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The Chinese developmental state during the Cold War: the making of the 1956 twelve-year science and technology plan

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ABSTRACT

In 1956, the government of the People's Republic of China made a 12-year plan for scientific and technological developments ('The Long-term Plan for the Development of Science and Technology for 1956–1967'), often credited as a visionary blueprint for its nuclear weapons programs and industrialization. Yet, this study suggests that the plan was not the logical manifestation of a unified national leadership, but rather the result of political contestations and compromises among the Communist party-state leaders, especially between Mao Zedong and Zhou Enlai, and between the state and the scientific–technological elite. It further indicates that the making of Chinese science and technology policy was shaped by the cold war geopolitics, national developmental aspirations and transnational influences, especially from the Soviet Union and the USA.

KEYWORDS

1956 12-year science and technology plan of China; nuclear weapons; Mao Zedong; Zhou Enlai; the cold war

In January 1955, V. A. Kovda, a Soviet soil scientist who was serving as the chief advisor to the president of the Chinese Academy of Sciences in Beijing, delivered a report to the academy on 'Some Measures for the Planning and Organization of Chinese National Scientific Research Work.'[1] A chain of events then ensued which led to the making, in late 1956, of an ambitious and influential 'Outline of a Long-Term Plan for the Development of Science and Technology, 1956–1967,' commonly known as the 12-Year Science Plan. It functioned not only as a detailed guide for the development of science and technology in China, but essentially a blueprint for the next stage of Chinese industrialization and its incipient nuclear weapons programs. Institutionally, it led to the establishment of the State Science and Technology Commission, now the Ministry of Science and Technology, the leading arm of science and technology policy-making in China. Perhaps, most importantly, the plan served as the basis for a new phase of large-scale Soviet technological aid to China. In other words, the 1956 plan helped make science and technology a key part of nation-building and state formation in the People's Republic of China.

Yet, as a pivotal milestone in the development of the Chinese developmental state, the 1956 science plan was not the natural and logical manifestation of a unified and visionary national leadership, as it is often portrayed, especially in standard accounts within China,

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but rather the result of political contestations and compromises among clashing undercurrents that had existed before its making and would soon resurface with a vengeance to dog its implementation.[2] Tensions existed both within the party-state leadership and between the state and its scientific and technological elite, many of whom had been trained and had returned from the West. At stake were issues over whether the party-state could or should trust the Western-trained or Western-influenced scientists and engineers to be loyal Communist builders? What should be the proper relationship between scientific research, technological developments and fulfillment of practical needs of the state? Not unlike in the USA, there were constant debates in China in this period over the priority of basic vs. applied research, which often went under the label of 'how to relate theory to practice,' and also on scientific professional autonomy vs. state mandates.[3] Most importantly, the making of the science plan reflected conflicts within the party-state leadership over the appropriate developmental strategies and their political implications in the form of a rising tension between a technocratic approach and one based on revolutionary mobilization that would soon come under the labels of mass science and people's science.[4] Thus, a focused study on the 1956 science plan helps us better understand the political economy of Chinese science in this period.

Additionally, the 12-year science plan illuminated the crossing of two powerful impulses in the post-World War II international geopolitics: the East–West cold war rivalry dominated by the American and Soviet superpowers and the developmental aspirations of newly emerging nation states, as elaborated in the editors' note for this special issue. Science and technology have been at the center of both currents, but existing literature in the history of science and technology as well as cold war and developmental studies, my own included, have generally separated the two in a way that masked the intimate connections that existed between them.[5] A detailed examination of the making and impact of China's 12-year science plan thus provides an opportunity to explore such linkages and what they reveal about the complex interactions of science, technology, international geopolitics and national determinations, especially how the above tension over technocratic vs. mass revolutionary approaches was related to divergence among Chinese leadership over the necessity, in the late 1950s, of continuing to learn from the Soviet Union and rely on its technological assistance. It also helps to shed light on the transnationality of modern science and technology: the plan pivoted not only on critical Soviet assistance, but also on the employment of a mainly Western-trained, especially American-educated, elite scientific and technological work force.

Toward planned science

To begin with, the idea of planning of science itself was part of a transnational scientific and political debate that perhaps most prominently originated in the Soviet Union and Great Britain in the early 1930s and picked up soon afterwards by Chinese scientists, still under the rule of the Nationalists. They debated the desirability and feasibility of planned science, as well as the proper balance between state planning and scientists' flexibility and between basic and applied science. As the Chinese historian Fu Banghong has shown, at least in the case of the Academia Sinica, which was established by the Nationalist government in 1927 as the official central organization of scientific research and where many of the country's leading scientists worked before the Communist take over of the mainland in 1949, the

pressure of the Sino–Japanese War of 1937–1945 gradually led to an acceptance of the need for state-planned science to serve national practical applications, although it was still possible for some scientists to maintain some degree of autonomy to pursue basic science. In 1949, the headquarters of Academia Sinica was relocated with the Nationalist government to Taiwan, but most of its institutes stayed in the mainland and became the basis for the new Chinese Academy of Sciences. Thus, the Communist government inherited not only a research infrastructure but also a scientific community dominated by an elite who were Western educated but who chose to stay on the mainland and who were already sympathetic to leftist ideas such as the planning of science.[6] In contrast to many of their counterparts in the West, these Chinese scientific leaders actually called for national planning in the early years of the People's Republic of China as a way to strengthen scientific research. The most influential one came in June 1955 when prominent scientists who had just been honored with membership in the newly established and prestigious CAS Academic Divisions called for the making of a long-term national science plan.[7]

But, as the Communist leader Mao Zedong himself acknowledged in 1955, the Chinese party-state was preoccupied with other priorities – such as the Korean War and revolutionary political reforms at home – to attend to the issue of scientific and technological development or industrialization. Perhaps even more importantly, Mao and a number of other party-state leaders distrusted politically the scientific and technological elite that the PRC inherited from the Nationalists or even those Chinese scientists the new government had beckoned to come back from the West. One indication of such political distrust of the scientists was the fact that during the first few years of the PRC, the mandate from the government to the Chinese Academy of Sciences focused mainly on solving mundane production problems and often harsh ideological reforms.[8] In those days, as a 1998 official biography of Zhou Enlai put it, intellectuals were viewed by some as dissidents [*yiji fenzi*], to be suppressed and attacked.[9] During the 'Thought Remolding' (*sixiang gaizao*) movement of 1951–1952, amidst the ongoing Korean War, the party intensified its campaign to pressure scientists and other intellectuals into political loyalists. Mao, who had always recognized the practical utility of science and technology but whose distrust of intellectuals can be traced to his early days as a library assistant at Beijing (Peking) University in the late 1910s, decreed on 23 October 1951 that 'thought remolding, especially the thought remolding of various intellectuals, is one of the critical conditions for achieving thorough and all-around democratic reforms and gradual industrialization of our country.'[10] As the historian Laurence Schneider concluded from his study of Lysenkoism in Maoist China, what irked Mao the most about the scientists was the idea that 'the self-contained authority of a cosmopolitan science community posed a threat to the authority of Mao's Communism.'[11]

In contrast, moderate and pragmatic leaders such as Premier Zhou Enlai and two of his close associates, Marshal Chen Yi and Marshal Nie Rongzhen, were more sympathetic toward the scientists and other intellectuals. All three had spent time in France in the early twentieth century and Chen and Nie were successively placed in direct charge of science and technology policy under Zhou during the Mao years. Frequent foreign travels by Zhou and Chen, the first and second foreign ministers of the PRC, probably also contributed to their appreciation of the increasing importance of science and scientists in the modern world.[12] Even before 1949, Zhou had cultivated extensive connections with scientists and other intellectuals when he headed the Communist Party's southern bureau during the War of Resistance against Japanese Invasion (1937–1945) and the civil war (1945–1949).[13]

A number of scientists who were underground party members had actually gone to the USA to study science and technology with the support of the southern bureau and would, after 1949, not only return to China themselves but also bring others with them.[14] Thus, in his well-known speech on 29 September 1951 at the beginning of the Thought Remolding campaign, Zhou Enlai used his own experiences to articulate the necessity for intellectuals to undergo political transformation, but he did it in a tone that was encouraging and understanding and gave them credit for their patriotism.[15]

Such differences over political assessment of scientists and other intellectuals would widen in the years to come, but in the early 1950s, the argument for intellectuals to undergo drastic 'remolding' in order to achieve national developmental goals prevailed throughout the party. What had in part triggered the campaign was the widespread resistance of professors to the government's move to restructure most Chinese colleges and universities into narrowly focused technical institutions according to reputed Soviet models.[16] As can be expected in a one-party political system with little respect for due process, Thought Remolding soon got out of control at the hands of zealots at the local level. Heavy-handed measures such as shaming sessions ('Criticism and Self-Criticism') were often deployed where senior scholars, such as vice presidents of the academy Zhu Kezhen (meteorologist), Wu Youxun (physicist) and Tao Menghe (sociologist) were denounced by their junior associates and former students.[17]

Newly discovered sources revealed higher levels of psychological and physical violence in the CAS, which was dominated by political suspect Western-trained 'bourgeois scientists,' than earlier thought. In the academy's Shanghai branch, for example, Liu Dawei, a senior chemist, his wife and two workers were driven to suicide in 1952.[18] In Beijing, Zhu was forced to confess his sins, such as his desire for upward social mobility, his reliance on old personal relations (termed 'clique-ism') and, most dangerously, his 'worshipping of America.'[19] While he ultimately survived the process, his friend Wu could barely stomach it any more. On 10 April 1952, Zhu recorded in his diary:

> I met Zhengzhi [Wu's scholar name] at noon, learning that because of the Thought Remolding campaign, he had several times contemplated committing suicide by hanging himself from the ceiling at home, having already gone out and bought a rope. Fortunately his wife came to join him yesterday, which led him to confide in her all his internal struggles and also reluctantly reveal them to us at noon today. Both I and Menghe tried to convince him not to seek such an extreme solution, because the Thought Remolding campaign is meant only to scratch up faces to reveal true identities [*zhuapo lianpi louchu zhenxing*]; it's not to destroy [*dadao*], but to unite [*tuanjie*] [its targets].[20]

Zhu's statement was not purely comforting words to a friend to prevent a tragedy, but an astute observation about the intention of the new party-state to transform intellectuals into loyal and useful tools, and further a coping mechanism for scientists like himself to survive in face of the new political and ideological reality. In the end, the suicides in Shanghai and elsewhere and Wu's attempted suicide helped alert the party leadership about the excesses in the movement and lead to its moderation before its end in late 1952.[21]

What lay behind the party-state's neglect of the CAS and distrust of Chinese scientists was a belief by Mao and other leaders that China could rely on Soviet technical assistance to accomplish both the cold war and developmental technological goals.[22] 'Rely on the workers for production and on Soviet experts for technology,' urged a popular saying within the party, excluding any significant role for the scientific and intellectual elite it inherited

from the Nationalists.[23] In 1950–1955, China signed agreements with the Soviet Union for the construction or reconstruction of 156 major civil and military industrial projects that became the infrastructural foundation of the PRC's economic development and defense buildup.[24] Indeed, one could argue that while the Sino–Soviet geopolitical alliance was an over-determined outcome, the Chinese Communist party-state's developmental objectives played an important role in what Mao famously called the 'Leaning to One Side' policy of siding with the Soviet camp during the early stage of the cold war. As Mao wrote in the *People's Daily* on 1 July 1949, China had to ally with the Soviets because the West would never give assistance to the new China and 'we belong to the Soviet-led anti-imperialist unified front and we can only seek truly friendly assistance from this side.'[25] Conversely, China's international alliance shaped its developmental goals and strategies in that reliance on Soviet aid gave it little incentive, in the early 1950s, to launch any serious attempt to mobilize its domestic scientific resources and make comprehensive scientific planning, especially given the relative weak technical manpower and a scientific elite it did not trust politically. On their part, many in the scientific community felt confused and disheartened about the new government's science and technology policy, quite apart from the overt political campaigns. As Fu Ying, a leading chemist at Beijing University who had returned from the USA in 1950, recalled in 1956, between 1950 and 1954, he was unable to engage in any research and afterward he was encouraged and supported to conduct research but frustrated 'because the direction of efforts was not clear.'[26]

In the end, Kovda's proposal, which was endorsed and transmitted by the academy to the top party-state leadership, did form an important step toward the launching of a massive effort to make a plan for science and technology. On 22 April 1955, the highest ranking Politburo of the party met to discuss the Kovda proposal and the accompanying report by the academy. Liu Shaoqi, the presiding party leader (Mao and Zhou were out of town), called the Kovda proposal 'very important and deserving attention.' He then ordered the State Planning Commission, the academy and other relevant agencies to make specific suggestions on implementing the proposals. In July 1955, Li Fuchun, chairman of the Planning Commission, wrote to the leadership of the academy urging it to take the lead in the making of the science plan, which then led to the making of the academy's own 15-year plan. Soon, a Group on the Planning of Scientific Research was established under the State Council which gathered more than 200 scientists and engineers in Beijing in December 1955 to start discussions on items to be put under a 12-year national plan for science and technology.[27]

In determining the ultimate shape of the 12-year science plan, perhaps even more important than these Kovda-inspired bureaucratic forward motions was the decision by the Chinese party-state leadership in early 1955 to embark on its nuclear weapons programs. Thus, even though neither the Kovda proposal nor the academy's report endorsing it mentioned national defense, that clearly was the key motivation in the central government taking up the call for a national effort to plan for scientific and technological developments in 1956.[28]

Yet, to ascribe the impulse for the making of the science plan solely to nuclear weapons and the cold war objectives misses the complexity of national science and technology policy as well as international geopolitics. First of all, it should be pointed out that the nuclear weapons projects were motivated by more considerations than military necessity. National prestige, for example, played a key part in the Chinese pursuit of nuclear weapons and spoke to the broader national aspiration for independence and self-determination in the context

of both perception of historical entitlement and the reality of international geopolitics. In 1955–1956, when China launched its atomic bomb project, Mao actually did not think that the world would see the coming of a major war or that China would face imminent danger of invasion by the USA for a decade or so. For example, in January 1956, Mao mused to a gathering of top party-state officials ('Conference on the Issue of the Intellectuals,' more later) about war and peace:

> Is it possible that we will have 12 years' time to complete socialist reform and basic industrialization? It appears so given the current situation. Of course, it is possible that a crazy might appear and create chaos in the world. This possibility must be taken into consideration. Our work must be based on the possibility that he might launch an early surprise attack. Thus our work needs to speed up a bit: we should push socialist reform and industrialization, as long as they are feasible and realistic, rather than adventurous or aimless. The sooner these can be accomplished the better, the more advantageous for us.[29]

Two days later, Mao told a delegation of Yugoslavia journalists that he believed 'it is possible that peace will be maintained for ten years.'[30] This expected decade of peace would, Mao further believed, be helped if China developed the atomic bomb. For example, at a high-level meeting of the party-state leaders on 25 May 1956, Mao announced that:

> National defense is indispensible. We are already stronger than before, and will be stronger still in the future. We shall have not only more aircraft and canons, but also atomic bombs. In today's world, if we don't want to be bullied by others, we will have to have this thing.[31]

Then, in a meeting with the North Korean leader Kim Il-Sung on 21 May 1960, Mao further expounded on the deterrence effects of nuclear weapons not only by China but by others as well: 'We should all try to make atomic bombs in order to create the condition to possibly deter wars.'[32] Thus, Mao and other leaders pushed for the making of long-term 12-year plans in many areas of national economy and defense, such as agriculture, atomic energy and soon science and technology, within this expected window of peace and also to coincide with the end of the expected third 5-year plan.[33]

In view of this sanguine assessment of the world situation and China's security environment, Mao and other leaders had moved development, along with national security, to the top of national planning in 1955–1956. Buoyed by the surprisingly fast rate of national socialist reformation of existing sectors of the economy – agriculture, industry and commerce – the party-state set socialist construction, especially industrialization, as the highest priority in this period. The two goals – development and positioning China well in the cold war – were of course not necessarily conflicting with each other. For example, at a gathering of representatives of the so-called Chinese 'national capitalists [*minzu zibenjia*]' on 29 October 1955, Mao presented a promising future for the country by arguing that through socialist measures such as the nationalization of their factories, industrialization would accelerate, China could hope to catch up to the USA, and Chinese national security would finally be guaranteed:

> Our goal is to catch up with America, and to surpass it…. Exactly how many decades would this take depends on everyone's efforts. At least fifty years, perhaps seventy five years. Seventy five years means fifteen five-year plans. We will finally breathe easily when we can catch up and surpass America.[34]

Indeed, the goal of industrialization was soon codified, especially in the first 5-year plan (1953–1958) that was finalized in 1955, and in the resolutions of the eighth party congress

in 1956 which significantly made economic development, rather than class struggle, the central focus for the party.[35]

The impetus for the 12-year science plan also derived from lessons learned from the earlier experiences of industrial development based on the Soviet model and with Soviet assistance. During the first 5-year plan, the Soviet Union helped China initiate, as mentioned above, 156 large, heavy industrial plants in China which would constitute the backbone of Chinese industrialization. Yet, the discussions with Khrushchev and internally, beginning in the mid-1950s, about the needs that would arise from the atomic bomb project led Mao and other leaders to realize that China would need to develop science and technology in general, not just heavy industry, and that China would ultimately need to rely on its own scientific and technological personnel to carry out both the nuclear weapons projects and the general industrialization. For example, at a meeting with the Polish ambassador to China on 31 October 1956, Mao said that

> we are paying more attention to agriculture and light industries. We should not devote too much to heavy industries. The Soviet Union may not have done the right thing by sacrificing light industries and agriculture for the sake of heavy industries.[36]

Thus, in this over-determined causal context, a comprehensive national plan for scientific and technological development became the logical choice and would serve multiple purposes: it would enable China to assess its current strengths and weaknesses in science and technology, to see the gaps with the scientific state of the art in the world, to set up a national coordination system, to draw on Soviet assistance in terms of planning for the contents and institutions of science and technology and, perhaps most importantly, to use it as a blueprint to gain further Soviet assistance.

The Conference on the Issue of Intellectuals

Finally, the issue of science planning gained public attention when Zhou Enlai mentioned the urgent need in this regard in a high-profile 'Address on the Issue of Intellectuals' on 14 January 1956 at a high-level 'Conference on the Issue of Intellectuals' in Beijing. The conference itself was a key step in improving the political status of scientists and other intellectuals in order to mobilize them and the country for the projects to build atomic bombs and guided missiles in particular and for industrialization in general. Such a positive move came as the result of a rare, and as it turned out, brief, softening of Mao's views on the political standing of the intellectuals in light of both international and domestic developments. Even though Zhou Enlai was the one who had originally proposed the initiative to solve the 'problem of the intellectuals' by improving their official treatment, Mao's endorsement of the idea was crucial.[37] Mao asked that the party hold a major conference on the issue. Having been buoyed by the faster pace of the socialist reform (nationalization) of existing capitalists, Mao now suggested that intellectuals had been 'remolded' better than originally thought and that they could be utilized more, especially through 'comprehensive planning.'[38] For Mao, planning would not only serve to rationalize development but also serve the critical political objectives of enforcing party control of science policy and continuing the ideological transformation of intellectuals. As he told a gathering of scientists and science administrators in March 1957, 'the party can exercise leadership [*lingdao*] in science through planning.'[39]

The centerpiece of the conference on intellectuals was Zhou's address, which was drafted by Hu Qiaomu, one of Mao's secretaries and a deputy director of the Propaganda

Department of the Central Committee of the Chinese Communist Party in charge of science. It was revised by Zhou, discussed and approved by the top party-state leadership, including, presumably, Mao himself.[40] In the preparation for the drafting of the speech, Zhou had ordered two major surveys: one domestic, collecting systematic data on the status and uses of intellectuals, especially scientists and engineers, in China, including a major 'Report on the Employment of Students Who Had Returned from Capitalist Countries,' and another one international, synthesizing information on scientific and technological developments in the Soviet Union, the USA, Great Britain, France, Japan and other countries.[41] Such surveys highlighted for the party-state leadership more than ever the problems it faced and the urgency of the task ahead. In his speech, Zhou Enlai reviewed the achievements of Chinese science and technology since the founding of the People's Republic of China, and then argued:

> But overall, the condition of our country's science and technology is still very backward. Not only have we not mastered or utilized many of the newest scientific achievements in the world, we can not even solve many of the complex technical problems encountered in our national reconstruction independently from Soviet experts. Yet, until very recently, we have not made comprehensive plans on lifting our country's scientific and technological levels; we have not even effectively utilized our existing potentials. Backwardness in technological sciences can not be separated from a weakness in scientific foundations. Yet, it was precisely in terms of scientific research that we have invested the least.[42]

Here, one sees Zhou not only making a differentiation between science and technology but also the need for more emphasis on the former, which must have come as a welcome sign to the scientific elite. Later in the speech, Zhou picked up the theme of 'catching up' again and related it up front with national defense:

> I want to speak a little more about science here, not only because science is the decisive factor affecting our national defense, economy, and culture, but also because world science has made very big and rapid progress in the last twenty or thirty years. Such progress has relegated us far behind in scientific development…. We must catch up to the world's advanced scientific level.[43]

Here, Zhou's speech evidently included technology under science in a way that privileged the latter, which, as the historian Paul Forman has pointed out, was a worldwide phenom-enon during the modern (in contrast to the postmodern) era.[44] In his speech, Zhou cited both specific scientific and technological advances, such as automation, remote control, supersonic transport, electronics and above all, 'the applications of atomic energy,' which Zhou termed 'the highest peak of the new scientific and technological developments,' and the belief that they brought the world to 'the eve of a new scientific, technological, and industrial revolution.'[45] In espousing a view of science and technology as radical trans-formative forces in the modern world, Zhou's pronouncements also found transnational echoes such as British Prime Minister Harold Wilson's famous 1963 speech on the 'white heat of technology.'[46]

Zhou acknowledged that there were many obstacles in achieving the ambitious goal of catching up, especially in view of the fact that other countries would not sit still in the meanwhile. Yet, he insisted that

> We must now propose this task: by the end of the third five year plan [1967], we should ensure that the levels of our most urgently-needed scientific and technological fields approach the world's most advanced standards, and that we could, through our own endeavors, quickly achieve the newest foreign advances.[47]

Zhou's speech revealed an important motivation in the making of the science plan – to help make more efficient use of expected further Soviet technical assistance. Even before the start of the conference, Planning Commission Chairman Li Fuchun had requested party leaders in the academy and the ministries to determine major scientific and technological projects 'in the same fashion as the planning of the 156 projects for industrial construction' – i.e. 'in collaboration with the Soviet Union and new democratic countries [Eastern Europe].'[48] Acknowledging that Chinese development needed Soviet assistance, Zhou in his speech argued that 'without comprehensive planning' such reliance would result in 'a lifetime of dependency and imitation, endless burdening of the Soviet scientific community, and impediments to a planned and rapid growth of our science,' even negatively impacting the strengths of the 'whole socialist camp.' A better approach, Zhou argued, was 'to conduct comprehensive planning, setting up priorities, and learning systematically from the newest achievements of Soviet science in order for us to catch up with the Soviet Union as soon as possible.' 'This way we could,' Zhou concluded, 'make the most effective and rational use of Soviet assistance, promote the planned development of our science, and establish relatively soon a mutually collaborative relationship between our two scientific enterprises' as well as to strengthen the socialist alliance. As an implicit acknowledgment of Kovda's proposal, Zhou called the latter approach 'the one that has repeatedly been suggested by both Chinese and Soviet scientists.'[49]

Moving from international considerations and alliances to domestic science policy, Zhou also addressed a major concern of scientists: too much attention to short-term, applied research and too little to long-term, basic and theoretical research. If such trends were allowed to continue, Zhou warned, 'we would be making big mistakes.' Already officials at various levels had neglected scientific research and 'often required scientists to solve relatively simple problems in technological applications and production operations.'[50]

Hoping that planning would help solve these serious problems and bring China from 'backwardness' into modernization, Zhou announced that:

> The State Council has asked the State Planning Commission to work with other agencies to make, within three months, a long-term plan for scientific development from 1957 to 1967. In making this plan, it is imperative to introduce the most advanced scientific achievements in the world, based on feasibility and needs, into the scientific, defense, production, and educational sectors of our country as soon as possible; to fill the gaps, as rapidly as possible, in those areas where our scientific circle is most lacking and the need from our national reconstruction is most urgent. The goal is that in twelve years our scientific and technological standards in these areas will approach those of the Soviet Union and other major world powers.[51]

Specifically, Zhou Enlai listed six measures toward meeting these goals: the sending of scientists for training in the Soviet Union; the coming of Soviet specialists in China as advisors; the utilization of such Soviet advisors as teachers and agents of technology transfers in China; the strengthening of scientific research and especially of the Chinese Academy of Sciences ('making it the locomotive in leading national efforts to enhance scientific research and training new talents'); encouraging faculties in universities to conduct research and training new scientists; and the establishment of research institutions in the various ministries to introduce new scientific results into practical applications. The success of all these measures, he insisted, depended on the making of a national scientific plan.[52]

Zhou's speech carried profound political implications for Chinese scientists not only by positioning scientific planning at the heart of the party-state's developmental policy,

but also with its explicit rehabilitation of them and other intellectuals. A vast majority of the intellectuals, including of course scientists, Zhou declared, 'have already become state employees, have been serving socialism, and have been part of the working class.' He then went on to call for the party to overcome its traditional distrust of intellectuals and for it to train a large number of socialism-supporting 'red experts' out of the ranks of 'advanced intellectuals,' almost certainly a reference to Western-trained senior scientists.[53]

In subtle contrast, Mao publicly gave his stamp of approval for the making of the science plan, spoke of the importance of science, technology and culture and praised the transformation of intellectuals, but stopped short of fully accepting them as politically trustworthy or as part of the working class as Zhou did in his speech.[54] At the conclusion of the conference on the intellectuals on 20 January 1956, Mao, according to newly released sources, explained to the assembled party-state leaders that intellectuals, whom many of the party leaders still held politically suspicious, had made ideological progress:

> We have underestimated the progress made by peasants, capitalists, and intellectuals. We have only focused on the shortcomings of intellectuals, but our new analysis shows that among them 30–40% are progressives, 30–40% are in the middle, and only 10–20% of them are laggards. Even the latter can still be converted.[55]

Then, he made the case that intellectuals were absolutely necessary for the technological revolution that was now at the heart of the industrialization drive, despite distrust from many in the audience. But his argument made it clear that such emphasis on the intellectuals was based mainly on utilitarian grounds:

> Our advantages (*zhudong*) are accumulating day by day, with increasing advantages in agricultural reforms, as well as increasing advantages in capitalistic business reforms. Yet, we have not produced advantages on the issue of the intellectuals, or on the issue of industry. Most major equipments need to be imported from abroad; we can not make precision instruments or large machines. On these fronts we have not gained advantages. We have not gained economic independence, nor scientific independence. In the last few days at this conference, some comrades have said things that are not very smart. They said that 'we can do without them [intellectuals],' and that 'I have been engaged in revolution all my life and can do without you.' Now what kinds of revolutions are we carrying out? Now we need to carry out a revolution on technology. It's called a technological revolution. We should do science, which is a revolution against stupidity and ignorance, a cultural revolution. Without them [intellectuals] this can not be done. We crude types won't do…. How are wars fought these days? Now airplanes can climb to a height of 18,000 meters, and its speed is supersonic. To make that thing [supersonic airplane] it won't do without them, and we are to become them too.[56]

The above passage also indicates that even Mao's utilitarian attitude toward the intellectuals, not to mention Zhou's more generous one, met with fierce leftist resistance within the party from those who continued to distrust them. Thus, in 1956, as the making of the science plan proceeded, Mao launched a number of liberalization measures designed to rehabilitate intellectuals from the Thought Remolding days and to legitimate a political role for them in Chinese public life, including the Double-Hundred ('let a hundred flowers bloom and let a hundred schools content') policy of encouraging pluralism in the arts and science.[57] For a while, he even appeared to have softened his own view on the political status of the intellectuals, calling them 'workers of intellectual labor' in a speech in March 1957.[58]

The convergence of Mao and Zhou on the heightened roles for the intellectuals hinged also on a critical moment in the simmering tension between them over the pace of economic development in this period. Already in the second half of 1955, Mao Zedong, who instigated

and welcomed the coming of a 'Socialist High Tide,' had started attacking Zhou Enlai, Liu Shaoqi and other moderate leaders of 'right conservatism' when they insisted on a slower and more balanced course of reform and development.[59] Mao's newly positive views of the intellectuals fit into his vision of a China nearer to socialist success than his opponents allowed. On his part, Zhou Enlai, while trying to adjust to Mao's ways of thinking, must have also seen Mao's optimism as an opportunity to rehabilitate politically the scientists and other intellectuals in the form of the conference on intellectuals. Mao consented to Zhou's initiative on intellectuals not because he completely trusted them politically but more as a necessary step toward a faster pace of building socialism. Indeed, it was at this conference that Mao openly advocated an approach to development that was marked by 'more, faster, better, and more economical' [*duo, kuai, hao, sheng*], accenting on the first two qualities. The slogan would become the dominant theme in the Great Leap Forward starting in 1958.[60]

But the utilitarian convergence on the intellectuals did not last long. Criticisms of the party-state by intellectuals in the party rectification movement of spring 1957 would lead Mao Zedong to crack down on them in the ensuing Anti-Rightist campaign. He would also return to a darker view of intellectuals as belonging to the reactionary bourgeois class, and most importantly to a belief that class struggle, not economic development, remained the key priority for the Communist party even under socialism. When his March 1957 speech was finally published in 1964, the passage on intellectuals as 'workers of intellectual labor' was conspicuously deleted and replaced with an assertion of their bourgeois nature.[61]

Even at the January 1956 conference on intellectuals, as one reads between the lines of Mao's and Zhou's speeches, one could already sense that their differences lay not only in their varying political assessments of existing scientists and other intellectuals, but also on the overall direction of the modernization drive. While both Mao and Zhou focused on the need to change the backwardness of China, Zhou's report put a technocratic emphasis on the use of existing intellectuals, the making of new intellectuals and effective use of Soviet assistance, while Mao expressed a grander and more revolutionary vision of mass technological mobilization. Thus, he spoke of a technological revolution along with a cultural revolution, which would soon acquire explicit meanings of political radicalism during the Great Leap Forward movement (1958–1960), when he openly attacked Zhou Enlai's 'rightist tendency,' forcing Zhou Enlai to tender his resignation of premier (it was not accepted).[62] Perhaps as another reflection of his concern over Soviet-style technocratic bureaucratism, Mao in his speech at the conference on intellectuals apparently did not mention the importance of Soviet assistance as did Zhou.[63]

A further indication of Mao's thinking about a modernization without losing the revolutionary spirit was his repeated calls for the training of new, presumably politically trustworthy scientific cadres. This would both fill a real need and solve the problem of having to depend on a politically questionable scientific elite for such a critical part of the party-state's developmental objectives. At the conference on intellectuals, he called on the party 'to train a large number of advanced intellectuals within a short period of time as well as ordinary intellectuals in even larger numbers.'[64] Similarly, he urged on the whole party to study science and work with 'non-party intellectuals' 'to strive for the rapid catching up of advanced world scientific standards.'[65] Soon, a 'March on Science' campaign that called on the masses, especially youths, to study and engage in science and technology was launched.[66] Even though not yet explicitly anti-elitist, the March on Science would pave the way for the

more radical mass science during the Great Leap Forward and the Cultural Revolution as explored by the historian Sigrid Schmalzer.[67]

Yet, in early 1956, buoyed by the surprising success of the socialist political transformation and optimistic about the forthcoming plans for economic development, Mao, Zhou and other party-state leaders appeared unified in their push for a science- and technology-based modernization. They also endorsed a key role to be played by Chinese scientists and other intellectuals in this process, which of course was a welcome development to the scientific community and its elite leadership. Indeed, on 21 January 1956, the day after the closing of the conference on intellectuals, many of the same highest ranking party attendees, including Mao and Zhou, assembled in Zhongnanhai, the compound of offices of the central leadership, to hear reports on the state of science and technology in China and the world given by four leaders of the Chinese Academy of Sciences. Wu Youxun talked about advances in physics, astronomy, mathematics, mechanics and chemistry, and Zhu Kezhen on those in biology, agriculture and geology. Reflecting his relative isolation, as a 'non-party intellectual,' from the high-level decision-making, including probably the decision to launch the nuclear weapons project one year ago, Zhu was surprised by the dramatic changes of fortunes of science and scientists from the Thought Remolding days. As he noted in his diary that day, 'I did not expect that the people's government would attach so much significance to science.'[68]

Mao did not apparently mention the science plan specifically when he spoke at the conference of intellectuals, but the following statement he made at a separate gathering was soon taken to be an endorsement for it:

> The people of our country should have a long-term and grand plan to strive to change our backward conditions in economics and science and culture, and to catch up to the advanced standards in the world in several decades. In order to realize this great objective, the most critical need is for cadres and for scientific and technical experts in large enough number.[69]

The science plan clearly received a boost from the conference on intellectuals. At the time, there was an urgency to develop nuclear weapons and pursue industrialization, which derived from not only the need to deter future American threat but also a sense that Soviet aid might be withdrawn at any time. The latter had been underscored for Chinese leaders when Khrushchev rebuffed their initial request for assistance to build China's atomic bomb in 1954. As Mao stated at the January 1955 meeting that launched the Chinese atomic bomb project, 'Now with the Soviet assistance, we should make it work. [Even if] we have to do it on our own, we can also definitely get it to work.'[70]

The making of the science plan

The conference on intellectuals kicked the making of the science plan, which had been going on under Li Fuchn's coordination, into high gear, and set in motion a number of measures to strengthen the party-state's science policy mechanism in general and the Chinese Academy of Sciences in particular. About two weeks after Zhou Enlai's announcement for the science plan at the conference, a Committee of 10 of mid-level officials came into existence under Li Fuchun to organize the making of the plan.[71] Taking advantage of its concentration of scientific and engineering talents and its designation, in 1954, as the central national academic institution, the Chinese Academy of Sciences negotiated for itself a position as a central player but not the overall coordinator in the making of the national science plan. In late 1955, Li Fuchun, as chairman of the State Planning Commission, had requested,

as mentioned before, that the CAS take up the job of the making of a long-term national science plan, but Zhang Jiafu, party secretary of the CAS, demurred on the ground that the academy was not knowledgeable about the national scientific efforts well enough. He was able to convince the State Council to designate Fan Changjiang, deputy director of the Second Office of the State Council, to be the organizer of the plan-making and chairman of the Committee of 10, with Wu Heng, deputy chief secretary of the academy, as a member.[72]

The academy's initial reluctance to take responsibility for national science planning, which mirrored that of the National Science Foundation in the USA in this period, derived from both its real concern over stepping on turfs of other, more powerful institutions and probably also the weak health conditions of its leader Zhang Jiafu himself.[73] At his request and in view of the expected increased role of the CAS in Chinese national development, the party-state quickly decided to move Zhang from the academy to the Second Office of the State Council and appointed the energetic and capable Zhang Jinfu, at the time minister of local industries, to be de facto leader of the academy as its vice president and party secretary. Also appointed to the academy leadership were Pei Lisheng, who as chief secretary would be in charge of the academy's defense research and development, and Du Runsheng who, as director of the CAS administrative office [*bangongting*], would be in charge of organizing the academy's science planning efforts. None of the three were trained in science or technology, but they quickly earned widespread respect within the academy for their effective leadership and close working relationships with the scientists.[74]

Shortly after the restructuring of the academy, the party-state also decided to upgrade the policy body on science planning by establishing, on 14 March 1956, a high-level Science Planning Commission of the State Council, with Vice Premier Chen Yi, as chairman, Li Fuchun, Bo Yibo, chairman of the State Construction Commission, Guo Moruo, president of the CAS, and Li Siguang, geologist and vice president of the CAS as vice chairmen, Zhang Jinfu as chief secretary and director of staff office and most of the former members of the Committee of 10 serving as deputy chief secretaries. Du Runsheng served as both a deputy chief secretary and deputy director of the staff office, running the day-to-day activities of the commission and playing the role of actual organizer of the plan-making.[75]

Thus, taking advantage of Zhou's designation of it as the 'locomotive' of national scientific research and training, the academy was now institutionally well represented in the Science Planning Commission and favorably positioned in national science policy. Strategically, through the making of the science plan and especially as it became deeply involved in the nuclear weapons projects, the academy moved itself away from having to consult on routine technical problems with civilian ministries and tied itself more closely with the national security sector, engaging in what Du Runsheng called 'applied basic research.'[76]

In this connection, the academy's maneuverings benefited from a change of leadership in the Science Planning Commission in late 1956 when Marshal (and Vice Premier) Chen Yi was replaced by Marshal (and also Vice Premier) Nie Ronzhen, who was simultaneously head of the Chinese nuclear weapons programs, including both the atomic bombs and guided missiles. Initially an ad hoc group, the Science Commission was turned into a permanent part of the State Council with the Chen-Nie transition, thus constituting a critical step in state formation that came out of the developmental needs to mobilize science and technology for nation-building. Nie also explicitly justified the move as a response to the enthusiasm of the scientists for participation in the work of the commission and as a way to continue to strengthen their ties with the party-state.[77]

In terms of the contents of the science plan, back in September 1955, at the urging of members of its Academic Divisions, the academy had gone ahead with the preparation of its own 15-year long-term plan of development.[78] Initially, the CAS's plans were mostly disciplinary based, which drew criticism from Soviet advisers. By then, the Soviet scientists had bought into the state prerogatives in science and technology while there were still signs of resistance from at least some Chinese scientists who pushed for a go-slow, but broad approach to science and technology, and failing that, to have more coverage and emphasis on basic research in the national plan.[79] For example, on 17 January 1956, Boris R. Lazarenko, the new Soviet advisor to the CAS president who had replaced Kovda, held an extensive discussion with leaders of the CAS on scientific planning in which he pushed for a crash project style of scientific and technological research in order to fulfill the mandate from the Chinese Communist Party to catch up to world standards in 12 years. His specific suggestion was for China to go at it in multi-prong, simultaneous approach: Chinese scientists should buy ready-made computing machines from the Soviet Union and make progress in semiconductor and computer science instead of waiting for Chinese chemists to produce the needed raw materials for the former or the making of a Chinese computer. At this point, Wu Youxun, the CAS vice president, acknowledged that 'in the past we had this view that in order to establish a scientific foundation, we needed to ensure that all work started from scratch. Now we realize that this is too slow and can not meet the needs.'[80] By 10 March 1956, the academy came up with a report titled *Significant Scientific Research Projects that Need to Be Carried by the Chinese Academy of Sciences in Twelve Years*. It listed 53 such projects, ranging from atomic energy, electronics and rocketry to natural resources and became the basis for the national science plan.[81]

At the national level, during the first half of 1956, the Science Planning Commission sponsored intense meetings involving hundreds of scientists and administrators from the Chinese Academy of Sciences, ministries and universities in making and collecting suggestions about priorities, in determining future growth areas and in calibrating overall directions in various fields.[82] The making of the plan consisted of several stages. During the first stage, about 1000 scientists were organized under dozens of Disciplinary Groups (*zhuanyezu*) to suggest 'central problems' for inclusion in the plan.[83] Then, about 600 specialists lived in a hotel in Beijing for 4–5 months to analyze and synthesize these proposals into a coherent plan.[84]

What's remarkable about this process was the critical self-learning that took place among Chinese scientists from different disciplines and institutions. Of particular importance was the introduction of cutting-edge scientific and technological developments by scientists and engineers who had recently returned from the USA and Europe. In this regard, Qian Xuesen (H. S. Tsien), who had recently returned from the USA where he had been involved in high-level aeronautical research, including advising the US Air Force, played a most critical role.[85] Appointed head of the General Group in charge of the overall drafting of the final plan, Qian not only drafted the sections on aircraft and missiles for the plan, but also lectured to other scientists on power generation and national communication systems.[86] More importantly, Qian won the critical debate over whether aircraft or missiles should have priority by making a convincing case for the latter: it was faster and easier to make due to its single-use and therefore low demand on material quality in comparison with the repeated use of aircraft.[87]

Figure 1. Chinese leaders Zhou Enlai (from left), Mao Zedong, Lin Boqu, Zhu De, Chen Yun, Nie Rongzhen and Deng Xiaoping met with Chinese scientists involved in the making of the 12-year science plan, 14 June 1956, Beijing. Source: Wang Yusheng (editor in chief), *Fendou yu huihuang–zhonghua keji bainian tuzhi (1901–2000)* [struggles and glories: a pictorial history of a century of Chinese science and technology] (Kunming: Yunnan Education Press, 2002), p. 112.

Soviet science advisors also played a key role in the introduction of new scientific and technological advances to those involved in making the science plan. Under Lazarenko's suggestion, the Chinese Government invited more than a dozen leading Soviet specialists to Beijing to participate in the review of the draft science plan in spring 1956.[88] They spent weeks with their Chinese counterparts to help guide them in the making of the plan and give lectures on their understanding of frontiers of science and technology in the world.[89] On 14 June 1956, Mao Zedong, Zhou Enlai and other party-state leaders met with scientists who were involved in the making of the science plan and had photographs taken with them (Figure 1).[90]

By October 1956, a draft of the science plan, now titled 'Outline of the Long-term Plan for the Development of Science and Technology for 1956–1967 (Revised Draft),' was completed and sent by the Science Commission to the Central Committee of the Chinese Communist Party. The latter, in turn, in December 1956, directed all relevant units in the country to provide feedback and to implement those measures deemed urgent.[91] The final stage in the making of the 12-year plan was for the Chinese Government to send it and associated documents, in May 1957, to the Soviet Union for reviews and revisions by about 700 specialists from various fields and institutions. These specialists worked on this project intensely from August to October 1957, resulting in written reviews totaling about 1200 pages. Perhaps most importantly, the science plan served as a blueprint for the Chinese Government to negotiate with the Soviet Union for future technical assistance and cooperation.[92]

The Sino–Soviet collaboration on the science plan coincided with the remarkable willingness of the Soviet Government under Nikita Khrushchev to provide assistance to China in both its atomic bomb and missile projects. Khrushchev did so in return for Mao's support of him in his domestic political power struggle and for Mao's endorsement of his leadership in international communism by attending the world congress of communist party leaders in Moscow to celebrate the 40th anniversary of the founding of the Soviet Union in October

1957. Thus, the 12-year science plan played a key part in allowing the Chinese Government to take full advantage of this window of massive Soviet technical assistance.[93]

In terms of the making of the plan itself, very early in the process, a knotty problem emerged: How to reconcile the strategic and practical needs of the state with the disciplinary interests of the scientists, as earlier experienced in the discussion at the academy? Pushed by government policy-makers and influenced by Soviet advisors, it was eventually decided to adopt the guiding principle of 'Let Tasks Guide Disciplines,' i.e. priorities of 'central problems' would be determined by their relevance to key mandates of the state.[94] Initially, 55 areas of scientific and technological fields were identified as 'Important National Scientific and Technological Tasks during 1956–1967.' These ranged from natural resources, mining and metallurgy, fuels and energy, machinery building, chemical industries, construction, transportation and communication, defense, agriculture to medicine and health. Of special importance was the category of 'New Technologies' which included:

Task 36: Peaceful uses of atomic energy

Task 37: Establishment of jet propulsion and rocket technologies

Task 38: Investigations of radio electronics and its new applications

Task 39: Mechanization and automation of production processes

Task 40: Establishment of semiconductor technology

Task 41: Establishment of computing technology

Task 42: Improving electrical and supersonic technologies and expanding their applications[95]

They were closely related to the development of both the atomic bomb and guided missiles. In fact, the bomb and missiles and four items from the above list – radio electronics, automation, semiconductors and computers – were considered so essential for nuclear weapons programs and new industrial development that they were singled out as the 'Emergency Measures' that led to immediate actions, including the founding of new institutes in the Chinese Academy of Sciences and elsewhere in these areas in 1956.[96]

Under Zhou's personal guidance, the general science policy was set with the slogan 'select important developments and catch up from behind' (*zhongdian fazhan, yingtou ganshang*).[97] Here, catching up from behind meant taking shortcuts and not re-tracing all the steps others had traveled. But it was not without controversy. Some scientists who were concerned about the impact of a crash-style developmental approach on long-term basic research had proposed 'select important developments, plan comprehensively, lay a solid foundation, and catching up from behind' (*zhongdian fazhan, quanmian jihua, tashi jichu, yingtou ganshang*). But this formulation was vetoed by the non-scientist leadership as too diffused.[98]

Later in the plan-making process, the related debate over state tasks and disciplinary interests also was rekindled. The slogan of 'Let Tasks Lead Disciplines' was questioned by scientists who feared that scientific subjects not directly serving practical application would be neglected. Zhou, who already highlighted the problems of just such imbalances in his speech on intellectuals, was sympathetic to these scientists' concern. With his support, a Task 56 on 'Investigations into some basic theoretical problems in the modern natural sciences' was added to the plan. The academy also took this cue and made detailed long-term

plans for all major scientific disciplines.[99] Later, a Task 57 on scientific and technological information was added.[100]

In December 1956, a revised draft of the Long-Range Plan for Scientific and Technological Development for 1956–1967 was delivered by the Science Planning Commission to the CCCCP and State Council. The preamble of the plan, which was not published at the time but widely distributed internally, justified the need for China to catch up in science and technology to 'world levels' mainly on developmental grounds:

> To make a plan for the long-term scientific and technological development is to accomplish this basic task of the nation: we need to quickly expand our national scientific and technological strength, to strive to have some important and urgent sectors to approach or catch up with the advanced level in the world within twelve years, so that we could gradually solve on our own the many complex scientific and technological problems encountered in our national construction, and carry out socialist construction faster and with better results.[101]

This language on science and technology was in keeping with Mao's developmental strategy in this period: domestic industrialization with national security guaranteed by the early success of nuclear weapons. In November 1956, for example, Zhou Enlai conveyed Mao's recent directive to other party leaders: given the relatively peaceful international environment for the next decade or so,

> we should now slow down our buildup in defense industry and focus on strengthening metallurgy, machinery industry, and chemical industry, laying a solid foundation [for moving forward]. At the same time, get the atomic bomb, missiles, remote control, and long-range airplanes off the ground, while doing less in other areas.[102]

Although the making of the science plan took place in the so-called 'golden year of Chinese science,' its implementation, however, was carried out against a most turbulent period in Chinese political and social history. In 1957, calamity came, as mentioned earlier, in the form of Mao's vicious 'Anti-Rightist' campaign that sent hundreds of thousands of Chinese intellectuals, including many scientists, to repressive labor reform camps and other forms of harsh punishment for having voiced, at Mao's own urging, their criticism of the Communist Party in spring 1957. The year 1958 saw the launching of the ultimately disastrous Great Leap Forward campaign that turned the country into a frenzy of wasteful backyard iron and steel making and soon a land of famine. Even though some science policy participants believed that the massive mobilization efforts during the Great Leap Forward did produce scientific and technological breakthroughs that might have been otherwise impossible, overall, as Nie Rongzhen himself acknowledged, it backfired in many ways. In the missile program, for example, 'during the Great Leap Forward, everyone wanted to go into space, with their own rocket models. Reality taught us: it is not that easy and it can not work like that.'[103] On top of such domestic turbulence, the Soviet Union withdrew its technical assistance and specialist advisors by late 1950s and the early 1960s, which further impeded the implementation of the 12-year science plan.[104]

Nevertheless, the 12-year science plan did enable China to recognize the new frontiers in modern science and technology and to mobilize national resources and Soviet technical assistance to fill in critical gaps, to train a large number of technical personnel and to establish new institutions and organizations to achieve national objectives using science and technology. As Nie Rongzhen explained in 1963, China's 'new technologies,' meaning missiles and atomic bombs, 'were still in a blank state in 1956 when the 12-year science plan was made, but now we have had a good beginning, saw great developments, although our

standards are still not very high.'[105] By then, it was believed that out of the 57 major tasks, 50 had achieved goals set for 1962 in the 1956 plan. Even though these goals were now recognized as representing the state of the art in the 1940s, it was no small achievement, which was confirmed by the successful testing of China's first atomic bomb in 1964 and its first intermediate range missile in 1965.[106] Based on these positive though modest assessments of the 1956 12-year science plan, in 1963, the renamed and enlarged State Science and Technology Commission made, under the leadership of Marshall Nie, a new 10-year plan for the development of science and technology for 1963–1972.[107]

Concluding remarks

The 1956 Chinese 12-year science and technology plan thus reflected both the urgency of national security needs and the developmental aspiration that unified a fractious Chinese party-state leadership that had been divided over the pace and direction of China's modernization drive, and helped it to mobilize Chinese scientists who had often fell under political suspicion. The large-scale and comprehensive nature of the making of the plan, probably unprecedented in the history of science and technology in the modern world, certainly in Chinese history, did much to contribute to the state formation of the People's Republic of China. It also helped to mediate the tension between the scientists, most of whom had been trained in the West but harbored strong Chinese nationalism, and the Chinese Communist party-state leadership that saw them and other intellectuals largely on an utilitarian basis. Institutionally, the plan helped reach consensus on the directions and organization of Chinese science policy: it led directly to the creation of the Science Commission, a strengthening of the Chinese Academy of Sciences and the recognition of the inter-connectedness and interdisciplinarity of modern science, technology and defense. The mutual learning and education of scientists and policy-makers during the process of the making of the plan was probably an unexpected bonus for the development of Chinese science and science policy.

But the tension within the party-state leadership, which included a divergence between the radicalism advocated by Mao Zedong and the moderate approach represented by Zhou Enlai and which was intensified by international geopolitics in terms of both the East-West cold war and the Sino–Soviet split, proved too much for the spirit of the 'golden year of 1956' to continue. The outward consensus on trusting intellectuals and on a technocratic science policy, as exemplified by the 12-year science plan, fell apart rather quickly with the Anti-Rightist campaign in 1957 and the launching of the Great Leap Forward movement in 1958. A 1956-like liberal interlude did return in the early 1960s, but the even more radical and chaotic Cultural Revolution brought it to an end in 1966. What did survive through all this political turbulence, however, was a key part of the 1956 consensus, i.e. a shared commitment, among Mao, Zhou and the scientists, to a strengthening of national security based on modern science and technology in the form of nuclear weapons programs, culminating in the successful testing of China's first atomic bomb in 1964 and its first detonation of a nuclear warhead carried by a missile in 1967. In this sense, the 1956 science plan turned out to be an enduring part of a nationalist project.

Yet, the making of the national science plan also reflected strong currents of transnational scientific and technological interactions. Soviet influence on the science plan was not only reflected in the role of Kovda in its origination. The making of the science plan

also benefited from constant advising by Soviet advisors in China, especially Lazarenko and those Soviet scientists who came in spring 1956 for this purpose. The detailed and extensive Soviet review of the plan in mid-1957 not only improved it but must also have helped facilitate the negotiations of further Soviet technical assistance. Of course the implementation of the plan would also draw heavily from such Soviet technical assistance, including the provision of sample V-2 rockets and other supplies to China in the late 1950s, before the breakup of relations in 1960.

It should also be noted that the Soviet Union was not the only transnational influence in the making of the 1956 Chinese science plan. The fact that a majority of the Chinese scientists involved in the making of the plan had returned from studies abroad in Europe and especially recently from the USA pointed to American and European imprints as well. Again, Qian, because of his extensive experiences in US aerospace research and policy making in the late 1940s and early 1950s, exemplified this phenomenon. Rising to Guggenheim professor in aeronautics at Caltech and membership in the Air Force's Scientific Advisory Board by 1950, he was persecuted during the McCarthy era and was allowed to return to China in 1955 in exchange for Chinese-held US POWs. Once back in China, he was quickly appointed head of the Chinese program to produce missiles with Soviet aid. As chair of the working group in charge of overall coordination of the making of the 1956 science plan, he benefited from his experiences in 1945–1946 in USA in assisting Theodore von Karmen and others in drafting pivotal reports to the Air Force on the future of militarily relevant science and technology entitled *Toward New Horizons*.[108]

Thus, it is clear from this examination of the making of the 1956 science plan that both international geopolitics and domestic political tensions shaped early Cold War Chinese scince and technology policy. While national security concerns and developmental aspirations provided the motivation, the development of science and technology in China in this period was also powerfully influenced by transnational interactions, especially in the form of a Soviet-assisted industrial infrastructure and a Western-, especially American-trained elite scientific and technological workforce.

Notes

1. "Zhongguo kexueyuan yuanzhang guwen B. A. Kefuda guanyu guihua he zuzhi zhonghua renmin gongheguo quanguo xing de kexue yanjiu gongzuo de yixie banfa" [V. A. Kovda, advisor to the president of the Chinese Academy of Sciences, on some measures in regard to the planning and organization of national scientific research work of the People's Republic of China], January 1955, in Wu, *Zhongsu liangguo kexueyuan*, 18–28.
2. For official Chinese studies of the 12 year science plan, see, e.g. Yang and Zhang, "Xin zhongguo." It should be noted that many of the archival materials related to PRC history in general and the making of the 1956 science plan in particular are still not released. Much valuable information has become available in recent years in the forms of official publications, especially *nianpu*, chronicles of daily records of important figures such as Mao Zedong and Zhou Enlai, and they are used extensively in this paper, but they are necessarily selective and could potentially be biased, for example, in giving undue emphasis on the views and actions of the political elite in contrast to those of less prominent players. One can only hope that restrictions on archival access will gradually ease and one can revisit the topic in the future.
3. On the debates over basic vs. applied research in the US in the 1950s, see, e.g. Wang, *In Sputnik's Shadow*, 59–62.

4. For a classic analysis of this conflict, see Suttmeier, *Research and Revolution*, which only mentioned the 1956 science plan in passing.
5. See, Lewis and Xue, *China Builds the Bomb*, 49–51; Wang, "Physics in China."
6. Fu, "Minguo shiqi."
7. Qian and Gu, *Zhongguo kexueyuan*, 43–44. It is not clear whether the division members knew of Kovda's proposal.
8. On the CAS in this period, see Qian and Gu, *Zhongguo kexueyuan*, especially 13–65.
9. Jin, *Zhou Enlai zhuan 1949–1976*, v. 1, 235.
10. Mao Zedong, "Sanda yundong de weida shengli" [grand victories of the three great movements], 23 October 1951, in Mao, *Jianguo yilai Mao Zedong wengao*, v. 2, 482–3. On Mao and intellectuals, see, e.g. Wang Laidi, "Yiguan choushi zhishi fenzi de Mao Zedong" [Mao Zedong as someone who had always been hostile to intellectuals], in Wang, *Zhonggong chuangshiren fangtanlu*, 296–320.
11. Schneider, *Biology and Revolution*, 281.
12. See Jin, *Zhou Enlai zhuan 1949–1976*, v. 1, 233.
13. See Fu, "Liumei kexie chengli shimo."
14. Wang and Liu, "1950 niandai guiguo."
15. Zhou Enlai, "Guanyu zhishi fenzi de gaizao wenti" [on the issue of reform of intellectuals], 29 September 1951, in Zhou, *Zhou Enlai xuanji*, v. 2, 59–71.
16. Luo Wei, "Zhishi fenzi," 39.
17. Wang, "Zhongguo kexueyuan."
18. Wang, "Zhongguo kexueyuan," 21.
19. Zhu Kezhen diary entry for 15 March 1952, in Zhu, *Zhu Kezhen quanj*, v. 12, 579–80. Zhu Kezhen's diaries related to the Thought Remolding have been collected and edited for easy access by Wang Yangzong in Zhu, "Zhongkeyuan."
20. Zhu Kezhen diary entry for 10 April 1952, in Zhu, *Zhu Kezhen quanj*, v. 12, 596.
21. Wang, "Zhongguo kexueyuan." Concurrent with the Thought Remolding was a harsh 'Three Antis' campaign which targeted embezzlement, waste, and bureaucratism.
22. Wang, "Physics in China."
23. Jin, *Zhou Enlai zhuan 1949–1976*, 235.
24. Zhang, Zhang, and Yao, "Technology Transfer." According to this study (110–11), during implementation there were changes to these technology transfer projects so the total number was reduced to 150.
25. Mao Zedong, "On the People's Democratic Dictatorship," *Renmin ribao* [people's daily], 1 July 1949.
26. Fu, "Yize yixi." For a review of science and technology policy in this period, see Qian, "Xin zhongguo."
27. See Institute of Contemporary China Studies, *Zhonghua renmin*, v. 1, 274–5.
28. Guo Moruo, "Guanyu guanche yuanzhang guwen kefuda jianyi xiang guowuyuan de baogao" [a report to the State Council on implementing the proposal by Kovda, advisor to the president of the Chinese Academy of Sciences], in Wu, *Zhongsu*, 28–31. On the impact of the decision by the Chinese party state leadership to build nuclear weapons (both nuclear bombs and guided missiles) on the development of science and technology in China in this period, see Lewis and Xue, *China Builds the Bomb*, 49–51, and Wang, "Physics in China."
29. Mao's speech at the "Conference on the Issue of Intellectuals," in Pang and Feng, *Mao Zedong nianpu*, entry for 20 January 1956, v. 2, 514–5. More on the conference later.
30. Pang and Feng, *Mao Zedong nianpu*, entry for 22 January 1956, v. 2, 516–8.
31. Pang and Feng, *Mao Zedong nianpu*, entry for 25 April 1956, v. 2, 567.
32. Pang and Feng, *Mao Zedong nianpu*, entry for 21 May 1960, v. 3, 398.
33. Pang and Feng, *Mao Zedong nianpu*, entries for December 1955, v. 2, 485; for 20 January 1955, v. 2, 514–5. On the 12-year plan for atomic energy, see Li and Ma, *Zhou Enlai nianpu*, entry for 22 December 1955, v. 1, 529–30.
34. Pang and Jin, *Mao Zedong zhuan*, v. 2, 447.
35. Pang and Jin, *Mao Zedong zhuan,* chapters 13–14.

36. Pang and Feng, *Mao Zedong nianpu*, entry for 31 October, v. 3, 20. See also Wang, "Physics in China."
37. Li and Ma, *Zhou Enlai nianpu,* entries for 14 November 1955, 16–24 November 1955, v. 2, 517 and 518–20, respectively. See also Jin, *Zhou Enlai zhuan*, vol. 1, 229–37.
38. Pang and Feng, *Mao Zedong nianpu*, entries for 23 November 1955 and 24, v. 2, 470–2.
39. Pang and Feng, *Mao Zedong nianpu*, entries for 13 March 1957, v. 3, 110.
40. See Li and Ma, *Zhou Enlai nianpu*, entry for 17 December 1955 and 19, v. 1, 528; entry for 12–13 January 1956, v. 1, 538–9; Pang and Feng, *Mao Zedong nianpu*, entry for 13 January 1956, v. 2, 510.
41. Jin, *Zhou Enlai zhuan*, vol. 1, 238–42.
42. Zhou Enlai, "Guanyu zhishi fenzi wenti de baogao" [a report on the issue of the intellectuals], 14 January 1956, originally published in *People's Daily*, 30 January 1956, reprinted in Zhou, *Zhou Enlai xuanji*, v. 2, 166.
43. Zhou, "Guanyu zhishi fenzi," 181.
44. Forman, "The Primacy of Science in Modernity."
45. Zhou Enlai, "Guanyu zhishi fenzi," 181.
46. Wilson's speech on 1 October 1963, is reprinted in Wilson, *Labor's Plan for Science*. My thanks to Jon Agar for drawing my attention to Wilson's speech. See also Matthew Francis, "Harold Wilson's 'White Heat of Technology' Speech 50 Years on," *The Guardian*, September 19, 2013, accessed in November 2015 at http://www.theguardian.com/science/political-science/2013/sep/19/harold-wilson-white-heat-technology-speech.
47. Zhou, "Guanyu zhishi fenzi," 182.
48. Li Fuchun to Zhang Jiafu, 5 January 1956, as quoted in Zhang and others, *Sulian jishu*, 170–1.
49. Zhou, "Guanyu zhishi fenzi," 182–3.
50. Zhou, "Guanyu zhishi fenzi," 183–4.
51. Zhou, "Guanyu zhishi fenzi," 184.
52. Zhou, "Guanyu zhishi fenzi," 184–5.
53. Zhou, "Guanyu zhishi fenzi," 166, 176. Indeed 1956 saw the admission of an unprecedented number of senior scientists into the Communist Party. In the Chinese Academy of Sciences alone, 10 senior scientists became party members in the first half of 1956 in contrast to only one in the entire period of 1949–1955. See Qian and Gu, *Zhongguo kexueyuan*, 69.
54. Zhou's statement was not reaffirmed in the formal party circular on the conference. See "Zhonggong zhongyang guanyu zhishi fenzi wenti de zhishi" [directive from the Central Committee of the Chinese Communist Party on the issue of intellectuals], 24 February 1956, in Zhonggong zhongyang wenxian yanjiushi, *Jianguo yilai*, v. 8, 132–47. See also Luo, "Zhishi fenzi," 55, and Shen, "1956 nian."
55. Pang and Feng, *Mao Zedong nianpu*, entry for 20 January 1956, v. 2, 513.
56. Pang and Feng, *Mao Zedong nianpu*, entry for 20 January 1956, v. 2, 515.
57. On the double-hundred policy, see Pang and Jin, *Mao Zedong zhuan*, v. 2, 486–93; and Schneider, *Biology and Revolution*, 165–85.
58. Pang and Jin, *Mao Zedong zhuan*, v. 1, 635–7.
59. Shen Zhihua, "Zhou Enlai yu 1956nian." As Shen recounted here, the tension between Mao and Zhou on the pace of economic development would intensify in 1956, temporarily be resolved in Zhou's favor due to Soviet support, but explode into the open 2 years later when Mao launched the Great Leap Forward movement.
60. Pang and Feng, *Mao Zedong nianpu*, entry for 20 January 1956, v. 2, 513.
61. Pang and Jin, *Mao Zedong zhuan*, v. 1, 721.
62. On Mao's attack on Zhou Enlai on the eve of the Great Leap Forward in early 1958, see Pang and Jin, *Mao Zedong zhuan*, v. 1, 767–89; Jin and others, *Zhou Enlai zhuan*, v. 2, 406–39. The issue of the cultural revolution would return in the form of the Great Proletariat Cultural Revolution (1966–1976) during which Mao purged technocratic leaders such as state president Liu Shaoqi and party general secretary Deng Xiaoping.

63. On 15 February 1956, ten days before Nikita Khrushchev's denunciation of Stalin in Moscow helped to trigger a full-blown Sino-Soviet split, Mao criticized the Soviet one-command system (*yizhangzhi*) (chief administrative officer in charge without collective party leadership) at the ministerial level: 'Some of the Soviet practices should not be borrowed.' Pang and Feng, *Mao Zedong nianpu*, entry for 15 February 1956, v. 2, 530. On Mao's increasing questioning of Soviet-style economic development in this period, see Luthi, *Sino-Soviet Split*, 44–45.
64. Pang and Feng, *Mao Zedong nianpu*, entry for 20 January 1956, v. 2, 513. Wang, "Physics in China."
65. Pang and Feng, *Mao Zedong nianpu*, entry for 20 January 1956, v. 2, 513–5. About a year later Mao was more explicit (and more optimistic) about the prospect of training new intellectuals to solve the problem of having to rely on old intellectuals: 'We have only one way out and that is to learn from them [old intellectuals]. In ten to fifteen years this would succeed. [Then] we can command them [old intellectuals] not only politically but also in professional and technological terms.' Mao's speech in Tianjin, 17 March 1957, quoted in Pang and Jin, *Mao Zedong zhuan*, 642. Mao soon would become disillusioned in the new intellectuals when they too joined the old ones in criticizing the party and lead him to purge them both in the Anti-Rightist campaign in spring 1957.
66. Xinhua Press, "Shubaiwan."
67. See, e.g. Schmalzer, "Self-Reliant Science," and her *Red Revolution, Green Revolution*. My thanks to Prof. Schmalzer for sharing her book manuscript with me.
68. Zhu Kezhen diary for 21 January 1956, in Zhu, *Zhu Kezhen quanji*, v. 8, 279. See also Wang, "Physics in China," 259. The reports by Wu, Zhu, and others can be found in Li, *Zhongguo kexueyuan*.
69. "Mao Zedong zhuxi zai zuigao guowu huiyi shang jianghua de zhaiyao" [excerpts of Chairman Mao Zedong's speech at the Supreme National Council], *Renmin ribao* [people's daily], 25 January 1956, reprinted in Hu, *Zhongguo keji*, 166–7.
70. On Sino-Soviet nuclear relations, see Shen and Xia, "Between Aid and Restriction."
71. Wu and Yang, *Dangdai zhongguo*, 90. See also Zhu Kezhen diary entries for 28, 30, 31 January 1956, in Zhu, *Zhu Kezhen quanji*, v. 14, 282–4.
72. Wu, *Keji zhanxian*, 160–1.
73. Zhang, *Gengshen yishi*, 134–7; Wu Heng, *Keji*, 160. On the NSF, see Wang, *In Sputnik's Shadow*, 172.
74. See Liu Zhenkun, "Zhang Jinfu," Li Gongde and others, "Pei Lisheng," and Liu Zhenkun, "Du Runsheng," in Yu, *Zhongguo kexueyuan*, 100–43, 224–61, 287–311 respectively. See also Zhu Kezhen diaries for 20 February and 9 March 1956, in *Zhu Kezhen quanji*, v. 14, 293–94 and 302 respectively.
75. Xinhua Press, "Guowuyuan chengli." See also Liu, "Du Runsheng."
76. Li and Han, "Wu Mingyu fangtan ji," esp. 36–39, 43. In the US, the equivalent concept to 'applied basic research' was 'mission-oriented basic research.' See Wang, *In Sputnik's Shadow*, 56–58.
77. Xinhua Press, "Guowuyuan chengli." Nie, *Nie Rongzhen huiyilu*, 766–7, 784–6; Xinhua Press, "Guowuyuan pizhun."
78. "Zhongguo kexueyuan guanyu zhiding zhongguo kexueyuan shiwunian yuanjing guihua de zhishi" [Chinese Academy of Sciences' directive on the making of a fifteen year long-term plan for the development of the Chinese Academy of Sciences], 15 September 1955, in Hu, *Zhongguo*, 136–9. See also Yang and Zhang, "Xin zhongguo."
79. On the orientation of Soviet scientists and engineers toward state goals, see, for example, Graham, *Ghost of the Executed Engineer*.
80. "Zhongguo kexyueyuan yuanzhang guwen lazalianke guanyu zhiding wuli shuxue huaxue bu ge xueke changyuan fazhan guihua tanhua" [a talk by Lazarenko, advisor to the president of the Chinese Academy of Sciences, on the long-term development plans of various disciplines in the Division of Physics, Mathematics, and Chemistry], 17 January 1956, in Wu, *Zhongsu*, 214–7, quote on 216.
81. Fan, *Zhongguo Kexueyuan*, 57–58.

82. See, for example, Qian, "Xin zhongguo" and Wang, "Physics in China."
83. Wu and Yang, *Dangdai zhongguo keji*, 90. Zhu Kezhen diary entries for February and March of 1956 in Zhu, *Zhu Kezhen quanji*, v. 14, 284–311.
84. Nie, *Nie Rongzhen huiyilu*, 776.
85. The best biography of Qian remains Chang, *Thread of the Silkworm*.
86. Zhu Kezhen diaries on 10, 17, and 19 March 1956, in Zhu, *Zhu Kezhen quanji*, v. 14, 302, 305–6.
87. He, "Qian Xuesen jiaoshou." Chang, *Thread of the Silkworm*, 211–12.
88. See documents in chapter 2 on "Soviet Studies and Archival Documents [from both sides] on Sino-Soviet Scientific Exchange and Collaboration" in Wu, *Zhongsu*, 160–282.
89. Nie, *Nie Rongzhen huiyilu*, 776.
90. Pang and Feng, *Mao Zedong nianpu*, entry for 14 June 1956, v. 2, 586.
91. "Zhonggong zhongyang tongyi guowuyuan kexue guihua weiyuanhui dangzu 'guanyu zhengqiu yijiuwuliu-yijiuliuqi nian kexue fazhan yuanjing guihua gangyao (xiuzheng caoan) yijian de baogao'" [the Central Committee of the Chinese Communist Party approves the report by the party group of the Science Planning Commission of the State Council on opinions on the revised draft of the long-term plan for the development of science and technology for 1956–1967] and attachments, in Zhonggong zhongyang wenxian yanjiushi, *Jianguo yilai*, v. 9, 425–540.
92. Guo Moruo, "Jiaqiang zhongsu kexue hezuo wei cujin kexue shiye de dayuejin er fendou – fangsu kexue jishu daibiaotuan zongjie baogao" [strive to strengthen Sino-Soviet scientific cooperation in order to promote a great leap forward in the scientific enterprise: A summary report of the delegation of science and technology to the Soviet Union], 1958, in Wu, *Zhongsu*, 79–91.
93. Shen and Xia, "Between Aid and Restriction," 102.
94. Nie, *Nie Rongzhen huiyilu*, 774–5.
95. "Yijiuwuliu-yijiuliuqi nian kexue fazhan yuanjing guihua gangyao (xiuzheng caoan)" [the revised draft of the outline of the long-term plan for the development of science and technology for 1956–1967], in Zhonggong zhongyang wenxian yanjiushi, *Jianguo yilai*, v. 9, 436–540. A section on defense is still missing in the released version of the science plan, but its main contents can be found in an article in a collection of Nie Rongzhen's military writings. See Nie Rongzhen, "Dui shiernian kexue guihua zhong guofang yanjiu xiangmu de yijian" [suggestions on defense research projects in the twelve year science plan], in Nie, *Nie Rongzhen junshi wenxuan*, 390–4. See also Zhou, *Nie Rongzhen nianpu*, entry for 12 April 1956, v. 1, 575.
96. See, e.g. Zhang and Zhang, "Founding," 17–33.
97. Yang and Zhang, "Xin Zhongguo."
98. Nie, *Nie Rongzhen huiyilu*, 779.
99. Wu Heng, *Keji*, 164.
100. Qian, "Xin Zhongguo."
101. "Yijiuwuliu-yijiuliuqi," in Zhonggong zhongyang wenxian yanjiushi, *Jianguo yilai*, v. 9, 436–7.
102. Zhou Enlai, "Jingji jianshe de jige fangzhenxing wenti" [several policy issues in economic construction], in Zhou, *Zhou Enlai xuanji*, v. 2, 229–38, on 236. One may even argue that Mao's defense strategy was similar to the New Look policy of the United States of reducing defense budget by relying on nuclear weapons.
103. For a defense of the scientific efforts during the Great Leap Forward, see Li and Han, "Wu Mingyu," mainly 32–34. Wu Mingyu was an assistant to Zhang Jinfu, the influential party leader and vice president of the Chinese Academy of Sciences in 1956–1966. For Nie's criticism of the Great Leap Forward, see Nie, "Guanyu daodan, weixing yanzhi he shiyan gongzuo de zhishi" [directives on research and experimental work on missiles and satellites], in Nie, *Nie Rongzhen keji wenxuan*, 561–3, on 562.
104. See Nie, *Nie Rongzhen huiyilu*, 808–13; Shen and Xia, "Between Aid and Restriction."
105. Nie, "Zai quanguo nongye kexue jishu gongzuo huiyi shang de jianghua" [speech at the National Conference on Agriculture Scientific and Technological Work], 21 February 1963, in Nie, *Nie Rongzhen keji wenxuan*, 373–404, on 376.

106. Nie, "Guanyu guojia kewei jiguan gongzuo de jianghua" [speech on the work of the National Science Commission staff], 23 December 1963, in Nie, *Nie Rongzhen keji wenxuan*, 486–507, on 486–7.
107. Nie, "Guanyu bianzhi yijiuliusan zhi yijiuqier nian kexue jishu fazhan gangyao qingkuang de baogao" [a report on the considerations that led to the making of the outline for the development of science and technology for 1963–1972], in Nie, *Nie Rongzhen keji wenxuan*, 481–5.
108. Chang, *Thread of the Silkworm*, 116–118, 211.

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