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Experiments in Total Engagement: Science-Society Interactions in the People's Republic of China, 1949-66

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Introduction

This chapter discusses the relationship between Chinese scientists, policy-makers and citizens in the turbulent years between the declaration of the People's Republic of China (PRC) in 1949 and the brutal purges of the 1966 Cultural Revolution, a time of amazingly rapid industrialisation which saw all-out efforts to transform almost every aspect of Chinese society. These enforced and often ill-planned changes brought hardship and tragedy into the lives of a great many ordinary Chinese families. They also opened up exciting new opportunities for huge numbers of peasants and workers, especially in education and the workplace.

During this period the attitude and policies of the governing Chinese Communist Party (CCP) with regard to the organisation and conduct of science followed two contrasting models or approaches. The dominant and recurring mode involved efforts to build up Chinese science and technology along the lines already established in the Soviet Union, an approach which broadly speaking attempted to adapt Western[2] arrangements to the needs of the Socialist state. However, for two short periods (the "Great Leap Years" of 1957-61 and during the 1966-71 Cultural Revolution) this "professional-bureaucratic" model was temporarily superseded (although never entirely replaced) by a distinctive "mobilization model" of "mass science". This approached the organisation and direction of the Chinese scientific enterprise from the viewpoint of a radical Maoist and Marxist-Leninist epistemology which attempted "…to "involve science and technology in an intimate way with revolutionary social change and mass cultural transformation" (Suttmeir 1975, 237).

Although this chapter paints a somewhat larger historical picture overall, its principal focus is on the four-year period from 1957 to 1961. These were the years of Communist Party Chairman Mao Tse-tung's so-called "Great Leap Forward", a time when the first version of the radical "mobilization model" was developed and held sway[3]. In choosing to discuss this period in some detail the chapter seeks to achieve two aims. The first is simply to introduce the reader to a little-known episode in the history of science education, communication and engagement. Despite a flowering of scholarship in these areas over the past four decades, there is arguably still too little discussion-at least in the Anglophone literature-of issues and experiences outside the Western mainstream. As one leading scholar of Chinese scientific history recently noted: "Eurocentric portraits of the rise of modern science… usually represent variations of a historical teleology of Western European scientific 'success,' and, by comparison, non-Western 'failure'" (Elman 2006, 10). This is arguably equally true for studies of science communication, an imbalance which may be at least partially redressed by what follows.

A second reason for examining this first Chinese experiment in "mass science" is its potential relevance for the debates currently taking place in Europe and elsewhere concerning the desirability of basing science-society interaction policies on concepts of "public engagement" rather than "public understanding" (House of Lords 2000; Irwin 1995, 2001; Bauer *et al* 2007; Rogers-Hayden & Pidgeon 2007). This debate both reflects and invokes challenging questions about the relationship between citizens and the methods and findings of modern science, and the part to be played by policy-makers in shaping that relationship. The discussion takes on a particular urgency in the light of the recently established and historically unique scientific consensus as to the certainty, extent and likely severe impacts of anthropogenic climate change (IPCC 2007). It is clear that science communicators and educators have an important part to play in

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explaining and encouraging the major attitudinal and behavioural changes that will be required if governments and citizens are to meet this global challenge. There may perhaps be something to be learned from the Chinese experience, where the radical experiments in science-society interaction described here formed part of a political, economic, technological and societal restructuring carried out on a scale and at a speed unprecedented in human history.

Science and Society in Post-Revolutionary China

At the time of the proclamation of the Chinese Republic in 1949 the Chinese population was around 548 millions, of whom some 85% worked in the agricultural sector and only 2.2% in industry. Approximately 90% of all Chinese were functionally illiterate; in many rural areas more than 95% could neither read nor write (Reiitsu 1979).

On their accession to power the Chinese Communist Party signalled immediate and significant changes in governmental attitudes toward the role of science in Chinese society. There was a clear recognition within the Party that their planned programme of modernisation required the establishment of effective and large-scale systems of scientific research and education. For both pragmatic and ideological reasons the Party unswervingly adhered to what Suttmeier (1975) has called a utilitarian view on science; a view almost entirely shaped by the desire for technological (and consequently economic and military) advancement rather than any interest in advancing basic scientific knowledge for its own sake. However, whatever their vision, the Party faced immense challenges in realising it: in 1950 there were only 862 natural scientists of Chinese nationality, of whom some 174 lived abroad (Suttmeir 1975).

Accordingly, in August 1950 the preparatory committee for the planned First All-China Natural Science Congress decided to register and unite China's scattered resident researchers. They also launched an appeal for patriotic émigré students, scientists and technicians to return from overseas. By the end of 1950 more than one thousand had done so, although in 1958-almost ten years after "The Great Liberation"-more than 10,000 Chinese students still remained abroad (Lindbeck 1961). In a society so overwhelmingly uneducated, these highly trained resident and returnee scientists formed a tiny intellectual elite. Over the following two years (1951-2) the Party reorganised and consolidated the existing, pre-revolutionary scientific research bodies, such as the Academia Sinica and the Peking Academy, and established an ideological reform movement aimed at enabling scientists to

> …recognise the new era, to distinguish between the enemy and ourselves, to criticise the erroneous ideas of the bourgeoisie and the petty bourgeoisie, and to establish a revolutionary standpoint of serving the people, thereby to improve scientific research work (Kuo Mo-Jo 1951, in Suttmeier 1970)

One of the earliest and most significant statements of the CCP's view on the place of science and scientists in Chinese society was made in a speech on 18 July 1952 by Ch'en Po-ta, then Deputy Director of the Propaganda Department of the Central Committee of the CCP. Quoting Lenin, Ch'en suggested that the Party must put its trust in the scientists, being prepared to learn from and assist them without interfering too much. The ideological assumption underlying this stance was that, in time, "a scientist or engineer will come to accept Communism through the data of his science in his own way" an assumption tempered by the warning that "only by joining the masses of the people and cooperating with the Communist Party will scientists be able to find their future" (Ch'en 1952). The role of science in the new Chinese Communist society was thus defined by Ch'en as that of utilitarian service of the masses, that is, of science in the service of production.

At this early stage in the development of the People's Republic Ch'en was articulating a science policy broadly based on the Soviet "professional-bureaucratic" model of the organisation of science. This approach enshrined "the principle of subservience of scientific research to the requirements of the state", implying the need for central direction and control of scientific research activities at all levels (Lindbeck

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1961, 116). All that was required for the proper development of science was the proper organization of science, the proper ideology of scientists and the proper environment for science. However the small size and possibly suspect ideology of the Chinese scientific establishment was clearly a problem if science was truly to become "a common enterprise of the people as well as a common enterprise of the scientists". Addressing this point, Ch'en attributed the lack of scientific progress in China before the revolution not only to inappropriate socioeconomic circumstances but also to the close association of scientists with "reactionary rule and imperialist domination". He particularly spoke out against "individualistic" scientists who wanted to strive for excellence in "odd, narrow little topics", suggesting that scientists who held the right ideological position would naturally select research topics that would serve the interests of the masses.

It was made clear that in a Chinese Communist context science was to be predominantly inductive, and therefore theory would only be considered relevant when unified with practice, the most relevant practice being that of the toiling masses. This classically Marxist-Leninist "practice-theory-practice" view of knowledge production implies the development of a kind of "mass science" (Suttmeier 1970) radically different from both the West and the Soviet Union. This idea was to underpin, and at times dominate Chinese thinking on scientific research and education over the next two decades.

The First Five Year Plan and the "March on Science"

The First Five Year Plan aimed at transforming the Chinese economy was launched in 1953. This was a period of very rapid growth in China's urban population, with consequent extreme pressure on both natural and man-made resources. Huge investments were made in industry, agriculture and establishing China's nuclear programme. In January 1956, following a call from the Central Committee of the CCP for "a march on science" the State Supreme Council established a twelve-year science plan which called, among other things, for the training of 10,500 new scientists by the end of 1967. In just one year, from 1955 to 1956, the national science budget underwent at least a six-fold increase from around $15m to $100m. By 1961 the funds allocated to science amounted to about $440m, around 1% of the total national budget (Lindbeck 1961).

Science policy for the First Five Year Plan focused on the organization of Chinese science and the repatriation of émigré scientists. However, Communist Party cadres continued to be deeply suspicious of the trustworthiness of foreign-trained or influenced scientists and engineers as participants in the process of reforming and modernising Chinese society, and this mistrust increasingly shaped the development of policy. As one contemporary commentator put it

> At Liberation, the Chinese Communist Party made great efforts to draw the intellectuals into the revolutionary camp, but problems soon arose in assimilating these people into socialist economic reconstruction. The solution was to remould the intellectuals for active participation in socialist construction. (Song Cheng 1954, quoted in Reiitsu 1979, 199)

As one way of addressing their deep misgivings about the ideological status and patriotic commitment of the scientific elite, the Party sought to completely reform the system of training new scientists and technicians, which consisted of two main components, conventional formal education and "ideological remoulding". A system modelled on the Soviet two-track pattern was set up for younger people. One track led from elementary to middle school, then to high school, college and graduate school. The other involved vocational training at various levels. In both cases, outstanding graduates were then selected for further study in the Soviet Union and other Eastern European countries (Saito 1973, cited in Reiitsu 1979). By May 1957, around 7,075 Chinese students were studying in fourteen foreign countries; of these the majority were in the Soviet Union. By 1960 some 3,700 students had returned to China having completed studies abroad, 1,500 having received advanced degrees. These degrees were predominantly in engineering and the applied sciences (Lindbeck 1961). Research equipment and facilities were imported *en masse*, mainly from the Soviet Union, and huge amounts of both Soviet and Western scientific books and periodicals were

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purchased, with over $5m in pounds sterling spent in 1956 alone (Lindbeck 1961). At the same time, the authorities launched mass literacy, numeracy, agricultural and technical education programs on a scale unprecedented in Chinese history.

Throughout the First Five-Year Plan the emphasis was very much on the Party leadership of science. The importance of research was recognised by the Party, but resources, especially personnel, were in short supply. As in the Soviet Union (see *e.g.* Graham 1993) the "professional-bureaucratic" approach produced tensions between the state and the scientific community, with the latter feeling that the Academy and its scientists should devote themselves to basic research, the establishment of new disciplines, and establishing and improving standards in scientific research and education. These tensions surfaced during 1957, when the CCP's "Hundred Flowers" campaign provoked a "bitter struggle" over the control and direction of science – a struggle which was definitively settled in favour of the Party view that the locus of control must, and would lie with them (Lindbeck 1961). To the scientists who advocated academic leadership of China's scientific expansion, the Party responded with accusations of political motivation based on their "class character", attacking the "bourgeois scientists who maintain that Communists are laymen" as "part of the problem" and accusing them of attempting to "oust the Party from the field of science" (Lindbeck 1961, 118-119). Some of the scientists and administrators concerned, labelled as "Rightists" were rebuked, demoted or dismissed; few however suffered the persecution, torture and execution that were the fate of many non-scientific intellectuals (Jung and Halliday 2006, 435-443). Although their obvious value to the state protected scientists at this time, the view of the Party cadres was that they could no longer be trusted to put the interests of the masses before their own.

This conflict and its outcomes clearly signalled a defeat for the moderate viewpoint-articulated in speeches by leaders such Ch'en Po-ta (as discussed above) and, most famously, in Chinese Premier Chou En-lai's *On the Question of Intellectuals*-that the Party and the people had to put trust in their scientists (Suttmeier 1970). Politicians and policy-makers took even firmer control of science and technology through the establishment (on November 23rd, 1958) of a powerful overseeing Scientific and Technological Commission, directly under Party control and of which none of the members were leading scientists. According to CCP spokesmen, the outcomes of the Party's victory in the struggle with the bourgeois elements within the Chinese scientific establishment were immediate and dramatic: for example, it was claimed that the published word-count in the academic journals for the natural sciences increased by 47% between 1957 and 1958–a more than twenty-fold increase on the 1952 level (Lindbeck 1961). The Commission proceeded to map out and assign local science and technology plans for all areas of China, setting out a strategy referred for "storming the heights of science". An important feature of these plans, directly stemming from the now even further entrenched suspicions of "elite, bourgeois science" among the Party leaders, was the creation of a new corps of "peasant and worker scientists" from the ranks of the people.

The Great Leap Years: "Mass Science" and the Mobilization Model, 1958-61

By the late 1950s massive rises in Chinese urban populations brought growing unemployment in the cities while the productive power of the countryside dwindled due to agricultural labour shortages (Glassman 1975). It was against this background that the CCP decided to instigate the next stage in the development of the People's Republic: a "great leap forward" into world superpower status. As defined by the Party Chairman, the goal of this "Great Leap" was: "to overtake all capitalist countries in a fairly short time and become one of the richest, most advanced and powerful countries in the world" (Mao Tse-Tung 1958, in Chang & Halliday 2006, 444). There was to be an all-out effort; huge sacrifices would be expected (and extracted) from the Chinese people. These decisions were taken against a background of almost inconceivable ambition and hubris on the part of the Party leadership. According to Dongping (2006)

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> …the 1950s were a decade of unprecedented triumphs for the Chinese people and the Communist state. The successes of the land reform, the military confrontation with the U.S. led UN forces in Korea, the socialist transformation of industry and commerce, and the organization of mutual aid groups, lower level and high level agricultural cooperatives resulting in significant increase of grain yield, created a climate of triumphalism. Conventional wisdom regarding what was possible and impossible had become irrelevant under the new circumstances.

Although it is difficult to establish definite numbers, some commentators (e.g. Chang & Halliday 2006) have suggested that during the 3-year period of the 'Great Leap' starvation and overwork claimed around 38m lives. In 1957 and 1958 Mao repeatedly told his colleagues in the top echelon of the Party to be prepared "…to sacrifice 300 million Chinese… half of China may well have to die" commenting that "Deaths have benefits. They can fertilise the ground" (Chang & Halliday 2006, 457-8).

The Great Leap brought radical reforms in China's education system. As the Party leadership became increasingly aware of the limitations of the capital-intensive approach to development embodied in the first Five Year Plan the focus shifted to a new, more labour-intensive strategy. This required a much larger number of less well-educated but more motivated and politically conscious workers. Coupled with the suspicion of intellectuals engendered by the "One Hundred Flowers" campaign, this led to major changes in the Party's attitude toward training and leadership in science and technology. Training programmes aimed at the few in the highly educated technical elite were cut back in favour of a massive expansion of all levels of the education system (Glassman 1977). One key aspect of this policy was a new flexibility – the aim being to provide a wide variety of educational opportunities rather than achieving consistent methods or standards. Educational planning and administration was decentralised to the provincial and municipal authorities, and governmental regulation cut back.

The effort to provide education for the masses was accompanied by a shift to a stronger emphasis on political training, with the aim of giving students and teachers an enthusiastic "proletarian viewpoint" which was both "red and expert" (Glassman 1977, 282). This new political consciousness was meant to be instrumental in erasing divisions between mental and manual labour, and was seen as an important part of developing new educational approaches which combined technical study with practical productive labour. All schools, at all levels, were instructed to involve their students in labour, to list productive labour as a formal course and to relate labour in all possible ways to academic work. Schools were directed to set up factories, and communes were told to set up schools (Glassman 1977). This policy had the added benefit that schools could generate their own incomes and thus reduce their need for state funds. Part-time education was massively expanded all over China. An entirely new type of school was established, to be run by production units on a half-work, half-study basis. These were intended to be entirely self-supporting.

The movement within science which accompanied the Great Leap Forward was deemed to be a "technological revolution" that would follow the "course of the masses" (Suttmeier 1970, 163). With previous efforts to maximise the potential of the elite scientists seen as only partly successful, the Party determined to unleash the scientific creativity of the populace at large. This instigated a period in the history of Chinese science-society interaction which might be termed an experiment in total engagement. The new Mobilization Model on which this policy was based completely embodied contemporary Chinese communist ideology with regard to scientific development and the role of science in society. Its main principles have been summarised by Suttmeier (1975, 219):

1. Scientific development is a function of social and economic factors external to science itself
2. Knowledge is the product of the unity of theory and practice
3. Science must serve production
4. The ultimate source of discovery and verification within science rests with the labouring masses
5. Science can be, and must be, led by the CCP, the representative of the masses
6. The establishment of a unique Chinese scientific tradition rests with the younger generation of scientists who must be prepared to rebel against the older generation if necessary

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The Mobilization Model underpinned the vision of "mass science" pursued by the CCP during the Great Leap years. This vision was one of a mutually beneficial partnership between science and society which seamlessly fused pragmatism and ideology. One of its most authoritative and clear definitions was provided by Yü Kuang-yüan, Head of the Science Division of the Propaganda Department of the Central Committee, writing in the CCP periodical *Red Flag* (Hung-Chi) in 1960:

> When we stress mass movements in scientific and technological work, we mean only to emphasise the need to mobilise the masses, and our opposition to any attempt to play down the positive and creative significance of the liberation of thought and the destruction of superstitions in the scientific and technological work… We always believe that the technical knowledge of the specialist is indispensable to scientific and technical research. This usefulness of specialists must be brought into full play… What we oppose is that the specialists… keep themselves away from the masses and stay outside ardent mass movements…
>
> (Yü Kuang-yüan, 1960, cited in Suttmeier 1970, 165).

Kuang-yüan went on to list specific contributions made by the masses to science in the late 1950s, which included gathering meteorological, geological, hydrological and biological data from around the country. Throughout, the main thrust of his argument was that encouraging total engagement would benefit science and citizens equally, contributing toward a series of "breakthroughs" in the construction of the new China. He argued that mass involvement in science would not just produce valuable scientific outcomes but would also serve to finally demystify science and undermine the negative aspects of its status as an elite pursuit. This would in turn pave the way for an outburst of creative scientific and technological activity in an atmosphere where "the unlettered would no longer be overawed by the 'expert'" (Suttmeier 1970, 166). The unleashing of "mass science" would also be the final stage in transforming the attitudes of the old guard of foreign-trained scientists, their contact with the people re-orienting them away from viewing American and European "bourgeois science" as their model.

Peasant Inventors, Worker-Origin Engineers and the "Two Participations"

Across the nation, the range and distribution of research activities increased hugely, as China began the wholesale transformation which was to result in its modern status as an "innovation nation… able to stand with the US and other leading nations as an equal partner" (Aldhous and Huang 2007). In 1958-9 more than 3m new small factories were created in the rural areas of China (Reiitsu 1979). About 20,000 of these were run by the people's communes themselves, while others were administered by the Counties. As important loci of regional change and learning, these factories contributed to a "flowering of science and technology in rural areas" (Reiitsu 1979, 210) by training around 1million new technical personnel. The vast majority of these newly-skilled workers came from low-literacy and non-technical backgrounds. For example, the Xuguangyi People's Commune in Hubei province appointed nine technological leaders from among their ranks who were sent to work and learn in new factories in Hankou and Echeng. At the same time mechanics, carpenters and blacksmiths from nearby factories, foundries and shipyards were sent to work with the peasants in the commune. One famous 'peasant inventor', Xio Gong-Zi, worked in cooperation with a student from Wuhan to produce conveyor belts, motorised sailing boats and milling machines. He was subsequently held up as a model in the Commune's campaigns to encourage others to learn technical skills. By 1958, 58 members of the Xuguangyi Commune were honoured as having mastered a range of such skills (Reiitsu 1979). In Jiangxi province, around 1m workers and peasants are said to have studied science and conducted rudimentary experiments.

It appears that some of the key initiators of the construction of industry at the local level during the Great Leap Forward and in subsequent years were the workers and peasants inducted into the many large-scale infrastructure projects initiated during the late 1950s. Large sectors of this new workforce eagerly seized the training opportunities presented to them on these projects. For example, in Shanxi, where around

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3m workers participated in waterworks construction, it is claimed that around 90% enrolled in on-site literacy and technology training (Renmin Ribao [The People's Daily] 1960, cited in Reiitsu 1979).

During this period workers also started to enter higher-level management and technical groups within the urban and rural factories, as indicated by the newly-coined title "worker-engineer" (*gongren gongchengshi*). This reorganisation within the rapidly expanding industrial base was carried out according to a set of principles enshrining the new approach of the CCP to managing technical-industrial expansion. This was usually summarised under the rubric of "the two participations, one reform and the triple combination". The two participations were (1) participation of workers in management and (2) participation of committed Party members (cadres) in productive physical labour. The triple combination was that of workers, scientist-technicians and managers working together in groups to solve specific problems in the production process (Reiitsu 1979). This meant that while workers and skilled peasants were being trained and promoted in agriculture and industry, existing scientific and technical personnel were taken out of the laboratories and sent to work alongside peasants and factory hands.

By 1959 the Academy of Agricultural Science alone has established around 7, 690 Commune Research Institutes or Experimental Stations where one or two trained scientists or engineers worked alongside local communities to improve agricultural and industrial production. The February 1960 edition of *Renmin Ribao* reported that Wang Bao-Jing, 28, leader of Fenghuo People's Commune, Lichuan County, Shenxi Province had begun to attend the Northwest Agricultural College. In the Chinese context, this event was remarkable enough in itself; even more than ten years after the revolution, a peasant attending college was still a rare and newsworthy happening. Wang Bao-Jing had been born into a poor peasant family, and his entire formal education consisted of six months attendance at primary school (Reiitsu 1979). Indeed, prior to the revolution no a single person in Wang's village had ever graduated from higher primary school. What makes the story even more remarkable, however, are Wang Bao-Jing's achievements prior to his belated re-entry into education, achievements which led to him frequently appearing in the Chinese press throughout 1959-60 as the epitome of the class of '"peasant scientist" associated with the innovations in science-society interaction made during the Great Leap Years.

At a time when the average corn yield in his village was a little over 224 kg per 10 acres, Wang Bao-Jing undertook plant breeding experiments which reportedly resulted in a 300% increase in productivity. At the same time he created several different varieties of wheat and a new strain of cotton (Reiitsu 1979). In 1955 the North-West Agricultural College began to send scholars to study the methods of the Fenghuo Production Brigade while also attempting to introduce the Brigade to new scientific ideas in agriculture. On three occasions in 1958, the college invited Wang Bao-Jing to lecture their students on corn breeding, and-in a move which exemplifies the changing locus of power in science and technology during the period under discussion-in May 1958 Wang was also appointed as a special researcher at the Shenxi branch of the Agricultural Academy. The admission of successful "peasant scientists" and "worker-origin engineers" to membership of academic organisations and research centres was seen as a means both of rewarding innovation among the masses and further undermining elite scientists' and engineers' efforts to create a professional research culture based on the Western model of "science for science's sake".

During the Great Leap years "worker engineers" came to comprise more than 10% of all engineers in China, many of whom were involved in the design and implementation of products and processes. However, although the adoption of the "triple combination" in state-run factories was meant to pave the way for worker participation in technical management, the question of where decision-making power should lie was often difficult to resolve. Workers frequently lacked the confidence to assert themselves in planning sections. A typical example is that of Shou Gui-Fu of the Shanghai Machine Tools Factory (reported in Reiitsu 1975, 217-8). Originally an unskilled cleaning worker, Shou was transferred to the cogwheel section in June 1954, quickly becoming a skilled worker, rising to section head and then workshop director. However, when Shou was transferred to the planning section he found himself in the company of older technicians against whose experience and formal education he was made to feel inadequate, under-confident and an outsider. This illustrates that although in principle workers like Shou could now take an equal place in decision-making, in practice it was the specialists who still set the

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standards and exercised what Reiitsu (1975, 218) calls "technological sovereignty". Similarly, workers involved in the new "workers universities" set up during this period were repeatedly reported to be in clashes with academics and other students-clashes which might be judged as contributing toward the ruthless persecution of intellectuals that just five years later was such a feature of the Cultural Revolution.

After the Great Leap-Consolidation and Rationalisation

The Chinese Communist Party's attempt to implement a radically new approach to science, science education and science communication in the Great Leap Years formed a relatively minor part of a massive and often cruelly inhuman experiment in social re-engineering. Between 1961 and 1966 reforms were enacted on a scale and at a pace which almost defy description. It is perhaps wholly unsurprising that, given the levels of ambition and coercion involved, with hindsight there appears to have been "inadequate preparation, implementation and anticipation of consequences" (Suttmeir 1975, 220). The full, terrible cost of these years is only now becoming evident (see Chang and Halliday 2006 for one recent account); what does seem clear is that the Great Leap Forward took China to the brink of total social disintegration. And, despite the efforts outlined above there continued to be a critical shortage of research personnel at all levels of the emerging Chinese scientific establishment (Lindbeck 1961).

In the period of retrenchment and stabilisation which followed, the Great Leap Mobilization Model of science organisation was superseded by the more conventional Soviet style of management, which had continued to develop throughout the Great Leap Years. A large number of the new commune factories were closed as inefficient, and many of the new local technical personnel they had employed returned to their former occupations as peasants and labourers (Reiitsu 1975). After-work and part-time schools were shut down and the expansion of local and regional research centres was halted. Administrative regulations for research establishments were revised to emphasize stability, effective reporting and the improved management of resources. The number of workers and peasants involved in scientific research dwindled rapidly. The 'professional-bureaucratic' model once again became dominant, and remained relatively stable for the next four or five years.

During this "readjustment period" the dominant trend was toward re-establishing the authority of the formally educated engineers and scientists. However, many of the young technicians and farmers who had emerged from the "mass science" movement continued to play a critical part in the modernisation and expansion of the Chinese economy. One factor underpinning this continuing influence was the rapidly deteriorating and increasingly confrontational relationship between China and the Soviet Union, a situation further exacerbated by the lack of full diplomatic and trade relations with the technologically-developed capitalist nations. Under these circumstances, many of the new class of worker-engineers and peasant inventors played leading and critical roles in some of the truly astounding achievements of Chinese agriculture and technology in the early 1960s. Reiitsu (1975, 219) cites three specific cases in which "working class technicians" took the lead: the development of the Daqing oil field; manufacture of a record-breaking 12,000 ton oil press; and the construction of Shanghai's Wuqing fertilizer plant, which became an important national emblem of projects designed and built with domestic resources and expertise.

Science and Society in Modern China

Since 1949 Chinese science, engineering and technology have expanded relentlessly. In 2007 China has a population of around 1.3 billion, with an active labour force of approximately 798m, of whom some 31% work in the service sector, 45% in agriculture, and 24% in industry. China has nuclear power, a successful space programme, a huge manufacturing base, and burgeoning information technology and pharmaceutical industries. More than 75% of those eligible are enrolled in school (Middleton 2007). Contemporary China is a nation led by technocratic political elite, many of them "red experts" who received their training during

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the period of the late 1950's and early 60s discussed here. The presence of scientists and technologists at the heart of government-the President and Premier of the PRC being an engineer and geologist respectively-stands in stark contrast to the situation in most Western countries where lawyers dominate the political establishment (Suttmeir, 2007).

Some commentators (*e.g.* Reiitsu 1975, Dongping, 2006) have suggested that a substantial part of China's transformation into an industrial superpower was achieved in early 60s by 'worker-technicians' (especially in the oil and chemical industries) and by "peasant-scientists" in agriculture, and that the dynamic presence of these individuals was only made possible by the rethink of the relationship between Chinese science and society embodied in the principles of the Mobilization Model. In considering these claims it is instructive to compare Chinese successes in establishing an economy substantially based on science and technology with developments in the former Soviet Union over the same period (see e.g. Graham 1993, Volkogonov 1999, Dezhina & Graham 2002).

However, it is again important to note that these radical initiatives in science-society interaction were part of a huge, often intensely tragic socioeconomic upheaval which was perceived by many at the time as having brought the fledgling Chinese communist state to the brink of disaster. As has been briefly sketched out above, the Great Leap years were followed by a period of retrenchment and revision, as it became clear that many of the policies set out by the CCP during the years 1957-61 had been either impossible to implement or produced unforeseen, often disastrous outcomes. After a brief period in which the "professional-bureaucratic" model was again dominant the Cultural Revolution of 1966-71 gave rise to a modified version of the radical approach which Suttmeier has dubbed the "mobilization model II". This model was influential until at least the late 1970s. Since then, both as a result of Deng Xiaoping's economic reforms (known as the "four modernisations") and the increasing influence of globalization, modern Chinese science and technology policy has moved ever closer to Western models. In 2007 the implementation of scientific research and education in China is once again very much "top-down" and "professional-bureaucratic" in nature; while CCP policy-making strongly relies on scientific evidence and expertise, the government retains tight, classically totalitarian control over information. Some critics claim that this trend has resulted in Chinese science becoming tangled in a web of bureaucratic and commercial interests which weaken prospects for creative science and open the door to misconduct (Fisher 2007, Suttmeir 2007). At the same time the Great Leap Years, for a long period held up both inside and outside China as an unmitigated disaster, are now under re-evaluation; as indeed are the tragedies and achievements of the whole Maoist era (see *e.g.* Chang & Halliday 2006, Dongping, 2006).

Discussion

For much of the Twentieth Century the various economic, political and cultural arguments advanced in support of efforts to promote civic "scientific literacy" in the Western industrialised nations have tended to be broadly "science-centred", inasmuch as they frame the relationship between science and society in terms arising from, and consonant with, the definitions and outlooks of scientists and scientific organisations themselves. As Irwin (1995, 18) notes, there has rarely been any suggestion

> …that science is open to change or should incorporate citizen views within science policy… science itself is not the problem-the problem is gaining public understanding and hence acceptance of science.

Science-society interaction programmes have accordingly often aimed (at least in part) as much at engendering public appreciation of, and support for science as they have at promoting genuine understanding or engagement. Frequently "deficit models" of knowledge transmission through education and information campaigns have been seen as the most viable means of encouraging such appreciation. In recent years, by highlighting the dialectic between "enlightened" and "critical" approaches to the relationship between science, democracy and citizenship researchers such as Irwin (1995, 1997, 2001) have

Harris S. R, and Thiessen, C. (2008) Experiments in Total Engagement: Science-Society Interactions in the People’s Republic of China, 1949–66. In Bell A, Davies SR, and Mellor F. 2008. Science and its Publics: Following Scientists into Popular Culture (pp. 37-56). Cambridge: Cambridge Scholars Publishing. ISBN: 1-84718-588-6.

paved the way for the emergence of a new reflexivity within science communication and policy-making, evidenced in the UK in a series of official reviews and reports (e.g. Royal Society 1985, House of Lords 2000; OST 2000, POST 2001, OST/MORI, 2005). This process has been accelerated by the publication of results demonstrating only marginal improvements in scientific literacy levels in Europe and the US despite large-scale investment in education and outreach programmes (see *e.g.* Miller 2004, Bauer *et al* 2007).

These developments have led to calls for new modes and models of science-society interaction, often accompanied by the suggestion that they should be based on an “interactive” approach to science communication in which scientific knowledge is seen as less fixed, and where the emphasis is less on a top-down flow of information and more on facilitating and improving communication between scientists, policy-makers and citizens (Einsiedel and Thorne 1999). This view was expressed in 2000 in an influential report from the UK Office of Science and Technology in the following terms

> At present, the main issue in science communication policy is how best to develop a dialogue between scientists, policy makers and the public, and to bring public opinion into the development of policy.

However, as various critics have noted (e.g. Logan 2001, Bauer *et al* 2007), there is as yet little firm evidence to suggest whether or not such strategies have any greater or different impact than more traditional approaches.

As has been outlined in this chapter, under the Mobilization Model of Mass Science, ordinary Chinese citizens were not only allowed, but encouraged to engage in research and innovation directly related to their labour in the fields and factories. New links were forged between academic, vocational and basic education, and between education, research and the workplace. These initiatives produced an entirely new level of direct contact, dialogue and collaboration between the public and scientists and fostered a programme of science and technology education and engagement with few parallels in recent history. With the industrialised nations of the world now facing the inconvenient truth that in order to survive and grow they must find ways to make their own “great leap” beyond the carbon economy into a new and more sustainable way of living on the planet, there may useful lessons to be learned from these experiments in “total engagement”.

Over the past thirty years or so there have been some radical, non-science-centred approaches to science-society interaction developed in the West, most notably in Europe and North America where networks of Science Shops and Community-Based Research Centres have been established with the aim of putting science into service for community groups and activist organisations (Leydesdorff and Ward 2005, Sclove 1995). One notion frequently invoked in this context is that of a “civic science” which articulates and illuminates science content in the light of societal issues (Schneider 2000; Kruger and Shannon 2000). However, in the West the predominant focus is still on citizens “actively learning about the scientific information that affects them and their communities” (Clark and Illman 2001, 12) rather than Alan Irwin’s more radical notion of the *citizen scientist* as an active contributor to the shaping, conduct and evaluation of scientific research programmes (Irwin 2005). In seeking to make rapid, radical and wholesale changes in China, the CCP were willing to put their trust in people with relatively low levels of formal schooling, encouraging them to undertake intellectual and technical tasks conventionally considered to be the sole and rightful province of professional scientists and engineers. The history outlined above suggests that these tactics were, at least in some part, successful. Faced with the challenge of mitigating and adapting to the impacts of anthropogenic climate change, both the developing and developed nations of the world may be forced to consider similarly radical strategies.

Notes

1. This chapter began life as a short essay by Claudia Thiessen, *An analysis of the CCP's Policies to Improve the Scientific and Technological Standards of the PRC from 1955 to 1960 and their Impact on Science Communication*.

Harris S. R, and Thiessen, C. (2008) Experiments in Total Engagement: Science-Society Interactions in the People's Republic of China, 1949–66. In Bell A, Davies SR, and Mellor F. 2008. Science and its Publics: Following Scientists into Popular Culture (pp. 37-56). Cambridge: Cambridge Scholars Publishing. ISBN: 1-84718-588-6.

The essay was written during the period November 2006-January 2007, under the supervision of Dr. S. R. Harris (SRH), while Claudia was undertaking a Masters' degree in science communication at the University of Glamorgan, Wales. Claudia presented this work to the annual University of Glamorgan Student Science Communication Conference in March 2007. Shortly after this event she was diagnosed as seriously ill, and returned to her native Germany for hospital treatment. Over the following months the original essay was revised and expanded by SRH in preparation for its joint presentation by the authors to the conference 'Science and its Publics' at Imperial College, London, on 19th May 2007. In the event Claudia was much too unwell to attend the conference; after a brave struggle, she passed away on September 1st 2007. The chapter in its current form contains additional materials arising from research undertaken by SRH in the months following Claudia's death. It is respectfully dedicated to her, in memory of an outstanding student and inspiring collaborator.

2. This chapter employs the terms "Western" and "the West" to indicate the technologically advanced capitalist countries-as opposed to China, the Soviet Union and the other Eastern Bloc countries-and so should be understood as including not only the US and Europe but also Scandinavia, Australasia, Japan, etc.

3. For an extensive and detailed description of the implementation of a second, somewhat different version of the mobilization model during the period of the Chinese Cultural Revolution see Suttmeir 1975, 225-236.

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