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The Historical Roots of Modern Bridges: China's Engineers as Global Actors

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'Engineering' in China

Like many other concepts, the idea of an engineering profession entered China from Europe in the nineteenth century.[1] However, 'master of work processes' (*gongcheng shi* 工程師), as the term engineer was translated, was in no way a novel role, as the railway engineer Cheng Qingguo and Tang Youcheng, then Head of the Geophysics Research Group at the Institute of Remote Sensoring Application, Chinese Academy of Science, emphasise in their 1984 study on bridges.[2] They explain that China's past had included numerous architectural and hydraulic masterminds who knew how to mobilise masses of workers, materials and land, and were technically adept. They assert that every type of modern bridge construction can be 'found in embryonic form in the ancient Chinese bridges, whose designers made such great progress and achieved such distinctive features in structure and construction so long ago'.[3] In their rendering of the past, artefacts verify technical expertise, while textual

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records illustrate these individuals' learnedness and altruism, as well as the political importance of their efforts and manifold deeds.

The historical continuity of both an engineer's technical prowess and his/her political responsibility were important aspects of China's late nineteenth-century quest for modernity. Both issues continued throughout the twentieth-century nation-building and identity debates, although they were increasingly coupled with a Chinese concern about global political recognition from 'Western' countries such as the USA and Europe as a modern, advanced and politically important actor. During the late Qing and Republican eras, we find scholars trained in the West, such as the geologist Ding Wenjiang 丁文江 (1888–1936), or practitioners such as the architect Zhu Qiqian 朱启钤 (1872–1964), who searched through China's history for exemplars with scientific and technical skills.[4] Others, such as the US-trained railway engineer Zhou Houkun周厚坤 (1889–?), attempted to make engineering responsible for preserving culture. In the 1910s, Zhou urged engineers to invent a typewriter for 'this wonderful language of ours',[5] instead of requesting a change in the language itself or assuming that engineers had reached the limits of their abilities. Republican and Communist politicians purposefully anchored modern ideals of science and technology into state practice, continuing the ritualisation of mythological emperors such as the flood tamer, the Great Yu 大禹, rebuilding his temples and memorials in Shaoxing between 1930 and 1939. Both Communist and Guomindang members politically promoted technocratic and expertocratic forms of leadership while, at the same time, historians such as Gu Jiegang 顧頡剛 (1893–1980) and the writer-politician Guo Moruo 郭沫若 (1892–1978) debunked the historical constructivism and social purpose of such mythological approaches.[6]

The Past in the Present

If Chinese actors saw historical continuity in technical prowess and an engineer's leading political role from the premodern to the modern age, how then, did this era explain the early modern-to-modern change? Many modern historical accounts distinguish these periods by referring to the growing scale of operations or the upsurge in mechanisation.[7] Cheng and

Tang pinpoint the increasingly globalised knowledge culture of the contemporary engineering trade. They assert that engineers of the modern age were able to cope with previously insurmountable difficulties such as the construction of a permanent bridge over the Yangtze River near its delta, because they could draw on 'not only the intelligence of the Chinese people but also the experience of other countries'.[8] Unlike classic scholars of the Song, Yuan, Ming or Qing dynasties (i.e. between the ninth and eighteenth centuries),[9] engineers after the nineteenth century thought beyond the nation-state and, by sharing their knowledge and expertise, were 'propagating friendship and association between peoples throughout the world'.[10]

In their 1984 article, Cheng and Tang articulated an aspiration that the new millennium would see expansion—in more than rhetorical terms—to countries in the Association of Southeastern Asian Nations (ASEAN) and diverse communities on the continents of Africa and Latin America.[11] Trained in technologies, architecture, economics and sociology, Chinese engineers in the twenty-first century envisage and realise the biggest, most costly and most technically challenging projects, such as a water pipeline from China's south to north, new railway lines with wide-spanning bridges, sports arenas or expansive highways across African deserts—or even entire continents. When other countries talk politics, China's political elite often remain silent in global discourses—and instead let engineering projects do the job. Another factor is that since the 1950s engineers increasingly moved from the back seat to the forefront of political, economic and social decision-making.

Of course, as Cheng and Tang anticipated, the methods and means of engineering have changed substantially. Bridges are higher, span wider and are lighter than their historical precedents. What concerns me in this chapter, though, is Cheng and Tang's claim that premodern engineers were more bound to political territories and regimes (that is, empires) and did not share their knowledge as easily as today. Is the political boundedness of knowledge, its identification within empires and nations, an important characteristic explaining/identifying the premodern/modern divide?

Although, prior to the eighteenth century, Chinese 'masters of work processes' did not see the world defined in terms of a globe, they—like their modern successors—believed themselves to be operating on a scale relevant to 'all under heaven' (*tian xia* 天下). In this political framework,

we can indeed see that they defined their skills and knowledge in terms of how their efforts to regulate natural forces were important for ordering (*zhi* 治, i.e. governing) the world, thus making it a habitable and 'cultured' (*wen* 文) place. As such, engineering projects to control water, land and society were mainly pursued by the cultured inhabitants of China's various dynasties, whereas the barbarians outside China were believed to be unaware of such means. Cheng and Tang indeed assert that historically Chinese bridge-building expertise was exported to places such as Edo-Japan, whereas they do not name any cases of foreign influx into China before the nineteenth century.

Cultures and Bridges

In fact, Cheng and Tang are right to assume that in the Chinese historical context, sharing knowledge meant civilising the world. The Chinese literati considered this shared knowledge to include more than just the scientific and technical proficiency and skills admired by twentieth-century Chinese engineers. The civilising influence of engineering know-how lay in its benefits for both the state and its common people, being dependent on the moral application of knowledge, defined in terms of commensurability.

The numerous historical accounts of hydraulic and construction projects are one example of this. These projects often achieved an order of magnitude that required attention from emperors, and thus became memorised in dynastic historiography. Substantial investment in resources was only justifiable because, once accomplished, such projects would benefit the community long into the future, far exceeding any single individual's vision, or even a whole generation's desire.

Rhetorically, scholars approached the state's responsibility for a *longue durée* view and issues of scale by adopting the mythologised account of ancient sage-kings. As the assigned Minister of Work (*gongbu* 工部) in the court of (the equally mythological) emperor Shun 舜, the figure of the Great Yu exemplified the imperial role in water management projects. Yu is recounted to have successfully channelled water into the major Chinese rivers. In this way, as Mark Lewis suggests, Yu accomplished 'the

structuring of the world through a process of [spatial] division'.[12] This enabled people to travel throughout the country on rivers and roads and determined which lands were suitable for agricultural cultivation. Following Yu's lead, court elites and scholar-officials took on the same tasks in the dynastic state. By the time of the Song Dynasty (964–1279), the emperor's legitimacy depended, to a large extent, on his ability to keep the capital Kaifeng free from floods and, after the dynasty withdrew to the south, to tame the water there to cultivate new land. Over the longue-durée, concepts as broad as Wittfogel's problematic hydraulic states as well as modern environmental history perspectives are employed.

In this legitimising role, the Great Yu appears, with short interruptions, in Chinese historiography at least since the Northern Song. While the task remained largely the same, the intervention strategies varied considerably, with emperors such as Huizong attempting to get to the root of the problem and redirect the waters of the Yangtze from its source.[13] Most imperial rulers settled on dealing with the outcomes or following a rhetoric of imperial tasks. However, Hongwu 洪武 (1328–1398, reigned from 1368), the founding emperor of the Ming, reinstalled the rituals of the Great Yu in the seventh year of his reign, 1374.[14] In addition, when he was a young prince, the later Yongle 永樂 emperor (1360–1424, reigned from 1402) was continuously reminded of the hardworking (*qin-lao* 勤勞) exemplar, the Great Yu.[15]

Water, Politics and the Engineer Hero Yu

While emperors may have controlled these projects, they relied on water management experts to actually implement them. 'Hydraulic engineers' populate China's dynastic and private histories. In addition to their technical ability, they had to be able to negotiate the suitable means and planning strategies to ensure the successful completion of such projects. They were granted moral judgement, yet they were frequently subjected to criticism and were blamed for the causes and results of any mishap.

A case that illustrates engineers' ambiguous moral role is that of the Song Dynasty civil servant and relative of the contemporary prime minister, Tang Zhongyou 唐仲友 (1136–1188). On visiting Tiantai district,

Tang designed a bridge that could withstand the difficult tides at that particular juncture. Even though Tang is shown in this context as a quintessential manager-engineer with exceptional technical abilities, the story's purpose is to depict Tang as a quintessential immoral villain. Tang initiated a huge, financially demanding and technically complex construction project to build a bridge comprising twenty-five connecting sections, with harbour wings for fifty boats, and embankments against the tides 115 *li* (5832 metres). towards the south—because he had felt forced to share a ferry with some drunken, ill-behaved passengers who had lost their moral standards.[16] His contemporary colleague and the originator of Song-orthodox Neo-Confucian philosophy Zhu Xi 朱熹 (1130–1200) accused Tang of having used inappropriate means—a technical solution—for a trivial social problem. He alleged that Tang had strained the wealth of the commoners and the imperial treasure trove, instead of simply educating his fellow travellers. Or, expressed in modern terms, Zhu Xi accused Tang of choosing technical over social engineering.

This incident showcases a disagreement over cost–demand efficiency and the adequacy of resources, as much as over the technical scale and scope of human planning. In a ritual tract that was published at around the same time, Zhu Xi stated that he favoured a method of minor interventions. In this work, he described how the social order of the state depended substantially on the proper placing of an ancestral shrine in each individual's home.[17] Proper action meant understanding that major outcomes could be achieved by taking care of rudimentary concerns.

Li Cho-ying's comparative research on hydraulic engineering during the Song and Ming period shows that debates about appropriateness also concerned the specific level at which decisions should be made. Whereas Song rulers centralised structures and took preventive and affirmative action, Ming rulers increasingly withdrew from such projects and left these matters in the hands of local officials and gentry.[18]

In a more recent study of hydraulics, Li draws particular attention to the third Ming emperor, Yongle, who abandoned hydraulic management and replaced it with tax exemptions and aid relief in around 1404. Li's research elucidates that the reasons for such political shifts, and the effect they had on the actors who were in charge of social, political and technical

decisions, were complex. Resource management—such as the availability of wood or labour—as well as straightforward financial considerations may have played an important role in Yongle's rash withdrawal from a redesign of water management practices in the Lower Yangtze region, in the same year that he moved the capital from Nanjing to Beijing. This spatial relocation of political power meant a need to renovate and rebuild the Yuan palace structures in Beijing, as well as carry out infrastructure projects such as constructing canals and roads. Furthermore, between 1403 and 1420 Yongle sponsored projects such the expansion of the Daoist complex of the Wudang shan pathway, which contained over sixty bridges, to open up routes through a sacred landscape for pilgrims.[19] Various temples and resting sites were included, spread across an area of 140 *li* (67200 metres). Yongle may not have envisioned the long-term financial and social implications of such large-scale projects in 1403, when he promoted the civil service examinee Xia Yuanji 夏原吉 (1366–1430) into ever-higher civil servant positions (up to the role of Minister of Finance), thus enabling XiaYuanji to develop a technical solution for dredging the waterways of the Lower Yangtze River. But he certainly had to deal with the various financial and social repercussions of these projects.

But clearly, as Li has also shown, the definition of an 'appropriate' mode and scope of intervention depended on its actual aims, which did not always involve an urgent environmental issue, an agricultural or even a social purpose. Yongle's redesign of the Lower Yangtze did not fill any immediate need such as extensive flooding, drought or famine. Rather, Yongle magnified small incidents 'to the degree that the entire region had to engage in water management…'. Hence, he initiated a huge project 'to legitimise his reign, without saying so explicitly'.[20] He politicised the flow of water, so as to justify an empire-wide—and in this sense for his world 'global'—technical intervention.

Two technical innovations are attributed to the historical engineer Xia Yuanji: a 'pedal pump rescue' and his specific 'polder dyke construction'. The nature of Xia's innovations were, however, systemic rather than technical, because Xia made sure that his 'machines' enabled local officials to control floods themselves—thus alleviating the central state of this central responsibility. However, he also made sure that the government could

still reach local homes, by implementing a tax for state management of the pumps.[21]

Historians of science have dedicated special attention to China's rich and resourceful history of engineers. But only lately have historical studies such as Li's started to look beyond innovative technologies and connected the dots between social, economic, environmental, scientific and technological change. Thus also the long-term implications that such projects had on knowledge standards and ideals as well as for hydraulic practices more generally. In fact the imperial context authorised technical solutions for succeeding generations. Scholar-officials in the late Ming and Qing emulated Xia's systemic choices over the next two centuries. Similarly consistent was Pan Jixun's 潘季馴 (1521–1595, *jinshi* 1550) later solution to channel the waters more narrowly into a torrential stream, in order to 'use water to attack water and regulate the river with the river' (借水攻水,以河治河).[22] Engineers in the 1950s consulted Pan's work carefully before attempting to speed up the water flow, so that it would flush the silt alongside the embanked riverbed.[23] Thus, certain ideas prevailed across the premodern and modern divide, serving as inspiration for new technical solutions or, in some cases, a reconstitution of the old ones.

Tensions, Compressions and Torsion: Political Arches

As central as ideas of nation-building are in contemporary China's engineering cultures, they also often address ideological continuities of a larger, less territorially bounded identity discourse, addressing the multiple concerns brought about by large-scale engineering interventions such as the remodelling of rivers, mountains or urbanised space. And here we can find another continuity. Like emperors, early Republican scientists, historians and politicians managed the public image of such projects and the public's concerns about them by employing state rituals and propaganda. While Song emperors financed dykes and canals, they commissioned paintings of rituals around the Great Yu and water mills as Liu Heping shows.[24] Sun Yatsen 孫中山 (1856–1925) worshipped the

mythological flood and river conqueror, the Great Yu in 1919 in a state ritual, as did Zhou Enlai 周恩來 (1898–1976), who, in 1939, suggested that China's political elites had not adequately studied 'Yu's lessons about flood control. They know restraint, but nothing about effective guidance and hence create a despotic tyranny…'.[25] The Guomindang regime continued legitimising rituals, whereas the Communists broke with such feudal practices.

As Mizuni, di Moia and Moore have recently argued, the limits of a nation-state-based historiography of economic development and engineering traditions lie 'in its neglect of the continuity between colonial Asia from Cold War Asia, and empires from post-WWII international development'.[26] In fact, a closer look clearly reveals such continuities within China's national engineering debates too. As recent research has shown, Communist politicians and state actors between the Great Leap Forward (1958–1962) and the Four Modernisations (since 1972) never entirely cut ties with the past in their joint aims to foster progress within nation- and identity-building. Following a policy of employing 'red and expert' (i.e. both politically conscious and professionally competent) civil servants and party members in the 1960s, the state still promoted the publication of classical tracts on agriculture for utilitarian means, such as *Nongshu*農書 (Book of agriculture) and Song Yingxing's *Tiangong kaiwu* 天工開物 (The works of heaven and the inception of things). Officials held that such classic literature would be a suitable guide to innovation after the Soviets had cut their technical and financial aid during the Great Leap Forward. Such examples of ancient wisdom also legitimised historical empiricism—that is, learning from the past—and enabled politicians to invoke former technical visions as important and now feasible project ideas in the changing political context. Along these lines, the idea of channelling the abundant waters of the south up to the drylands of the north (*xibu da kaifa* 西部大開發), developed in the 1950s by Ministry of Water personnel, was put into effect in 2000. In between proposal and implementation, a new ruling class of engineers such as Jiang Zemin 江澤民 (b. 1926) emerged and ascended to the highest positions of political power. Jiang, who was state president from 1993 until 2003, received a technical education at one of China's elite universities (Shanghai) before the Cultural Revolution of 1964 (before the term 'red engineer' fell out

of favour). He was an advocate of the Three Gorges Dam, and he actively reinvigorated the cult of the Great Yu in Shaoxing in 1995, supporting the state financing of temples and memorials.[27]

In contrast to Jiang Zemin's rise, engineers such as Cheng and Tang anchored their social responsibility in a Henri de Saint-Simon-type ideal of economic planning based on scientific principles, which mobilised the Communist ideals of common production means and public property within a capitalist market economy in a seemingly paradoxical, yet very efficient, combination.[28]

Conclusion

Engineering traditions in Asia did not develop out of a void. Bridges existed or were built where ferry passages had previously crossed rivers, and irrigation is constantly updated but still continues flowing in its old beds and grids even today. Overlooking the desired and unwanted continuities of Chinese engineering history and historiography beyond the modern age means dismissing, all too easily, another cultural means that helped to shape identity and promote an engineering modernity within changing political climates and new economic ideals. The political instrumentalisation of past state mythologies within a revived modern Neo-Confucianism philosophy since the 1990s shows that such references had important social and moral implications as well as technical consequences. When Jiang Zemin attended a ritual and left a plate in his own handwriting on the Great Yu's tomb (Da Yu Ling 大禹陵), he was deliberately promoting technical solutions for both social and environmental challenges. His successors have taken similar viewpoints since the 1990s, and increasingly on a global scale.

The state remains a major actor in both the small- and large-scale endeavours of China's engineers today. The people of Shaoxing city celebrate the Great Yu by offering a small sacrificial ritual each year, a public sacrifice every five years and a grand sacrifice every ten years (with the exception of 2003). This event has even turned into a modest tourist attraction, and with the economic benefit, and globalisation debates, the public increasingly embraces the political messaging as a sign of culture

and identity. In 2007 the ritual achieved national status not unlike previously in imperial times. Jointly promulgated by the city, regional and state organisations, the stakeholders revived an imperial format (*dili* 禘禮) of thirteen sacrificial steps. At the same time, international representatives, including several groups from Taipei, Japan, Korea, Poland, India, Iran and France, attended the celebration. From a Chinese perspective, therefore, it is not so important that China takes a front row seat in worldwide politics as long as Chinese engineers can confidently hold major agency in the very political nature of an engineered, globalising world.

Notes

1. Chen Yue 陳悅 and Sun Lie 孙烈: 'Gongcheng yu gongchengshi ciyuan kaolüe 工程與工程師詞源考略', *Gongcheng Yanjiu* 5/1 (2013), pp. 53–7. Most of these concepts arrived in China through railways and other infrastructure and thus were mediated through Japan. Andre Schmid. *Korea between Empires 1895–1919* (Columbia University Press 2002)
2. Cheng Qingguo and Tang Youcheng: 'The traditions of bridge technique and modern bridge engineers of China', *European Journal of Engineering Education,* 9/1 (1984), p. 13–19.
3. Cheng and Tang, 'Bridge engineers of China', p. 13.
4. The best biography in English is still Charlotte Furth: *Ding Wen-chiang: Science and China's New Culture,* Cambridge: Harvard University Press, 1970. Zhu Qiqian (1932/2004) provides historical biographical data on craftsmen, engineers and other experts, in Yang Yongsheng 楊永生 (ed.): *Zhejianglu* 哲匠錄, Beijing: Zhongguo jianzhu gongye chubanshe, 2004.
5. Thomas Mullany: *The Chinese typewriter: A history,* Boston: The MIT Press, 2017, p. 138.
6. Robin McNeal: 'Constructing myth in modern China', *The Journal of Asian Studies,* 71/3, (2012), pp. 679–704, p. 687.
7. See A.A. Hamm, Brian W. Beetz and Rudi Volti: *Engineering in time. The systematics of engineering history and its contemporary context,* London: Imperial College Press, 2004 – for instance, their survey of the period

1800–1940 entitled 'Expansive Engineering'. B. Marsden and C. Smith emphasise this growing industrialisation and mechanisation in: *Engineering empires: A cultural history of technology in nineteenth century Britain,* London: Palgrave Macmillan, 2004. Michael Adas discusses the notion of a Western expansive hegemonic regime in: *Machines as the measure of men. Science, technology, and ideologies of Western dominance,* Ithaca: Cornell University Press, 1989.

8. Cheng and Tang, 'Bridge engineers of China', p. 16.
9. These dynasties are traditionally referred to as 'premodern' because of a defined set of characteristics shared with the European periodisation 'early modern'.
10. Cheng and Tang, 'Bridge engineers of China', pp. 15–16.
11. Ashley Kim Stewart and Li Xing: 'Beyond debating the differences: China's aid and trade in Africa', in Li Xing and Abdulkadir Osman Farah (eds.): *China-Africa relations in an era of great transformations,* Farnham: Ashgate, 2013, pp. 23–48. See also Greg Brazinsky, Winning the Third World. Sino American Rivalry during the Cold War (University of North Carolina Press 2017)
12. Mark E. Lewis: *The flood myths of Early China,* Albany: State University of New York Press, 2006, p. 30.
13. Ling Zhang: *The river, the plain and the state. An environmental drama in Northern Song China, 1048–1128,* Cambridge, MA: Cambridge University Press, 2016. See also Ruth Mostern: *Dividing the realm in order to govern: the spatial organization of the Song state (960–1279),* Cambridge, MA: Harvard University Asia Center, 2011.
14. Xia Yuanji 夏元吉, Yang Shiqi 楊士奇 et al.: *Ming Taizu shilu* 明太祖實錄, Taipei: Zhong yanjiuyuan shiyu suo jingyinben, 1604/1962, p. 1501. Sun Yuantai 孙远太: 'Dayu jidian yi da yu wenhua de zhuanbo 大禹祭典與大禹文化的傳播', *Qianyan* 263/9 (2010), pp. 181–184.
15. Xia Yuanji, *Ming Taizu shilu,* p. 1209. For the role of Yu in the Ming era, see Xu Jin 徐進: 'Mingdai Da Yu jiyi ji qi wenhua yiwen 明代大禹記憶及其文化意蘊', *Yindu Xuekan,* 32 (2016), p. 35.
16. The stone stele Xinjian Zhongjing qiao beiji 新建中津橋碑記 is included in Lin Biaomin 林表民 (ed.) (*c.* 1450): *Chicheng ji* 赤城集. Wenyuange siku quanshu-edition, Chap. 12.
17. Francesca Bray: 'Technics and Civilisation in Late Imperial China: An Essay on the Cultural History of Technology', *OSIRIS,* Vol. 13 (Special Issue: *Beyond Joseph Needham: Science, Technology, and Medicine in East and Southeast Asia),* 1998, pp. 11–33.

18. Li Cho-ying: 'Contending Strategies, Collaboration among Local Specialists and Officials, and Hydrological Reform in the Late-Fifteenth-Century Lower Yangzi Delta', *East Asian Science, Technology and Society: An International Journal,* 4:2, 2010, pp. 229–253.
19. Song Jing 宋晶: Mingdai Wudang Shan Qiaoliang chutan 明代武當山橋樑初探 in *Journal of Hubei University*, 33:5, 2006, pp. 587–590.
20. Li Cho-ying: '"As a sage-king re-emerges, all water returns to its proper path": Xia Yuanji's water management and the legitimisation of the Yongle reign' in Francesca Bray and Lim Jongtae (eds.): *Science and Confucian statecraft in East Asia,* Brill: Leiden, forthcoming.
21. Michah Muscolini, *The Ecology of War in China: Henan Province, the Yellow River and beyond 1938–1950* (Cambridge University Press 2014), looks at destruction caused by war, disaster and engineering.
22. Pan Jixun: 'Hefang Yilan 河防一覽' in Wu Xiangxiang 吳湘湘 (compiler): *Zhongguo shixue congshu*, Vol. 33, Taipei: Taiwan Xuesheng Shudian, 1965, Chap. 8.23b, p. 658.
23. See also Miriam Seeger: *Zähmung der Flüsse: Staudämme und das Streben nach produktiven Landschaften,* Berlin: LIT Verlag Münster, 2014, p. 75; Randall A Dodgen: *Controlling the dragon: Confucian engineers and the yellow river in Late Imperial China,* Honolulu: University of Hawaii Press, 2001, p. 18.
24. Liu Heping (2012), 'Picturing Yu Controlling the Flood. Technology, Ecology and Emperorship in Northern Song China', in *Cultures of Knowledge: Technology in Chinese History*. edited by Dagmar Schäfer (Leiden: Brill), pp. 91–126.
25. Xie Xingpeng 謝興鵬, *Jiuzhou fangyuan hua Da Yu* 九州方圓話大禹. Sichuansheng Da Yu yanjiu hui, 2002, p. 50.
26. Hiromi Mizuni: 'Introduction: A Kula Ring for the Flying Geese: Japan's Technology Aid and Postwar Asia', in Hiromi Mizuni, Aaron Moore and John diMoia: *Engineering Asia. Technology, colonial Development and the Cold War order,* London: Bloomsbury Academic, forthcoming.
27. Judd Kinzley, Universities of Wisconsin Madison/Harvard Energy Conference from 2013/Dissertation: Staking Claims to China's Borderland: Oil, Ores and State-building in Xinjiang Province, 1893–1964. Conference website http://sites.fas.harvard.edu/~histecon/energy/Asia_History_Energy/participants.html /the project is ongoing at Harvard and MIT.
28. Cheng Li: *China's leaders: The new generation,* Lanham, MD: Rowman & Littlefield, 2001, p. 27. It is along those lines that Cheng Li identifies them as 'technocrats'.