Scientific Multipolarisation: Its Impact on International Clinical Research Collaborations and Theoretical Implications

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The article explores the contemporary dynamics of global scientific multipolarisation, and the empirical and theoretical implications of this trend for international clinical research collaborations. The focal point of the article is an ethnographic study of the China Spinal Cord Injury Network (China SCI Net), a transcontinental clinical research infrastructure that is active in Mainland China, Hong Kong, Taiwan and the US. Based on findings from this case study, the author suggests that the transition toward a multipolarising science world is associated with significant changes in the ways international collaborations are initiated, organised and justified. For many years, clinical research collaborations between partners in high- and low-to-middle-income countries have involved geographically bound hierarchies between the sponsors, intellectual creators and facilitating technicians of the research. However, the data from the China SCI Net indicate that these boundaries are in important respects transcending, and that a new modality of international clinical research organisation may gradually be taking shape. Theoretically, this article engages in a reflective dialogue with post-colonial theory, and post-colonial science and technology studies. The author suggests that several of the analytical tools that post-colonial science studies offer remain of great relevancy also in the context of a multipolarising science world. Simultaneously, however, the conceptual, methodological and ideological presumptions embedded in post-colonial theory require careful scrutiny, and other complementary strategies are required to capture the impact of the current multipolarisation process in the sciences more completely.

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Introduction

In recent years, post-colonial theory has led to a vital field of inquiry in science and technology studies (STS) and the anthropology and history of the sciences. Initially under the heading 'Postcolonial Science Studies' (Harding, 1994), later under the label 'Postcolonial Technoscience' (Anderson, 2002), this evolving analytical programme has explored how knowledge, scientific practices and technology 'travel' across cultural, socio-economic and geopolitical borders. Attention has been drawn in particular to the historical circumstances and politico-economic relations that have enabled and shaped these flows, and to the ways in which these motions have transformed local situations and subjectivities (Prasad, 2008). The vantage point of these studies has initially been the residual effects of European colonialism on processes of post-colonial science, state and identity formation. Since the late 1990s, however, post-colonial science studies have increasingly addressed also 'new forms of exploitative global relations' (McNeil, 2005). Harding has summarised these, as processes of 'neo-colonisation and neo-imperialism' (2009, p. 406), which have evolved in relation to more contemporary manifestations of 'European–American empire' (Harding, 1998, 3).

In a series of recent essays, Anderson (2002, 2009) and Anderson and Adams (2008) proposed more subtle ways of using post-colonial theory for the study of processes of science and globalisation. Rather than departing from 'simple [notions] of dominance and submission' (Anderson, 2009, p. 392), the authors suggest exploring post-colonial exchanges, flows and forms of relatedness, as processes of complex entanglements, hybridisation and heterogeneity. Most noteworthy, Anderson and Adams (2008) have proposed to enlarge the post-colonial agenda in STS beyond the study of post-colonial societies, and to integrate post-colonial analytical tools and perspectives, for the study of science and globalisation at a more general level. The authors state the following:

> Postcolonial analysis […] offers a flexible and contingent framework for understanding contact zones *of all sorts* [my italics], for tracking the unequal and messy translations and transactions that take place between different cultures and social positions, including between different laboratories and disciplines even within Western Europe and Northern America. (2008, p. 184)

If my interpretation is correct, the clause 'contact zones of all sorts' means in this quotation not only a focus on the making of science in 'postcolonial societies' and in relation to 'the West', but to science *interchanges* between potentially *all* places. Whether or not I am on the right track is touched upon in a statement they make later, in the same text. The authors ask the following:

> If we now recognize complex sites of technoscience outside Europe and North America, what do we know about travel between these places? How do we avoid default to the old stories of the expansion of Europe, and instead manage to recognize the multiple vectors of technoscience? (Anderson and Adams, 2008, p. 189)

With these questions, it is of my opinion that Anderson and Adams indicate a fundamental alteration of the analytical scope of post-colonial science studies. They take seriously the changing geographies of exchange and collaboration that emerge in relation to (and between) the currently evolving scientific and geopolitical centres outside of Europe and Northern America. If this is so, then the authors would have 'liberated' the field from its defining—but single-minded—focus on the transformative global role of 'the West' and, at the same time, open up new research pathways for post-colonial studies of technoscience at a time when American–European forms of global hegemony are increasingly under pressure. Post-colonial technoscience would, thus, evolve into an analytical framework for the study of science and globalisation in a very open and general sense.

Science and Multipolar Globalisation

Just how appropriate is the use of a post-colonial analytical framework for studying science and globalisation in the contemporary world? Globalisation, after all, is increasingly driven by multiple geopolitical and economic force fields and scientific centre regions, in an era in which Europe and the USA are dealing with various crises, and have less political and economic influence globally. Is a post-colonial framework sufficient to capture the complex dynamics, the changing forms of partnership and activity, and the redirections of global flows, power, property and infrastructure that are occurring in the evolving multipolar scientific world system?

In this article, these issues will be addressed by exploring the empirical and theoretical implications of the current trend of scientific multipolarisation, with a particular eye on international clinical research collaborations. My focal point is an ethnographic study of the China Spinal Cord Injury Network (China SCI Net), a transcontinental academia-centred clinical research infrastructure that is active in mainland China, Hong Kong, Taiwan and the US. Based on this case study, I suggest, that the transition toward a multipolarising science world is associated with significant changes in the organisational forms of international clinical research partnerships, and in the ways these are initiated and legitimised.

Clinical research collaborations between partners in high- and low-to-middle-income countries have for many years been based on geographically bound hierarchies between the sponsors, intellectual creators and facilitating technicians of the research. The findings from the China SCI Net suggest, however, that this situation is in important respects transcending, and that a new organisational modality of international clinical research collaborations may gradually be taking shape. The study of the China SCI Net indicates too, that the conceptual, methodological and ideological presumptions embedded in post-colonial theory require careful scrutiny. Complementary analytical strategies are required to capture the impact of the current multipolarisation trend in the sciences more completely.

Part I of this article introduces the concept of scientific multipolarisation and outlines the ways in which the transition towards a 'multi-polar science world' (Veugelers, 2008) is described in the existing literature. Part II considers the limitations and potential pitfalls of post-colonial analysis for the study of science in the context of multi-polar globalisation. Part III presents the organisational structure of the China SCI Net, and explains how this model differs from (a) clinical trials organised by the drug industry, and (b) other academia-centred clinical collaborations between high- and low-to-middle-income countries. The article ends with a conclusion. Before I proceed, however, a brief note on methodology.

Methodology

A combination of ethnographic fieldwork, documentary research and literature review was used to inform these discussions. Fieldwork was conducted over a period of ten months in Hong Kong, Taiwan and mainland China, between April 2010 and April 2011. The operation of the China SCI Net was analysed against the wider background of clinical stem cell research and applications in these regions, particularly in mainland China (Rosemann, 2012, 2013). The data generated in Taiwan are not included in this article because the main activities of the Network during the fieldwork stage took place in Hong Kong and China. Open-ended in-depth interviews were conducted with twenty-eight people affiliated to the Network. These included senior executives, principal investigators, clinical researchers and fundraisers, from ten participating hospitals and institutes. Documentary research was conducted using text sources provided by people from the Network and from the Internet, scientific papers, opinion pieces, newspaper articles, as well as video-documentation of panel discussions and presentations during international symposia organised by the China SCI Net. The article draws, furthermore, on observations of scientific conferences, expert meetings and visits to hospitals and research centres.

Part I: Scientific Multipolarisation

With the term *scientific multipolarisation*, I refer in this article to the emergence of new scientific centre regions in the world; these significantly change the way in which scientific and technological resources, opportunities, artefacts and products are globally realised, accessed, distributed and applied. According to Wagner, a global science system is emerging in which the USA and Europe will be two single players among several others (Wagner 2011, cited in Swayne and Messer 2011, p. 1). Similar conclusions can be drawn from the US National Science Foundation's (NSF) science and engineering indicators. Using the 2008 figures, Veugelers (2008) describes the shift in the status of European Union (EU) and the TRIAD countries (USA, EU and Japan) as follows:

> The evidence demonstrates that despite the continued dominance of the US and the increasing importance of the EU, the TRIAD is in relative decline. Other geographic sources of science outside the TRIAD are rising, both in quantity, but also, although still to a lesser extent, in quality. Especially China drives this non-TRIAD growth. This catch-up of non-TRIAD countries drives a slow but real process of global convergence. (Veugelers, 2008, p. 14)

The NSF indicators for 2012 show the rapid upswing of non-Triad countries over recent years. In terms of expenditure on R&D (research and development), China overtook Japan in 2009, and now lies second behind the USA (National Science Foundation, 2012, O-4). Another indicator is the relative output of research article. NSF figures reveal a decline in the dominance of papers from the EU and US (National Science Foundation, 2012), again with China taking second place.

> [In 2009] Asia's world-article share had 'expanded from 14% to 24%, driven by China's 16% average annual growth. By 2007, China surpassed Japan's article output and moved into second place behind the United States – up from 14th place in 1995. By 2009, China accounted for about 9% of world-article output. India's output of scientific and technical articles, stagnating through the late 1990s, began to rise after 2000, but India's ranking hardly changed from 12th to 11th place in 2009. Japan's output declined in volume and global share. (National Science Foundation, 2012, O-7)

It is important to note that scientific multipolarisation does not automatically follow the same pattern as economic multipolarisation. The BRICS countries—Brazil, Russia, India, China and South Africa—showed the greatest economic growth over the last decade, but only two of them—China and, to a lesser extent, India—are approaching global leadership status in science and technology. In 2012, the other BRICS nations are still outperformed by small non-BRICS countries, especially those in Asia like South Korea, Taiwan, Singapore and Hong Kong, all of which are likely to become global scientific centres (National Science Foundation, 2012). A 2011 report by the Royal Society (2011) proposed the following:

> …the strength of the traditional centres of scientific excellence and the emergence of new players and leaders point towards an increasingly multipolar scientific world, in which the distribution of scientific activity is concentrated in a number of widely dispersed hubs. (Ibid., p. 5)

The trend towards scientific multipolarisation is increasingly driven by multinational corporations. This is not only reflected by the offshoring of the R&D laboratories from US and European multinationals to the new scientific centre regions (Scholtissek, 2008), but progressively by the merging and acquisitions (M&A) of companies in the Triad's regions by non-Triad multinationals. As Sleigh and Lewinski point out, through M&A these corporations gain access to the R&D laboratories of established and high-quality enterprises and brands. In doing so, they at once move to the top of the global value chain, and furthermore, obtain access to established marketing and branding strategies (2006, p. 50). This is not a trivial process. According to the 2012 *Forbes Global 2000 Companies List*, more than half of the world's largest corporations are now in countries other than the USA and Europe. South Korea, with its relatively small population hosts 68 companies, and China hosts 106—up from 44 in 2007 (DeCarlo, 2012).

As a consequence, the flow of capital and investments is being substantially redirected. Large-scale foreign direct investments (FDIs) are being made by multinational corporations of emerging economies for acquisition of US-American, European and Japanese companies, including well-known ones who produce well-established brands. According to Sauvant, Maschek and McAllister, (2010), there has been a forty-fold increase in outward FDIs from emerging economies in the last three decades alone—rising from US$50 billion in 1980 to over US$2.1 trillion in 2007.

Part II: Scientific Multipolarisation and Post-colonial STS

In their essay 'Pramoedya's Chickens: Postcolonial Studies of Technoscience', Anderson and Adams (2008) point out the need for a 'critical spatial consciousness', which allows the identification of trans-local schemas of connectedness, of forms of asymmetric exchange, of heterogeneous practices and contestation. As analytical foci, the authors proposed:

> A multiplication of the sites of technoscience, revealing and acknowledging hidden geographical notations and power relations, and further study of the mechanisms and forms of travel between sites. It means we have to be sensitive to dislocation, transformation, and resistance; to the proliferation of partially purified and hybrid forms and identities; to the contestation and negotiation of boundaries; and to recognizing that practices of science are always multi-sited. (Anderson and Adams, 2008, pp. 183–184)

This quotation, and other passages in the text, reveal six inter-related core themes of the study of science and globalisation. These analytical themes are as follow: (a) the study of transnational flows and forms of connectedness; (b) a focus on heterogeneity/multi-perspectiveness; (c) a concern with hybridity and processes of hybridisation; (d) the tracking of power asymmetries and related inequalities; (e) a preoccupation with processes of contestation and resistance; and (f) a focus on science as situated practice (Rosemann, 2012). It is obvious, that these analytical themes will remain of central importance to a nuanced understanding of the operation of science also in the context of a multipolarising scientific world system. Post-colonial studies have, furthermore, introduced what Rizvi has called the 'five epistemic virtues' of post-colonial theory – historicity, reflexivity, relationality, positionality and criticality (2009, p. 109). These 'virtues', no doubt, will remain at the centre of nuanced globalisation scholarship. Post-colonial studies of science and technology, in sum, offer crucial analytical tools to the study of science, in the context of multi-polar globalisation. There are, however, also significant pitfalls, regarding the use of post-colonial analysis.

The Historical, Geographic and Political Connotations of Post-colonial Theory: A Source of Bias?

The central reference point in post-colonial science and technology studies has been a deep-seated and critical concern with the historical roots of the contemporary sciences, and the ways in which colonial forms work through, or are replicated (in one way or the another) in the present. As Seth puts it: 'The history of almost all modern science, it has become clear, must be understood as 'science in a colonial context' (2009, p. 374). Most of the empirical situations that the field addresses, thus, have been grounded in the study of the global impact of Euro-American forms of dominance; first in relation to colonialism, then in connection to other forms of control, such as those embodied in development, neoliberal trade policies, or foreign military interventions. The investigative counterpoint in these studies remains essentially 'the West'. Hence, the practices, techniques and discourses of domination, and their trans-local responses, which have been the objects of analysis in post-colonial science studies, have grown out of very specific historical, cultural and geopolitical contexts. Moreover, these investigations have been part of a critical and emancipatory political project, that aimed to deconstruct and overcome colonial assumptions, definitions and stereotypes. The analytical repertoire that post-colonial analysis provides, therefore, is far from 'neutral'. Its application in new historical contexts must be combined with a critical appraisal of its methods and concepts, and the underlying assumptions, values and political agendas on which they are based. Three issues shall be discussed in this respect.

Implicit Assumptions, Encoded Beliefs

The first refers to reified imaginaries of knowledge through fixed geographic categories. Abraham (2006) notes in this respect, that 'knowledge that is western' is sometimes conceived as 'a fixed knowable and dominant entity', which is 'counterposed to other [knowledges]' that are framed as 'alternative' or 'unmodern', and 'characteristic of subaltern or marginal sites in a global political economy' (Abraham, 2006, p. 210). A related point Abraham makes is that such geography-bound forms of knowledge reifications (that is, claims in which specific forms of knowledge are treated as concrete and clearly separable objects, that are bound to particular territories) frequently go hand in hand with a host of other implicit assumptions in post-colonial science studies. These, his text implies, are often tacitly presupposed, rather than empirically verified (Abraham, 2006, p. 210). What Abraham refers to are encoded beliefs on 'unequal exchanges', 'exploitation' and 'clashes' between 'Western' and 'alternative' knowledges, that are frequently presumed—rather—than thoroughly deduced from empirical studies of actual practices and perceptions of people (Abraham, 2006, p. 210). In identifying and addressing '"local" and incommensurable knowledges that are build around non-western ontologies', Abraham's critique continues, post-colonial technoscience studies evoke notions about 'the invisible knowledge work of subalterns being subsumed into capitalist property relations that will eventually lead to exploitation, expropriation and even extermination' (Abraham, 2006, p. 210). Abrahams critique may be overstated, but in the light of the current global transformations, in particular the shift towards scientific multipolarisation, Abrahams' points are of significance. This will be shown in the next section.

Voluntary Engagement, Changing Geographies of Inequality

In the currently evolving scientific and political global centres, there is a widespread, typically voluntary and strategic engagement with 'Western' knowledge forms, technologies, and scientific methodologies. These processes are usually intensely promoted from within—not imposed from the outside. In this process, newly imported forms are disassembled, locally transformed, merged with other knowledge practices and developed further. These hybrid forms, and domestic inventions, are utilised for projects of independent innovation, economic development, and national self-strengthening. Indeed, it is difficult to say whether and where concepts of 'foreign' and 'domestic' start and end in light of the complex, trans-local joint production of scientific forms, escalating interdependencies and multi-directional flow of knowledge.

In this complex global field, forms of asymmetric exchanges and the strategic use of various types of differentials will, of course, continue to exist, and must be identified and mapped. Furthermore, a critical engagement with the global role of science and power in the US and European societies remains in this respect vital. However, the fact that the production of science is now increasingly marked by multiple vectors and geopolitical force fields, and the implications this has, will have to be explored in greater detail. The diversification of geopolitical and economic influence across several global centre regions simultaneously, will—aside to manifold opportunities—almost certainly also result in novel forms of subjectification, utilisation, and dependencies. There will also be revised patterns of regional peripheralisation and exclusion. Many of these processes, however, are likely to occur *not* in relation to manifestations of North American or European power, but in relation to the activities of other emerging spheres of influence.

Intermediary Conclusions

In sum, to push post-colonial studies of technoscience beyond its conventional analytical focal points requires a nuanced awareness of the current historical and geopolitical transformations that drive the formation of global scientific centres outside of Europe and Northern America. It requires, furthermore, a detailed understanding of the implications of these processes (with respect to forms of global labour organisation, competition, interdependencies, changing identities, shifting patterns of ownership, political influence, and so on). If post-colonial technoscience studies really start to take seriously the investigation of the global impact and role of the 'complex sites of technoscience outside Europe and North America' (Anderson and Adams, 2008, p. 189), then a mere focus on the 'travel between these places', as suggested by Anderson and Adams, will be too narrow. In order to account for the reconfigurations of global exchange routes, forms of collaboration and geographic patterns of dependency that emerge in relation to these evolving scientific centre regions, such studies would also need to focus on the exchanges between the evolving global 'poles' and economically less advanced regions and countries elsewhere (as reflected, for instance, in China's engagement in African societies). A further area of interest would be, the ways in which these emerging scientific centre regions impact on processes of science and technology invention, production, application and distribution throughout the US, Europe and Japan. The shift towards scientific multipolarisation implies that vital structural changes and social ramifications in these established scientific centre regions can be expected; for instance, through the increase of foreign investments in domestic scientific infrastructures, companies and universities (Scholtissek, 2008).

While the specific details of these transformations remain to be explored on a case-by-case basis, it is apparent that a very specific vocabulary and set of analytical tools are required to capture these dynamics. An open question is, in this respect, whether such investigations should still be conducted under the label 'Post-colonial Science Studies'. While the situation of 'post-coloniality', that is, post-colonial dynamics and the residual impact of colonialism continue to play a role in current globalisation processes, it is one among various historical and political dynamics that shape the deployment of technology and science in the contemporary world.

Part III: Scientific Multipolarisation and International Clinical Research Partnerships

One departure point for studying the operation of science in the context of a multipolarising science world, is a focus on international scientific partnerships, networks and organisations, and the geographies of joint innovation, collaboration and technoscientific exchanges that emerge in this respect. In this third part of the article, I will focus on one such international partnership—the China SCI Net.

On the basis of the data from this case study, I contend that the transition towards a multipolarising global science system goes along with significant transformations of the organisational forms of international clinical research partnerships, and of the ways in which these are organised and legitimised. I suggest, in this respect, that the case of the China SCI Net exemplifies how a new modality of transnational clinical research and trial organisation is gradually taking shape. The organisational forms of this modality differ from both, conventional forms of international clinical partnerships coordinated by Big Pharma, and other academic international clinical collaborations. In this partnership model, geographically bound hierarchies between the sponsors, the intellectual creators, and the facilitating technicians of clinical research, are in important respects transcended. The existence of these socio-spatial hierarchies, however, has epitomised international clinical research collaborations between high- and low-to-middle-income countries for many years. As I will show in the following sections, these changes are intrinsically linked with the current dynamic of global scientific multipolarisation. The increasing availability of finance, cutting-edge technologies, high-end clinical infrastructures, a rich pool of clinical expertise and motivated staff, is resulting in new socio-economic demands, claims for joint leadership, revised patterns of benefit sharing, and more active forms of intellectual participation. Before I start, however, a brief introduction to the China SCI Net.

The China SCI Net comprises 25 hospitals and research institutes in mainland China, Hong Kong and Taiwan. It was initiated in 2005 by Prof. Wise Young, a Hong Kong-born spinal cord researcher from the US. He also founded the W.H. Keck Centre for Collaborative Neuroscience at Rutgers University in New Jersey. The Network was initially set up under the organisational umbrella of Hong Kong University, as a clinical research infrastructure for the developing and testing of promising therapies for spinal cord injury. Since 2009, the network in China is paralleled by a network in the US, the Spinal Cord Injury Network USA (SCI Net US), which comprises eight hospitals.

The China SCI Net comprises twenty-five hospitals and research institutes in mainland China, Hong Kong and Taiwan.[1] It was initiated in 2005 by Prof. Wise Young, a Hong Kong-born spinal cord researcher from the USA. He also founded the W.H. Keck Centre for Collaborative Neuroscience at Rutgers University in New Jersey. The Network was initially set up under the organisational umbrella of Hong Kong University, as a clinical research infrastructure for the developing and testing of promising therapies for spinal cord injury. Since 2009, the network in China is paralleled by a network in the US, the Spinal Cord Injury Network US (SCI Net US), which comprises eight hospitals. Until May 2013, the China SCI Net had conducted six clinical studies (see Table 1). A first, observational study (CN100), was carried out between 2005 and 2008 in twenty-two hospitals, testing

Table 1 Clinical Trials Conducted by the China SCI Net

Name of Clinical Study	*Assigned Interventions*	*Study Type and Design*	*Clinical Trial Locations*	*Number of Recruited Patients*
CN100[i]	None	Observational cohort study	22 hospitals in mainland China, Hong Kong and Taiwan	Up to 600 acute and chronic SCI patients
CN101[ii]	Lithium Carbonate	Non-randomised phase I safety study	MacLehose Rehabilitation Centre, Hong Kong	20 chronic SCI patients
CN102a[iii]	Lithium Carbonate	Randomised placebo-controlled phase II safety/ efficacy study	– China Rehabilitation and Research Centre, Beijing – Buddhist Tzu Chi Hospital, Taichung, Taiwan	57 chronic SCI patients
CN102b[iv]	UCB mononuclear cells/ Lithium/ Methylprednisolone	Non-randomised phase I/II safety/ efficacy study	– Queen Mary Hospital, Hong Kong – Prince of Wales Hospital, Hong Kong	8 chronic SCI patients

Name of Clinical Study	*Assigned Interventions*	*Study Type and Design*	*Clinical Trial Locations*	*Number of Recruited Patients*
CN102b_KM[v]	UCB mononuclear cells/ Lithium/ Methylprednisolone	Randomised phase I/II safety/ efficacy study	Chengdu Army Kunming General Hospital, Kunming, China	20 chronic SCI patients
CN102c[vi]	UCB mononuclear cells/ Lithium/ Methylprednisolone	Randomised phase I/II safety/ efficacy study	Chengdu Army Kunming General Hospital, Kunming, China	60 acute and sub-acute SCI patients
CN103[vii] (in reparation)	UCB mononuclear cells/ Lithium/ Methylprednisolone	Randomised phase III efficacy study	Not yet known	400 chronic SCI patients

Sources: [i] For the full details of this study, see http://www.clinicaltrials.gov/ct2/show/NCT00517374?term=CN100&rank=1; http://www.clinicaltrials.gov/ct2/show/study/NCT00592722?term=china+spinal+cord +injury (accessed on 19 July 2013).
[ii] For the full details of this study, see http://www.clinicaltrials.gov/ct2/show/NCT00431171?term=CN101&rank=1 (accessed on 19 July 2013).
[iii] For the full details of this study, see http://www.clinicaltrials.gov/ct2/show/NCT00750061?term=CN102a&rank=1 (accessed on 19 July 2013).
[iv] For the full details of this study, see http://www.clinicaltrials.gov/ct2/show/NCT01046786 (accessed on 19 July 2013).
[v] For the full details of this study, see http://www.chinascinet.org/index.php?option=com_content&task=view&id=136&Itemid=129 (accessed on 19 July 2013).
[vi] For the full details of this study, see http://www.clinicaltrials.gov/ct2/show/NCT01471613?term=NCT01471613&rank=1 (accessed on 19 July 2013).
[vii] For the full details of this study, see http://www.chinascinet.org/index.php?option=com_content&task=view&id=139&Itemid=129 (accessed on 19 July 2013).

the ability of network-affiliated centres to recruit eligible patients and to collect long-term medical data of overall 600 acute and chronic spinal cord injury (SCI) patients. In 2007 and 2008, a phase I safety study (CN101) and a phase II safety/efficacy study (CN102a) with lithium carbonate was conducted in chronic SCI patients (Wong et al., 2011; Yang et al., 2012). These studies were followed in 2010 and 2011 by two-phase I/II studies in Hong Kong (CN102b) and Kunming (CN102b_KM). These studies tested the safety and efficacy of the combination of umbilical cord blood (UCB) mononuclear cells, lithium carbonate, and methylprednisolone, also in chronic SCI patients. In 2011, an additional phase I/II safety/efficacy study (CN102c) was launched in Kunming. In this study, the combination of UCB mononuclear cells, lithium and methylprednisolone was tested not in chronic, but in acute and sub-acute spinal cord injury patients. These trials were coordinated from the organisation's headquarter in Hong Kong. A multi-centre phase III trial

(CN103) that will include hospitals in mainland China, Hong Kong and Taiwan is being planned for 2014. The SCI Net USA has not yet conducted clinical trials, but a phase II and phase III study are in preparation.

Industry-sponsored Multicountry Trials and Their Organisational Basis

Multi-country drug-research programmes are frequently associated with the outsourcing of clinical trials to low-income, population-rich countries. This trend was initiated by the pharmaceutical industry. According to Petryna (2005, 2007), this trend often follows older forms of labour division and exploitation, with relatively one-sided flows of economic and scientific benefits, and strategic utilisation of relative differences in costs, regulations and biological and epidemiological characteristics of populations. From an organisational perspective—the rules and roles of industry-sponsored clinical trial collaborations are usually firmly fixed, and are defined only by the sponsor. The administrative model used for outsourcing of clinical trials is, in essence, a hierarchised form of contract labour, in which local clinicians, hospitals and contract research organisations (CROs) are assigned to the role of facilitators and technicians. The original innovation underlying the therapy to be tested normally occurs elsewhere, and the research findings flow back from the trial sites to the sponsor. The sponsor, usually located in a different country, legally owns the data and is the only party who can transform the findings into profit (Rajan, 2010).

The organisational model of the China SCI Net differs in many ways, and is based on a more collectivist approach to knowledge production. As I will introduce below, this approach is characterised by (a) processes of collaborative funding, and the sharing of costs and labour among associated partners, (b) the sharing of benefits, as well as a more communal approach to ownership, (c) the flattening of hierarchies and decision-making processes, and (d) the formation of a domestic innovation platform.

Sharing of Costs and Labour among Associated Partners

Funding of the China SCI Net is based on a highly complex organisational model that involves the acquisition of monetary resources through multi-stranded pathways and opportunities. With the exception of sponsorship for the stem cells, which was obtained through the US-Taiwanese umbilical cord blood-bank company Stemcyte, the operational expenses of the China SCI Net have almost exclusively been met within China and Hong Kong. Most money has been obtained through charitable activities within Hong Kong, complemented by resources from local hospitals and grants from provincial governments in China and the Health Division of the People's Liberation Army. Tapping into financial resources within China is highly untypical for an internationally operating clinical trial programme initiated by an overseas researcher, and it may be unprecedented; it certainly has not been reported in the literature before.

The China SCI Net is legally registered as a non-profit corporation in Hong Kong. In the words of the Network's founding director Professor Young, this constitutes a 'membership-based corporate organisation with a non-profit character'.[2] The term 'corporate organisation' is not meant here in the conventional sense of 'company' or 'commercial corporation', but rather (in the words of Young) as a 'professional society', meaning a group of people who are legally authorised to act as an organisational entity.[3] The non-profitable status of China SCI Net is affirmed by the fact that buying or trading shares of the organisation is not possible. Also, there is a self-imposed debarment on the generation of profits from any products or services provided or developed by the group. Money for the organisation is primarily received by way of charity funding in Hong Kong, and its operations are supplemented by government grants and forms of company sponsorship. As Young stated, all incoming money is 'always spent to fund the mission' of the Network.[4]

This academia-centred, non-profit organisational model goes hand in hand with a collectivist approach to knowledge production. Clinical labour and research costs (that is, medical examinations, surgical procedures, patient care) are, in several respects, integrated into the routine work processes of participating investigators and related staff. Furthermore, expenses for hospitalisation, medication, etcetera, are shared between involved institutions if additional grants from hospitals or local government units are forthcoming. Research costs are broken down in this way, into comparably small and 'do-able' portions. Compared to industry-sponsored clinical trial partnerships, in which technological, biological and human resources and services are in each respect hired and paid for, this model embodies a more collectivist and inventive form of cost reduction. As Prof. Young pointed out, high-profile clinical trials are in this way carried out 'far below' the operational 'expenses of the pharmaceutical industry'.[5]

The access to these financial, infrastructure and labour resources in China is achieved through a strongly communalistic approach to knowledge production. In this model, labour, benefits, the generation of scientific data and decision-making processes are, to a large extent, shared among the academic partners. This is the focus of the following sections.

Communal Approach to Ownership and the Sharing of Benefits

Since participation in the Network is voluntarily, and the work of investigators is—in contrast to industry-sponsored trials—not financially remunerated, a benefit and incentive system was developed that differs markedly from conventional models of the drug industry. This involves (a) a distinct approach to data ownership, and (b) unrestrained access to applications of the tested treatment (provided it is proven efficient) by partners in the Network.

There are two central principles affecting the data ownership—the publication of research findings, and the ownership of the information. In the China SCI Net, the contributions and work of the investigators are fully acknowledged in publications appearing in academic journals. Data are stored and analysed at the Network's headquarters in Hong Kong, and the articles are prepared by a writing committee comprising two Network directors and the investigators from the relevant study.

In smaller phase I and II trials, lead authorship status is awarded to the principal investigators of the hospitals in which the trials were conducted. Draft articles for phase III trials will be prepared by the writing committee and distributed for feedback from every involved investigator. Lead authorship is determined on merit and given to the individual in the institution making the greatest contribution; all the other investigators are named as co-authors. Papers are submitted to first-rate journals (Wong et al., 2011; Yang et al., 2012), which, as I determined during interviews with investigators in mainland China, is a strong incentive for participation in the research. In the China SCI Net, the data produced by participating institutions remain the legal property of the institution. Thus, after submission of any collective publications through the China SCI Net, the data can freely be used by the original investigators for any other publication they produce in their own name.

Potential Applications of Tested Treatment

In contrast to drug trials in the pharmaceutical industry, in which tested treatments may be marketed overseas but remain unavailable in the countries in which clinical testing was performed (Rajan, 2010), the trials conducted by the Network give local patient populations full access to the treatment. If, as planned, the safety and efficacy of the stem cell–lithium combination treatment is established in the context of IND (investigational new drug) applications to the drug regulatory authorities in the administrative regions in which the trials are conducted (China, Hong Kong and Taiwan), then every spinal cord injury centre in these regions should be able to offer the treatment to their patients. The surgical and transplantation procedures used for administering stem cells were an innovation of researchers in China, and they are not rights protected; the details will be published and will be freely available, without any intellectual property restrictions.[6] This means that clinicians all over the world can use these techniques with other cell types in trials for spinal cord injury.

The situation is different for the stem cell–lithium combination therapy. Provided it is proved to be safe and efficient, hospitals offering this treatment in the future will be required to purchase their cells from Stemcyte. This is because the sponsorship from Stemcyte was only secured after making a licensing agreement with Rutgers University which protects the company's intellectual property rights for the application of their UCB stem cells in combination with lithium. The higher cost of the patented cells would probably limit access to treatment to middle- and high-income patient groups. Researchers affiliated to the China SCI Net reported, though, that legal prosecution of clinics in China that would offer the combination of lithium and UBC cells from somewhere other than Stemcyte is very unlikely. Therefore, alternative UCB products would probably soon surface in the Chinese market. The licensing agreement made with Stemcyte shows that the boundaries between non-profit and for-profit operations are blurred; commercial and non-commercial interests are inevitably intertwined. The Network may operate as a non-profit organisation, but involvement with corporate sponsors leads to unavoidable commercial and intellectual property rights considerations.

Flattening Hierarchies and Opening up Decision-making Processes

Another difference between the Network and industry-sponsored clinical trials is the flattening of organisational hierarchies and opening up of decision-making. Flattening of hierarchies involves a reduction in the distinctions that normally exist between sponsors, intellectual creators and facilitating technicians. These hierarchies are typical of industry-sponsored collaborations, yet these boundaries are significantly blurred in the Network's interactions. Funding is attracted collectively by senior researchers within the organisation, and—with the exception of Stemcyte's cells—is acquired entirely from within East Asia. The financiering and technical performance of the trials they conduct, thus, often falls into the hands of the same people.

Moreover, network-affiliated investigators have made important intellectual contributions to the development of the stem cell-combination treatment. For example, lithium's effects on cell proliferation and the repair of spinal cord injury were identified by researchers at Hong Kong University (Yick, So, Cheung and Wu, 2004) and some of the earliest preclinical evidence for the efficacy of UCB stem cells in spinal cord injury was obtained by researchers from mainland China (Zhao et al., 2004). Furthermore, investigators from China contributed their unique experiences of spinal cord and cell transplantation surgery.[7] This 'sloping down' of hierarchical boundaries between sponsors, creators and facilitators, as shown above, is realised through collaborative resource mobilisation, and a more egalitarian mode of data and benefit sharing, with less exclusive approaches to ownership of intellectual rights.

The communal, more egalitarian approach is also reflected in collective decision-making processes. These are characterised by open debate and collective evaluation of candidate therapeutic approaches, involving discussion of promising approaches at conferences, workshops and principal investigator meetings. At the first international conference of the China SCI Net in Hong Kong in 2005, various treatment options were introduced, and agreement on the most feasible approaches was arrived at by a consensus panel designed specifically for the purpose. The final decisions, though, were done by the board of directors and the senior leadership. Between 2005 and 2012—with the exception of Wise Young, who is a US citizen—the members of the senior leadership and board of directors were all senior researchers from Hong Kong and mainland China. Once a specific approach has been decided upon, the clinical trials protocols are defined, and specific protocol committees are set up for each trial. The protocol for the first lithium–cell combination study in Hong Kong relied on close collaboration between Network investigators in both Hong Kong and mainland China. For instance, to identify a standardised approach to the surgical and cell transplant techniques, a specifically designed consensus meeting was held in a hospital in China. Various teams from different hospitals of the Network came together on a single day in 2008 and presented numerous possible techniques; and a consensus was reached.[8] Other practical aspects of the treatment protocols were dealt with by local experts on specialist committees. These included separate committees for the treatment protocol, outcome measurement, regulatory approval and implementation. Each comprised investigators from the hospitals in which the study was carried out, as well as members of the senior leadership and external staff and experts. These committees were formed for each trial.[9]

Formation of a Domestic Innovation Platform

A fourth characteristic, in which the China SCI Net differs from industry-initiated 'top-down' forms of clinical-research alliances is in the targeting of local forms of innovation and knowledge production, and the integration and positioning of these inventions within the internationally recognised circuit of high-profile science. The Network functions, in this respect, as both a platform for domestic knowledge production, and as a device for international integration. In its former function, the Network operates as a structure in which promising therapeutic approaches developed by partners in China can be clinically tested in a reliable way. In its latter function, the Network works as an integrating device, by building bridges between regions, places, institutes, and hospitals whose knowledge products would otherwise remain unrecognised, and by positioning these inventions in the arena of internationally recognised science. For Wise Young, the China SCI Net shall function as an independent innovation platform, providing a clinical infrastructure that does not only test therapies from abroad, but also therapies from China, developed by Network-affiliated researchers or other researchers. To intensify domestic innovation processes, Young initiated two or three educational workshops per year between 2006 and 2009 for junior and mid-level personnel of the participating hospitals in China, with a focus on pre-clinical research strategies. The aim is described below:

> [The aim was] that they regard themselves as being a part of the pipeline for the therapies. They are discovering therapies. They don't regard themselves as just a tester of therapies. You know – just testing things that other people have made is not as…I guess…you are being a technician…you are applying…But the discovery process is something that we have started in China. [So that] things grow beyond us…And already it is happening. The first thing is the discovery of the intradural decompression study. And that is a Chinese story, and there is great pride in this. […] And, lithium, in Hong Kong University discovered. It is not [imported]. And this is one of the very attractive things why we have chosen it. Because it is not something discovered in the US, but it is discovered by one of our centres.[10]

The notion, thus, that research innovations in China could be developed and tested by the Network and published internationally was a central motivation of the organisation from the outset. As Young states here, the integration of domestic innovations in China has been achieved already, through the discovery of lithium's role in the survival and growth of transplanted stem cells (Su, Chu and Wu, 2007) and the development of the intradural decompression technique. The latter, is planned to be tested in a multi-sited randomised controlled trial by the network in the coming years.

Differences from Other Academic Research Collaborations between High and Low-to-Mid-Income Countries

International academic clinical trial partnerships based on collective forms of fund-raising and the integration of processes of clinical labour into the routine work of collaborating investigators are not new of course. However, academia-centred clinical trial collaborations with clinical partners in low-cost and low-income countries such as China, have usually been based on sponsor–host relationships, in which the investigators from high-income countries assume also the role of financial sponsor; and often also of intellectual leadership (OECD, 2011, p. 52). The reason for this is commonly the non-availability of local forms of funding for international research projects, with the bulk of the funding for international projects being acquired in the Triad countries. This, however, creates dependency structures, and the solidification of geographically bound hierarchies (Montgomery, 2012; Simpson and Sariola, 2012). In the case of the China SCI Net, such spatialised patterns of inequality are largely transcended, since virtually all of the money for the organisation and execution of the Network's clinical trials is acquired domestically. The local and collectivistic character of the project, as suggested above, is reflected also in the fact that the Network can be used as an independent innovation platform for the clinical testing of novel therapeutic approaches developed in affiliated hospitals in China. This is a second core difference from conventional forms of international academic clinical–research partnerships.

Conclusions

This article has pointed to the contemporary dynamic of global scientific multipolarisation, and explored the empirical and theoretical implications of this trend for international clinical research collaborations. Based on a case study of the China SCI Net, the article has put forward that the ongoing trend of scientific multipolarisation is leading to the emergence of new forms of transnational clinical research and trial organisation. As I have shown, the organisational model of the China SCI Net differs from both the organisation of clinical trials by the drug industry, and other forms of academic clinical trial collaborations, between high- and low-to-middle-income countries. Funding for the China SCI Net, as I have illustrated, has almost exclusively been raised domestically, within Hong Kong and mainland China. In the context of a large-scale transnational research project, the tapping of financial resources from local hospitals, provincial governments and the Health Division of the People's Liberation Army in China appears to be unprecedented in the history of international collaboration in clinical medicine in China. The money raised through charity fund-raising throughout Hong Kong, in combination with the funds from mainland China, has enabled the Network to finance its clinical trials independently of support from the drug industry and state resources from funding agencies of the US or other developed countries. I have suggested in this respect, that the far-reaching access to the financial, technical, infrastructural, human and knowledge resources in China has only been possible because the China SCI Net is set up around a highly collectivist model of international knowledge production, that creates substantial benefits for local spinal cord researchers, patients and hospitals in China. This collectivist approach is manifest not only in the collective mobilisation of financial resources and the sharing of costs and labour, but also in (a) the incorporation of local research innovations, (b) the sharing of research benefits, (c) the flattening of decision-making processes, (d) the use of the Network as platform for domestic innovation, and (e) by providing local access to effective and safe treatments.

These findings are significant. International clinical research has for many years involved geographically bound hierarchies between the sponsors, intellectual creators and facilitating technicians of the research. In the case of the China SCI Net, these boundaries are in significant respects transcended. A form of transnational clinical research organisation is taking shape here, which in important regards resembles academic clinical-research partnerships within developed countries. I contend, in this respect, that these organisational changes are intrinsically linked with the current dynamic of global scientific multipolarisation. The increasing availability of funding in China, high-end technology, dependable clinical infrastructures, and a rich pool of clinical experience and competent staff, is resulting in new socio-economic demands, forms of joint leadership, revised patterns of benefit sharing, and more active forms of intellectual participation. In summary, my analysis of the China SCI Net suggests, that the far-reaching access to human, technical and knowledge resources in the evolving science pole China, is resulting in vital changes in the ways that international academic clinical research collaborations are defined and organised. The roles and responsibilities of involved partners are shared more evenly, with one-sided exchanges more difficult to institutionalise and justify. Processes of collective financiering and joint-innovation, inevitably sit alongside re-articulations of patterns of labour division, decision-making, benefit sharing, profit sharing and revised forms of ownership regarding inventions and research data. An open question is, in this respect, whether and to what extent similar developments can be observed also in other international clinical research projects, and in the context of co-operations with institutions from evolving global scientific centre regions, other than China. Further research will be required to determine whether the insights of this study can be extrapolated to a more general level.

From a theoretical viewpoint, this article underpins the need for a critical awareness of the empirical and theoretical implications of the gradually unfolding trend of scientific multi-polarisation. This involves, in particular, a reflexive engagement with the conceptual, methodological, but also ideological presumptions of existing theoretical approaches to the study of science and globalisation. The findings of this study, for instance, sit uneasily with several of the ontological assumptions that are frequently associated with post-colonial science and globalisation theory. The forms of scientific collaboration, exchange, and benefit sharing to which this article has referred, run counter to notions of subalternity, unequal exchange and exploitation, that are often taken for granted in post-colonial studies, as inevitable consequences of the histories and political–economic relations that shape contemporary global scientific flows. While in many situations these assumptions have proven valid, the findings of this study suggest that the enduring dynamic of scientific multi-polarisation is giving rise to revised patterns of international research collaborations, in which geographical hierarchies are partially transcending, new practices for socio-economic and intellectual participation emerge, and lop-sided exchanges are increasingly difficult to institutionalise and legitimise.

These changes do not mean, of course, that under the influence of global scientific multipolarisation, asymmetric exchanges come to an end. It means, however, that the increasing availability of funding, expertise, knowledge and technological infrastructures in the evolving scientific centre regions in the world, is about to result in important re-articulations of the organisational forms and the kinds of transactions and subjectivities that characterise international research partnerships. A critical engagement with the global role of science and power in 'the West' remains in this respect vital. However, the fact that the production of science is now increasingly marked by multiple vectors and plural geopolitical force fields means too, that many of the forms of subjectification, utilisation, peripheralisation and dependency that are likely to emerge in the context of the evolving multi-polar scientific world system will be related to the activities of global spheres other than North America, Europe, or Japan.

NOTES

1. For an introduction of the China SCI Net and affiliated spinal cord injury centres, see the organisation's website: http://www.chinascinet.org/index.php?option=com_content&task=view&id=23&Itemid=53 (accessed on 21 June 2013).
2. Interview Wise Young, Hong Kong, 24 June 2010.
3. Same as note 1.
4. Same as note 1.
5. Same as note 1.
6. Interview Kwok-Fai So, Hong Kong, 7 January 2011.
7. Interview Nr. 32, senior researcher Central China, 14 September 2010.
8. Interview Wendy Cheng, Hong Kong, 12 June 2010.
9. Same as note 7.
10. Same as note 1.

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