The De-nationalization and Re-nationalization of the Life Sciences in China: A Cosmopolitan Practicality?

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Stem cell research and synthetic biology offer complementary insights on the nature of scientific governance in China. Stem cells were essentially promoted by top-down semi-governmental initiatives. Yet it was through a process of 'de-nationalization' (in which a diversity of cross-border communications initiated by scientists effaced the dominance of a singular national voice) that China's stem cell research gained global recognition. Meanwhile, the emergence of synthetic biology has shown a reverse pathway. While many 'Chinese' synthetic biology projects are primarily associated with international programs, this 'de-nationalized' start did not lead to an abandonment of a national agenda.

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The text

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Abstract

Stem cell research and synthetic biology offer complementary insights on the nature of scientific governance in China. Stem cells were essentially promoted by top-down semi-governmental initiatives. Yet it was through a process of 'de-nationalization' (in which a diversity of cross-border communications initiated by scientists effaced the dominance of a singular national voice) that China's stem cell research gained global recognition. Meanwhile, the emergence of synthetic biology has shown a reverse pathway. While many 'Chinese' synthetic biology projects are primarily associated with international programs, this 'de-nationalized' start did not lead to an abandonment of a national agenda. Rather, synthetic biology in China has been transformed into a grassroots proposition of a 'Big Question' approach, which in effect creates a 're-nationalization' by bringing synergy among domestic experts. Chinese stakeholders' experience seems to indicate that scientific development is steered by a (cosmopolitan) practicality, which has lead to a bottom-up instrumentalization of the nation-state.

Keywords

scientific governance, China, national science policy, globalisation

Dénationalisation et renationalisation des sciences de la vie en Chine : une pratique cosmopolite ?

Résumé

La recherche sur les cellules souche et en biologie synthétique offre des perspectives complémentaires sur la nature de la politique scientifique en Chine. Les cellules souche ont été essentiellement promues par des initiatives semi-gouvernementales du haut vers le bas. Cependant, c'est à travers un processus de « dénationalisation » (dans laquelle des communications transfrontières diverses initiées par des scientifiques effacent la domination d'une voix nationale unique) que la recherche chinoise sur les cellules souche a obtenu une reconnaissance globale. Simultanément, l'émergence de la biologie synthétique a montré une trajectoire inverse. Alors que de nombreux projets « chinois » en biologie synthétique sont associés au premier chef à des programmes internationaux, cette première étape « dénationalisée » n'a pas mené à un abandon de l'agenda national. Au contraire, la biologie synthétique en Chine a été transformée en une proposition, ancrée sur le terrain, d'une approche en termes de « Grande Question », qui de fait a créé une « renationlisation » en favorisant une synergie entre les experts nationaux. L'expérience des parties prenantes chinoises semble indiquer que le développement scientifique est dirigé par une pratique (cosmopolite) qui a conduit à une instrumentalisation par le bas de l'État-nation.

Mots-clefs

gouvernance scientifique, Chine, politique scientifique nationale, globalisation

Recent developments in the life sciences in China exhibit two seemingly paradoxical trends regarding the role of nation-state. Firstly, the development of China's stem cell research demonstrates a process of '*de*-nationalisation'. Whilst national funding and government endorsements were key in giving China's stem cell research a head start at the beginning of the millennium, as the research progressed, existing institutional supports alone were seen as inadequate in coping with China's stem cell development. During my field work between 2006 and 2010, there emerged a multiplicity of social actors (individuals, professional networks, civil groups) in influencing the governance of stem cell research. Not only was there a diversification of research funding and a developing constellation of localized research policies, but also, certain areas which were traditionally under national monopoly (such as stem cell donor registries) had been challenged by civil initiatives. Yet, a reverse trend, which this paper calls a '*re*-nationalisation' process, seems to be taking place in the development of synthetic biology. Here the term 'nationalisation' is not employed as in its narrow definition of state ownership, but in its quintessential connotation of government dominance in structuring and managing a particular social affair. Synthetic biology emerged in China in 2007. In contrast to stem cell research, its early progress was closely aligned with transnational scientific initiatives and largely supported by foreign funding. However, as Chinese synthetic biologists became increasingly visible on the world scientific stage, they deemed national strategy, rather than international networking, as the key in advancing this field. In a joint proposal made by leading Chinese synthetic biologists to the Ministry of Science and Technology at the end of 2009, a national 'Big Question' approach was put forward, calling for a top-down organization in steering synthetic biology's development. This proposed '*re*-nationalisation' by globally networked scientists seemed to imply a more radical nationalistic approach than what occurred at the beginning of the development of stem cells.

This co-existence of the *de*-nationalisation and *re*-nationalisation of the life sciences in an overlapping period of time in China may seem puzzling, especially when it is seen through a traditional techno-nationalism lens. For much discussion has been on how modern science has been instrumentalized by the Chinese government in developing its global competitiveness (Wang, 2002; Schneider, 2003). Although the approaches of such instrumentalization may vary in different phases of China's opening to the world, the two main lines under investigation here both took place within the same national scientific infrastructure and are subject to the same research policies. However, they seem to simultaneously portray contradictory directions of how research has been organized and what roles the Chinese government plays.

In fact, as will be demonstrated in this paper, a closer examination of these two fields further suggests that a nation-state perspective fails to capture the significance indicated by these two paradoxical trends. Perhaps instead of thinking in linear terms of how nation-states instrumentalize science, there needs to be a re-examination of the emerging governance dynamic at work. Investigations on China's ongoing scientific development identified that increasing globalization has promoted an emerging cosmopolitan outlook amongst Chinese stakeholders (Tyfield and Urry, 2009; Zhang, 2010a, 2010b). This paper follows this line of enquiry and argues that the seemingly paradoxical trends in China's life sciences may be better comprehended through a cosmopolitan analytical lens. For this would allow us to extend beyond the conceptual reductions of national/global dichotomy and direct our attention to what is happening on the ground. This paper suggests that a more fruitful line of enquiries may be to illuminate *how the relevance of the nation-state is currently defined and constructed.*

Sociological cosmopolitanism and scientific development

Intensified global exchange has rejuvenated debates on cosmopolitanism. Whilst all cosmopolitan investigations stress the interconnectedness and interdependence of human practices, they differ in empirical themes and conceptual focuses. Contemporary cosmopolitan discussion can be summarized into five categories: a) Philosophical cosmopolitanism, which reflects the moral obligations and normative ideals of universal hospitality (e.g. Nussbaum, 1996; Singer, 2002); b) Political cosmopolitanism, which attempts to resolve national institutions, international democracy and global governance (e.g.

Bohman, 2007; Calhoun, 2007); c) Global justice and cosmopolitan law (e.g. Caney, 2005; Brown, 2009); d) Cultural cosmopolitanism which explores an ever complex multiplicity and heterogeneity of cultural life (Benhabib, 2002; Waldron, 1999); and finally, e) sociological cosmopolitanism, which focuses on the process of how socio-political power is (re)constituted, resulting in new forms of sociality among individuals (Beck, 2000; Touraine, 2003; Urry, 2000).

This paper mainly falls into the category of sociological cosmopolitanism with reference to political cosmopolitanism. Both schools emphasize that while cosmopolitanism is closely associated with globalization, they are not synonymous. In relation to the discussion of this paper, there are at least three points argued by both schools that worthy to be noted:

Firstly, a cosmopolitan perspective does not perceive social reality through a global/national dichotomy. Cosmopolitan endeavors are not '*beyond* borders but *across* borders' (Bohman, 2007, p12, see also p91-100, p129-33, p153-8). It is widely acknowledged that existing social boundaries no longer necessarily mark the distinction between how a certain issue is handled from the inside versus the outside of a nation-state. Yet this does not pronounce the end of national solidarity. On the contrary, this highlights the importance of close study on how these borders are 'chosen' and continuously 'redrawn' (Beck, 2002, p19).

Secondly, while the nation-state remains significant (Calhoun, 2007), one should also be attentive to the fluidity of social spheres and the corresponding changes in power dynamics. Social actors who 'inhabit networks of communication and interaction' (Bohman, 2007, p189) increase their political leverages by consciously seeking to 'internalize (either individually or collectively) immaterial and relational connections and solidarities'(Harvey, 2009, p259-260).

Finally, the essence of 'cross-borderness' also lies in what Ulrich Beck termed 'globalization *from within*, globalization *internalized*' (Beck, 2002, p23, original emphasis). That is, 'globalization' denotes that 'processes involve not only interconnections across boundaries, but [they also] transform the quality of the social and the political *inside* nation-state societies' (Beck, 2002, p17, original emphasis). Thus, the consequence of globalization may not be limited to exchanges that take place *between* nation-states, but also *within* a nation-state.

Scientific communities have been at the forefront of cross-border exchanges. With international travel made easy and surging R&D investments in Asia, the world scientific atlas is covered with complex and interwoven networks of human mobility. The essence of contemporary scientific policy-making has thus become 'think locally, act globally' (Wagner, 2008). Developing countries, such as China, which used to suffer from a 'brain drain', now seem to manage a certain degree of global 'brain circulation'. It is not uncommon to liaise local scientific projects with international initiatives. Sociologists David Tyfield and John Urry's research on China's low-carbon technology and the author's stem cell research in China are two empirical studies on the emerging cosmopolitan outlook within Chinese scientific community.

Tyfield and Urry (2009, p802-6) have identified five central characteristics that enabled a Chinese cosmopolitan science: a) Extensive mobility, which promotes both physical and virtual contacts; b) Global openness with the willingness to accommodate cultural and political 'others'; c) Social reflexivity, which is the ability to compare global options; d) Increasing social plurality and the development of civil society; and, e) The awareness of a global 'public'.

The author's previous work (Zhang 2010a, 2012) further specified emerging cosmopolitan heuristics underlying scientific agenda setting in China. In brief, the author identified a pluralization and differentiation of social allegiances employed by Chinese stakeholders in interpreting their responsibilities, entitlements and interests. It was argued that ethicization, or the institutionalization of a societal issue, and reflexive negotiation amongst domestic and global influences have become essential processes in scientific development. In this process, both grassroots and institutional social staging of concerns have revolutionised how political capital and social leverage are conceived. Similar to Luis Cabrera's empirical findings on the practice of global citizenship, the author's research on China's life sciences also indicated that, even in the absence of cosmopolitan institutions, individuals can still enact significant aspects of their 'individual duties in a cosmopolitan frame', which in turn prepares for and

promotes institutional transformation (Cabrera, 2010, p. 17, p. 258-62).

Whilst the research cited above highlighted an emerging social plurality and empowerment of civil initiatives within China's science, the interplay between internationalized scientific communities and the agendas of an authoritarian state remains under-explored. Would a cosmopolitan mindset be employed as merely 'neo-techno-nationalism' in disguise, which represents 'a deep-seated-nationalism, albeit one accommodated to the realities of techno-globalism' with 'government agencies' as the principal drivers (Suttmeier, Yao and Tan, 2006, p31)? Or does it indicate a more substantial change in social power relations?

The two paradoxical trends exhibited by stem cell research and synthetic biology together seem to offer insights on this question. For the contrasts alert us to a possible contextual *(re)definition and (re)construction of the relevance of the nation-state on the ground*. It will be demonstrated that rather than abstract notions of national pride or global professional solidarities, Chinese stakeholders' experience in the last decade seem to indicate that scientific development on the ground is steered by a sense of (cosmopolitan) *practicality*. It is a practicality that aims at assessing, mediating and exploiting both the national and global resource pools in attending particular social interests. In the case of Chinese life sciences, such practicality seems to lead to a *bottom-up instrumentalization* of the nation-state.

Methodology and structure

Data used in this paper combines two separate research projects conducted by the author from 2006 to 2010. The case study on stem cell research was funded by the Wellcome Trust. In total 48 key Chinese stakeholders (scientists, ethicists and regulators) were interviewed in six cities (Beijing, Tianjin, Shanghai, Guangzhou, Hangzhou and Changsha) during the period of 2006 and 2009. The case study on synthetic biology was funded by the UK's Royal Society Science Policy Centre. As part of a larger study on the international governance of synthetic biology, the author visited four leading research teams in three cities (Beijing, Tianjin and Hefei) in 2010 and interviewed 10 researchers. In both studies, interviews were recorded and transcribed. Through detailed and repeated analysis of the data, the transcripts were then indexed into themes by identifying reoccurring concepts (Corbin and Strauss, 1990).

Despite the fact that these are two systematic investigations in each field, it must be remembered that, as with many qualitative sociological enquiries, they are limited in scope for practical reasons. Data presented in this paper may not be representative of Chinese science as a whole. Rather, the value of great qualitative depth is that it is indicative of the changing sociality and power dynamics on the ground, which provide timely correctives to existing analytical frameworks.

The subsequent sections are organized as follows: First, the development of stem cell research and synthetic biology in China will be examined in turn. Second, the common themes emerging from the two cases are discussed in relation to transnational studies in general and cosmopolitan theory in particular. Finally, a conclusion is presented.

Case study one: The 'de-nationalization' of stem cell governance

It was not until after the birth of Dolly the sheep in 1997 that 'stem cell' became a buzzword in biomedical research. As with many developing countries, the Chinese government sees stem cell research as an opportunity in joining the 'top squad' of the global scientific force. Apart from its permissive governance stance, the Chinese government has also been a major sponsor in this area from the start. The number of stem cell-related projects funded by National Natural Science Foundation of China (NSFC) has increased from 9 projects in 1999 to 166 in 2007 (isis.nsfc.gov.cn). The amount of investment also rose steadily, currently at 44.09 million RMB. Attention from the National Basic Research Program (the 973 Program) and the National High Technology Research and Development Program (the 863 Program) administered by the Ministry of Science and Technology (MOST) have also upgraded stem cell research's profile[1]. Key stem cell research centres were set up from 2000, all

1. According to its official website (www.973.gov.cn), the 973 Program initiated two national Major Projects on stem cell research as early as 2001. Among the 82 Major Projects it launched in 2006, seven are stem cell-focused. In 2006, the State Council issued 'The National Mid-term and Long-term Science and Technology Development Plan (2006-2020)', in which stem cell research was identified as one of the frontier development subjects. In the same year, the 863 Program launched a new Major Project on 'Stem Cell and Tissue Engineering' (MOST, 2006).

supported by government funding and hosted by state research institutions[2].

Many scientists interviewed highlighted government channeling of scientific resources and its consequential control over research as a particularity in the early stage of stem cell development in China. They described the funding procedures not so much as a scientific decision, but an administrative one, or a form of government 'task-commissioning' (Interviewee 01, 16, 08). Similar to China's hierarchical authoritarian administration in other scientific fields (Cao and Suttmeier, 2001), such task-commissioning was to ensure that a national development strategy for stem cells was entrusted into the 'safe hands' (Interviewee 21) of few elite senior scientists. This semi-commission relationship brought stem cell scientists directly accountable to government agendas and subsequently enforced compliance with ministerial soft rules as a condition of receiving financial backing (Barr and Zhang, 2010). This may help to explain why, for foreign observers, China's loosely termed guidelines on stem cell research was alarmingly deficient (Giles, 2006), yet in the eyes of Chinese researchers, they were considered 'adequate', since 'nearly all scientific research in China relies on government funding' (Cheng et al, 2006).

An overview of China's administrative system of stem cell research can be summarized in Figure 1. Administrative powers radiate from one centralized office, the State Council's State Steering Committee of S&T and Education (*Guowuyuan Keji Jiaoyu Lingdao Xiaozu*), and are disseminated through a parallel division of executive branches. In terms of stem cell research, MOH (Ministry of Heath) and MOST were the main regulators, while MOST, NSFC and CAS (Chinese Academy of Sciences) were the main funders. In short, at the beginning of stem cell development in China, all regulatory decisions and scientific resources can be traced back to a handful of national-ministry-level organizations.

2. For northern China, Peking University Stem Cell Research Centre was founded in 2000, in collaboration with the Embryology Department in Peking University Health Science Centre. For central China, the National Human Stem Cell Engineering Research Centre in Hunan province was established in 2001 on basis of the Human Reproductive Engineering Laboratory (news.csu.edu.cn). The biggest stem cell research centre in southern China, Centre for Stem Cell Biology and Tissue Engineering, was founded in 2002 at Sun Yat-sen University (www.stemcells.cn).

As the Chinese stem cell community expands and starts to establish regular transnational scientific exchange and collaborations, the exposure to international criticism, alternatives practices and global resources challenges China's national control from at least two perspectives. Firstly, there is a 'dilution' of national dominance, in which a national agenda and centralised government directives are increasingly required to incorporate, work with, and respond to an emerging multiplicity of funding sources, regulatory authorities, and governing visions within and without national borders (Sleeboom-Faulkner, 2010; Zhang, 2012). Secondly, there is a 'disruption' of national dominance, in which the role of the nation-state and its governing approach is directly questioned, contested and transformed. This point can be best illustrated by the development of two bone marrow donor programs, commonly referred to as 'blood stem cell bank' in China: China Marrow Donor Program (hereafter the 'China Stem Cell Bank') founded in 1992 and Sunshine Marrow Donor Program ('Sunshine Stem Cell Bank') founded in 2002.

The significance of blood stem cell banks, apart from their scientific implications, is that they are key in advancing stem cell transplants to cure leukaemia. To put their basic operations in a nutshell, these banks recruit and register volunteers for potential donation. They then collect blood samples and record relevant data specification, provide hospitals with database search service, make donation confirmation when an ideal match is found and set up necessary medical coordinations when donation is agreed. A large database, efficient communication among stakeholders, and reliable working standards are all positively related to higher success rates in such treatments.

With the absence of private funding, for a long time in China, such enterprises were thought as only possible to be managed by the state. Sure enough, for almost an decade, China Stem Cell Bank was the only stem cell banks in China. According to its Beijing Branch Director (Interviewee 10) almost 90% of the stem cell bank's expenditure came directly from the government. Its daily operation also depends on sister government or semi-government agencies, such as the Beijing Red Cross, key transplant hospitals, and local Communist Youth League Committees.

However as the national bank is comfortably positioned in the web of government institutions, it showed little interests in promoting public understanding of the risk and benefits of blood stem cell transplant. For its Beijing Branch, a better managed division of the national bank, most donor recruitments relied on 'volunteers sent by universities or work units to meet the annual semi-political mandates made by local Communist Youth League and local Offices of Conduct (*Jingshen Wenming Ban*). Although many submitted their blood sample, few would eventually agree to be registered as potential donors. During the period between 1992 and 2001, China Stem Cell Bank only has a registry of 20,000 records, a database that was only one-tenth the size of the stem cell bank in Taiwan. It was too small to provide service for the 4 million newly diagnosed patients each year.

In 2001, Liu Zhengchen, a Peking University student was diagnosed of leukaemia and needed a blood stem cell transplant. However, as with many leukaemia patients, the national bank failed to find Liu a match at the time. Fortunately for Liu, his condition allowed him to switch to medication as alternative treatment. Liu survived but was deeply disappointed by the national bank. In the following year, he and his fellow students initiated a 'Sunshine 100 Project' at Peking University, with the aim of promoting public awareness of blood stem cell transplant and recruiting 100 volunteers for their own blood stem cell bank. With much help from student associations of Peking University and a bit of luck, although Liu's 'bank' had limited number of registered donors and little private funding, it was able to pair the first transplant match in January 2003 (www.isun.org). Two years after its foundation, Liu's bank already upgraded its aim to 'Sunshine 10,000' (Xiao, 2004).

It was around this time, that the national bank first contemplated a merger with the Sunshine Bank. At the time, such proposal was considered a 'friendly gesture' and 'favour' from the national bank (Interviewee 10 and 32). It would create a win-win situation, where the Sunshine Bank not only receives political endorsement but also automatically benefits from national scale institutional support and the national bank assimilates the positive societal image created by this burgeoning student initiative. But this offer was turned down by Liu. The Beijing Branch Director's initial reaction was, 'What do they think they can achieve? They've got no government endorsement or backing. They are just a student association.'

However, it seemed that Sunshine Bank's potential was underestimated by the national bank. Not only did their registry expanded, but they also set up a donors club, offered free data searches, hosted public concerts, university lectures and other fund raising activities. What is worth highlighting was that, unlike the national stem cell bank's reliance on governmental support, Liu and his colleagues closely worked with international networks, such as the US Morrow Donor Program, Bone Marrow Donors Worldwide and Gift for Life. The aim was both to seek technical assistance and to incorporate managerial experiences and public engagement strategies (www.isun.org). In the years that followed, several attempts of negotiating a merger were made by the national bank, but were all turned down by the Sunshine Bank. Liu explained his stubbornness as follows:

> My initial motivation in setting up a blood stem cell bank was because I was denied treatment since the national bank cannot find me a donor. And I thought it would help other patients if we can set up an alternative source for people to look for transplant matches… I can set up an individual organization and let them [national stem cell bank] see how things could have been done differently and influence them. But of course, this is not to say that the national bank is all bad, we also learnt a lot from them.

In a 2008 official correspondence from Sunshine Bank to the China Stem Cell Bank, two points were made clear: a) Sunshine Bank welcomed any form of collaboration with the national bank and opened its database to the national bank so as to facilitate donor searches; and b) the Sunshine Bank reaffirmed its position on remaining an independent organization (Sunshine Stem Cell Bank, 2008). In fact, after years of application and appeal, in April 2009, the Sunshine Bank was granted full legal status as independent civil organization by Beijing's Civil Affair Bureau. By that time, this grassroots student association had became more than a stem cell bank, but a comprehensive leukaemia-focused health institution, known as the New Sunshine Charity Foundation. It not only provides database searches and exercise programs for leukaemia patients, but

also offers supporting forums and an information centre for the patients' family.

It then became clear that a merger may never take place. However, during the years of scepticism and rivalry, the China Stem Cell Bank also much improved its work efficiency, with its database increased almost four folds (www.bjmdp.org.cn). During my site visits to the Beijing Branch in 2007 and 2009, the operation of the national bank also became attentive in assimilating international experiences, supporting patient group events and hosting regular public engagement activities. Thus to some extent, there was a win-win situation in the field of blood stem cell banks. It was just a different sort of win-win from what the national bank had originally envisaged.

Sunshine Bank is but one example of how previous state dominance has been displaced by non-government initiatives as China's stem cell research progresses. However it may be the most celebrated example. This is not only because it's an achievement led by a surviving leukaemia patient, but more importantly, it attests to the extent in which access to global (financial, managerial and professional) alternatives enables Chinese stakeholders in altering the map of scientific governance in China. In fact, it indicates grassroots' potential in challenging and reshaping domestic power relations, which was commonly thought as impossible within the Chinese context only a decade ago. Two further points deserve to be highlighted.

Firstly, Liu and his colleagues made particular efforts in maintaining organisational independence from government control. However, their success did not solely depend on assimilation of international experiences and networking with global partners. Rather the growth of Sunshine Bank was equally a result of exploiting China's social opportunities (such as public lectures and charity concerts) and new political schemes (such as NGO status registration). Thus the long-strived displacement of government dominance was less of an act of antagonism, but more of a strategy to effectively promote China's leukaemia community's knowledge of 'how things could have been done differently'.

This leads to my second point. What motivated Liu and his colleagues in establishing a civil stem cell bank was not an disagreement of principal, such as whether stem cell banks should be privatised, or whose managerial procedure should be followed. Neither was it so much about competition with the national bank, as Sunshine Bank welcomes collaborations with the national bank and hosts an open database. Rather Sunshine Bank cheery-pick fund raising techniques, professional codes of conduct, global and national resources in serving one practical concern: to 'help other patients'. It is from the perspective of protecting the interests of leukaemia patients that Sunshine Bank sought for both organisational independence and cooperation with national institutions.

In short, at the onset, stem cell research in China was organised through a hierarchical nation-state apparatus. Ministerial institutions functioned as the main gateway of commissioning scientific resources and national agendas to selected scientists. Increasing global communications and exchanges naturally opened Chinese scientists to global funding options, transnational collaborations and international research norms. However, global possibilities were not merely a dilution of nation-state dominance, but, as exemplified by the Sunshine Bank, could also revolutionise governing structures at home. The national monopoly of the stem cell donor registry is now replaced by a shared influence between a civil and government bank.

Case study two: The 're-nationalization' of synthetic biology

In contrast to stem cells, synthetic biology's initial development in China was not driven by national developmental directives, but mainly benefited from transnational initiatives. China's first synthetic biology-related project, launched in October 2006, was part of the 'Programmable Bacteria Catalyzing Research' (PROBACTYS) project, funded under the EU's Sixth Framework Programe (Yang, 2010). China's first synthetic biology centre, the Edinburgh University-Tianjing University Joint Research Centre for Systems Biology and Synthetic Biology, was also the fruit of cross-border collabotrative effots (Zhang 2008).

In addition, China's involvement in synthetic biology was largely promoted by the participation of students in the International Genetically Engineered Machine competition (iGEM), an international undergraduate contest initiated by the Massachusetts Institute of Technology in the

USA. Before the iGEM training workshop hosted by Tianjin University in spring 2007, there were no research records and only two literature reviews on synthetic biology in Chinese scientific databases (Zhao and Wang 2007). According to Chunting Zhang of Tianjin University, a leading figure in promoting synthetic biology in China, it was during these workshops that Chinese research institutions joined their efforts for the first time (Zhang, 2008). From the onset, the organization of these workshops were engaged in international networks. World leading synthetic biologists, such as Drew Endy and Christina Smolke, were invited. Later that year, another training camp designed for iGEM tutors was organised in Tianjin and included delegates from Australia and Japan (Zhang, 2008). During the 2010 competition, eleven teams from nine universities in six provinces/municipalities participated.

Training for iGEM has grown beyond winning student awards and has become a key component in Chinese researchers' exchanges with the international community (Ding, 2010). Many Chinese scientists interviewed recounted how their initial involvement in synthetic biology overlapped with their participation in tutoring iGEM teams. One associate professor at Tianjin University, who wrote China's first undergraduate text book on synthetic biology, half-jokingly said, "I mainly learnt [synthetic biology] through tutoring new iGEM teams every year."

Increasing involvement with these transnational initiatives not only helped to popularise synthetic biology in China, but also influenced how Chinese scientists situate themselves in global scientific community. One indicative example is that the iGEM competition involves using standard biological parts (BioBricks) and subsequently submitting new BioBricks to an open registry based in the US (biobricks.org) for future sharing. During my fieldwork, I asked one team whether there has been any plan in setting up a 'national bank' for hosting all designs from Chinese iGEM teams to benefit domestic teams. Both the tutor and team members thought this proposal a bit "strange". The team captain responded:

> But why? There is no need. With BioBricks Foundation, we can get any parts we want quite easily. Plus, it directly connects us with all the data produced by iGEM teams around the world, let alone in China. A national bank would just be a small-scale duplicate. (Interviewee 54)

The response was pragmatic. The main point, as far as Chinese teams were concerned, was to employ standard biological parts in their laboratory designs. As long as they have access to a good pool of resources, they were indifferent to whether it carried an 'international' or 'national' label, or whether it was based in the US or in China.

The sense of being an integrate part of the fabric of global society is also exhibited in Chinese synthetic biology community's proactive approach in engaging with international debates. Chinese scientists are keen to increase their visibility in the formulation of international regulatory norms. The CAS and the Chinese Academy of Engineering are currently engaged with their peer institutions in the UK and the USA to "design more robust frameworks for oversight, intellectual property and international cooperation" on synthetic biology (Royal Society, 2009, p11).

Yet in discussing the roadmap for further advancement of synthetic biology, these globally well-networked individuals turned to the nation-state for support. Towards the end of 2009, the Chinese Academy of Sciences hosted a series of conferences on synthetic biology. According to the interviewees, one of the main outcomes was the founding of a 'China Synthetic Biology Coordination Group', which was an informal association of around 30 conference delegates from various research institutions. This group formulated a 'Regulatory Suggestion' to MOST, which stated the necessity and implications of supporting synthetic biology-related research. More specifically, this 'Coordination Group' appealed to MOST to play a key role in integrating national expertise through a 'Big Question' approach.

It might be very tempting to equate this '"moon-landing" project' analogy as yet another national stride towards a new modernity. However, if one were to reduce what's happening in China's synthetic biology research to techno-nationalism, and see 'nation-state' as the key unit of analysis (Edgerton, 2007), then one would miss the actual dynamic and significance of this scientific development.

Firstly, to date, the principal drivers of synthetic biology in China were not state authorities, but individual scientists from different parts of China. It is useful to recall that even before

synthetic biology appeared on MOST's agenda, these grassroots scientists had collaboratively set up an elaborate network of training programs and an informal Coordination Group. Not only was state involvement a result of a grassroots request, but also the role of such involvement was, to some extent, prescribed in the 'Regulatory Suggestion'. As one Academician, who contributes to MOST consultations, explained, 'It [the 'Big Question' approach] was initially conversations among us scientists over the past couple of years. We saw this as an alternative way to keep up with international development and possibly lead to some scientific breakthrough. But we are happy to see that the Ministry is excited and wants to support such an idea as well' (Interviewee 55). It is, of course, still too early to tell how MOST will fulfill its expected coordinative role and how power relations may evolve after the state institution enters the picture. But what was already apparent was that state involvement should not be taken for granted. It was urged and shaped by a series of bottom-up endeavors: assessments on the value and strength of national and global resources (such as BioBricks, professional network, global funding and national administrations), reflections on existing operational arrangements and actions on basis of these considerations. In the case of synthetic biology, it was cross-sector organization that needed to be enhanced, and scientists demanded such performance from government ministries.

Secondly, the primary concern of the Big Question project was more embedded in scientists' respective professional interests, rather than in a nationalistic vision. According to one professor in Beijing, who was a key initiator of the Big Question approach, the proposition of a nation-wide synergy was not so much to develop a 'Chinese' synthetic biology but concerns research practicality. She explained, "synthetic biology is at the convergence of many disciplines, computing modeling, nano-technology, bioengineering, genomic research etc. Individual researchers like me can only operate on part of the production chain. But I myself would like to see where my findings would fit in a bigger picture as well. It just makes sense for a country the size of China to set up some collective and coordinated framework so as to seek scientific breakthrough." (Interviewee 58)

Similar to the case of stem cell research, the development of synthetic biology in China has a cosmopolitan feel to it. In the eyes of Chinese scientists, national and international resources are but one accessible global pool. From its emergence to its ongoing development, cross-border initiatives, such as international student competition and transnational funding opportunities, all play a vital role. Yet factors such as geographical proximity, language, collegial familiarities, and shared interests in economic development also attracted Chinese scientists to the national strategy as a sustainable mid- to long-term coordination amongst various research groups across scientific disciplines and industrial sectors. Neither the national nor the global frame would allow us to perceive the relations of dominations at work in full. Rather it requires a combination of the two.

Discussion: A Swing of the Pendulum

In the last few years, there seems to be a swing of the pendulum in China's life sciences communities between taking national and global routes of development. In the case of stem cell research, the pendulum swung away from centralised hierarchical control towards a de-nationalisation of research practice and governance. In the case of synthetic biology, the opposite holds true. A globally well-connected research community appealed to a national research agenda and a centralised coordination amongst domestic groups. It is difficult, if not impossible, to make any conclusion (or even prediction) on *where* the pendulum is eventually going to settle.

However, the situation may only seem inexplicable when one, through a techno-nationalism lens, strives to find the 'balance point' between the National and the Global. If China's scientific development is comprehended with a sensitive eye to the fluidity of social boundaries and the versatility of power relations between multiple actors, then a prime question may be: *who* is swinging the pendulum?

In both the de-nationalisation of stem cells and re-nationalisation of synthetic biology, bottom-up initiatives were most visible. Sunshine Stem Cell Bank was initiated by a leukaemia patient, started with limited private funding, and operated, for the larger share of the last decade, as a student association. The new 'moon-landing' grand scheme of synthetic biology also originated from

grassroots communications amongst Chinese scientists and was jointly proposed through an informal *ad hoc* scientific group.

This finding is important, as it indicates a powerful corrective to a common approach in perceiving scientific development. How science advances is often set on the premises of how societal institutions (such as the government) could best 'open up' and respond to *the relevance of grassroots social actors* (Stirling, 2008; Callon, Lascoumes and Barthe, 2009). This may be especially true for China. Despite an increasing ratio of overseas-returns, 'top-down interference' from government institutions are still believed to be an overriding influence. However, I argue, we should at least be aware of the possibility (or in the two cases of China's life sciences, a reality) of a fundamental *overturning* of how this dynamic is formulated. That is, it may be *the relevance and utility of a nation-state* that is subjected to a bottom-up evaluation, criticism, questioning and (re)conceptualisation in the development of scientific governance. This developing grassroots capacity is not unique to Chinese life sciences. In fact, contemporary cosmopolitan investigations (Beck, 2006;

Cabrera, 2010; Harvey, 2009) repeatedly highlight the bottom-up initiatives in mediating immediate social particularities and global alternatives.

Of course, this is not to say that the nation-state is 'irrelevant' or 'insignificant'. In both cases, the Chinese government remained vital. In a negative sense, the irresponsiveness and inefficiency of the government hampered the development of science, such as in the case of stem cells. In a positive sense, government input and national coordination were still essential in securing mid- to long-term research advancement and promoting regional scientific competitiveness. But it is also important to be reminded that Chinese iGEM victories and Chinese joint synthetic biology projects and ethical discussions all took place before the government got involved. In the case of stem cells, despite the complex long establishment of the national stem cell bank, a patient's discontent eventually led to a disruption of government dominance in this field.

More importantly, contrary to an implicit techno-nationalism assumption that state contribution is essential for scientific progress, in both case studies, state presence was decoupled from national scientific competence. For example, a national biobrick registry was considered as redundant in improving national competitiveness at iGEM. Despite China's early foundation of a national stem cell bank, it was not until the establishment of a civil bank a decade later that the national database started to show fast expansion. Thus, in addition to expanding a nationalistic gaze to an attentiveness to a multiplicity of social actors, it may also be important to consider a possible reformulation or even an overturning of social dynamics among these actors.

A second point that can be drawn from the two case studies is that the relevance of the nation-state was identified and steered through what I termed as a sense of 'cosmopolitan practicality' on the ground. It is a sense of practicality as in both cases stakeholders reshaped the government's role to better accommodate their interests, such as patient benefits (as in the case of stem cells), long-term support and local conveniences (as in the case of synthetic biology). I want to further draw attention to the 'cosmopolitan' nature of such practicalities, as they are initiated and advanced by 'globalisation from within' (Beck, 2002, p17) or a contextual reflexivity towards global alternatives.

To begin with, in both case studies, the framings of stakeholders' rationales were primarily based on exploiting a world of potentials. For example, it would be extremely difficult, if not impossible for a leukaemia patient to launch a competitive stem cell bank in the absence of technical supports from international agencies. Chinese synthetic biology scientists would probably not have gained leverage or been persuasive with Ministry of Science and Technology had they not been networked within the global community. However it is equally important to note that both cases exhibit not an either/or logic of either going national or going global, but a both/and scenario, in which domestic and international advantages are synthesised. Chinese stakeholders interviewed demonstrated not only a global openness but also an appreciation for plurality.

Moreover, the cosmopolitan nature of Chinese stakeholders' rationales also exhibited an open-ended reflexiveness. In both cases, bottom-up initiatives (e.g. the improvement of stem cell bank management and the involvement of the ministry) were directed by continuously comparing, reflecting, criticising and mediating diverse practices at home and abroad. They were not

aimed to follow a certain 'prototype' or to adhere a set of absolute principals. Rather these initiatives were primarily guided by what 'made sense' and left open the door of introducing 'how things can be done differently'.

Concluding words

How nation-states instrumentalise science and scientific communities in driving its development agenda has long been a central question in feeling the pulse of scientific advancement in Asian countries, such as China (Ong and Chen, 2010; Schneider, 2003). However, findings in the recent development of stem cell research and synthetic biology in China seem to question the appropriateness of a conventional nation-state focused line of inquiry.

For both the development of stem cell research and synthetic biology, the significance and relevance of government institutions were not taken for granted by Chinese stakeholders. Rather, the relevance of government input are, to various degrees, challenged, reflected upon and reshaped through grassroots practicalities in reference to global alternatives. In the case of stem cells, despite generous state funding and permissive regulations, Chinese stakeholders discerned that following national directives alone was not enough in ensuring scientific excellence or efficiency. Foreign experiences and resources were employed as an extension or corrective to existing national frameworks. In the case of synthetic biology, the nation-state originally played little role. To some extent, it was the scientists that steered China's ministerial involvements into this field.

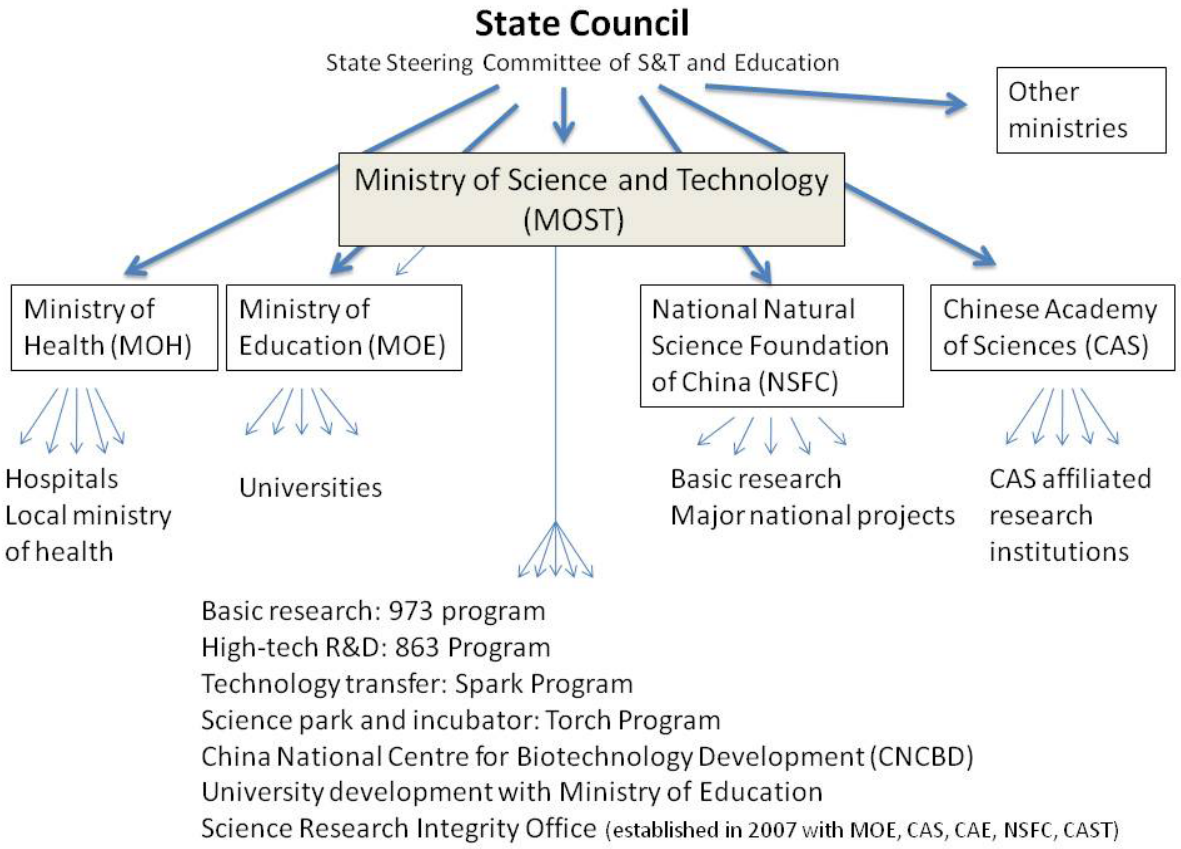
I have demonstrated throughout the paper how a bottom-up synthesis of national and global resources denotes a 'cosmopolitan' outlook. I further elucidated in the Discussion that the importance of recognising emerging bottom-up power leverages lies not simply in a new division of dominance, but also may indicate a more radical change to power relations between social actors. The governance implications of such findings are at least twofold:

Firstly, even in cases where the structure of the national innovative system remains the same, the actual governing dynamics at work may still be contextual and in constant flux. In the case of China, it is well acknowledged that its science and technology administrative framework 'has not implemented any major changes for more than 20 years' (Zhong and Yang 2007, p324). The two cases studies this paper examined took place in an overlapping period of time. However, the relations between grassroots actors and government institutions were quite different, and these relations change within respective scientific context over time. For example, the relations between Sunshine Bank and the national bank evolved from antagonistic to mutual respect. At least at the time of the author's fieldwork, there was a sense of collegiality rather than a chain-of-command between synthetic biologists and MOST.

Secondly, and related to this first point, the empowerment of a multiplicity of social actors may expand the sources and incentives for regulatory change. To be sure, the national agenda is still important in advancing science. Yet in both stem cell research and synthetic biology, progress in the organization of sciences was not guided by the concern of the national economy or national competitiveness, but was generated by a diversity of influences, such as alternative patient care, professional codes of conduct, international funding opportunities and local industrial concerns.

Correspondingly, for social scientists, there may also be a need for reframing sociological enquiries. This means not only an expansion of nationalistic frameworks to accommodate diverse actors, but also a sensitivity to the fluidity of power dynamics within and without national borders. Instead of weighing the transfers and shifts of influence amongst existing conceptual categories, it may be more fruitful to empirically examine how dominance is formulated and steered on the ground.

Figure 1: Administrative framework regarding stem cell research



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