Books, 1974, p.81.

21. Keiji Yamada, Op.Cit.,f.n. 19.

22. See Zhu Hongyuan, "Use Mao Zedong's Thinking to Guide Scientific Research", Renmin Ribao, July 4, 1965, in Translations on Communist China's Science and Technology, JPRS: 31457, August 9, 1965, pp.114-121; Tang Aoging, "The Thought of Mao Zedong is a Sharp Weapon in Studying Natural Science", Hongqi, No.11, 1965, pp.15-21 in Translations from Hongqi, JPRS: 32698, November 3, 1965, pp.25-37.

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