

# Terraforming “Beautiful China” Island Building and Lunar Exploration in the Making of the Chinese State

Laurence Bashford, Jonathan Galka

## Abstract

Chinese terraforming projects in the South China Sea have been condemned as geopolitically and ecologically destabilising. Following years of escalating construction and tourism initiatives, China pivoted in January 2019 by announcing ecosystem restoration efforts on several terraformed islands. Days later, the Chinese National Space Agency made the first soft landing on the far side of the moon, carrying with it a micro-ecosystem of living seeds and insect eggs. The micro-ecosystem sprouted the first plant on the moon, whose brief lifespan was met with rapt attention by the Chinese public as it disseminated across the national mediascape. This article contends that terraforming efforts in the South China Sea and the Chang’e 4 lunar biosphere project are related material-symbolic instantiations of a uniquely Chinese sociotechnical imaginary. Prevailing interpretations of Chinese island-building, outer space ventures and ecological civilisation tend to construe Beijing’s intentions as primarily antagonistic. These accounts are useful yet insufficient for comprehending China’s terraforming projects on Earth and beyond. The authors instead refigure terraformation as an imaginative, material and bio-geophysical process enacted in the globalising pursuit of new Chinese horizons.

**Keywords:** China, South China Sea, Paracel islands, Chang’e 4, lunar biosphere project, terraforming, ecological civilisation

Legends tell of a beautiful woman called Chang’e, who lived long ago, at a time when ten suns had risen in the sky, rendering farmland barren and life unlivable. In a bid to save the Earth from total desolation, her husband, an expert archer, shot the suns down and was rewarded for his efforts with an elixir of immortality. Chang’e stole the potion and fled toward the heavens, where she found refuge upon the moon. Chang’e is depicted as a lonely figure, at times even addicted to the elixir, which she spends her days brewing so as to live in solitude on the moon forever (An et al. 2005).

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In May 2016, Liu Zhen<sup>1</sup> reported for the *South China Morning Post* from aboard a Chinese tourist cruise in the Paracel (Xisha) islands. One evening on the journey, participants viewed the 1974 state-made documentary *Battle of Xisha*, which depicts Peoples' Liberation Army ships heroically wresting control of the archipelago from South Vietnamese forces, while “a thin new moon appeared in the sky above the Crescent Group, in the western part of the Paracels. The golden curve was silently reflected on the surface of the sea, in between naval vessels lying at anchor” (Liu 2016a). Some years later, on 3 January 2019, the Chang'e 4 Lunar Lander came to rest on the far side of the moon, carrying with it a biological module containing insect eggs, potato and *Arabidopsis* seeds, and life-sustaining support systems, intended together to “establish a simple ecosystem on the moon” (Graham 2018).

This paper asks what relationships might emerge in narrating how these reflections and refractions pass through one another – the story of Chang'e in the South China Sea (SCS) islands and of Chinese islands on the moon, and their material and imaginative resonances within the People's Republic of China (PRC) and beyond.

One of the most widely discussed trends in recent Chinese development strategy has been the promotion of sustainability and environmental objectives, notably culminating in amendments to the Chinese national constitution in 2018.<sup>2</sup> When considered in light of China's well-documented “war against nature” (Shapiro 2001) and established record of environmental devastation in the pursuit of industrial growth (Economy 2010), this volte-face on the part of Beijing has naturally been met with scepticism in international fora. Yet the speed with which the PRC and its corporate agents have invested in renewable energy research, generation and distribution suggests the perception of a unique opportunity.

China's new strategy promises a chance not only to avoid further damage from climate change and industrial pollution, while reducing China's dependence on foreign fuel imports, but also to assume a new position of global leadership in the field of green technologies (Lo 2014). Whether or not claims to a new era of “ecological civilisation” (*shengtai wenming*) herald a fundamental shift for state-building and global geopolitics remains to be seen. While the possibility exists that this rhetorical posturing serves only to disguise the pursuit of nationalistic self-interest, nevertheless the implications of these claims are

1 Chinese names in this article follow the conventional order of family name first, followed by given name – e.g., “Xi Jinping” – unless stated otherwise.

2 Under Part 6, Article 89 of the revised Constitution, the protection of the environment forms part of the duties and powers of the State Council: “*lingdao he guanli jingji gongzuo he chengxia jianshe shengtai wenming jianshe* [to lead and manage economic affairs, urban and rural development, and the construction of an ecological civilisation]”; see [http://www.gov.cn/guoqing/2018-03/22/content\\_5276318.html](http://www.gov.cn/guoqing/2018-03/22/content_5276318.html) (accessed 11 December 2021).

far-reaching on local and planetary scales, and so continue to warrant thorough consideration.<sup>3</sup>

Following recent studies of contemporary Chinese development, we turn to Sheila Jasanoff’s theorising of “sociotechnical imaginaries” to consider the expansive scope of Chinese ecological civilisation. Broadly defined as processes of collective imagining that undergird co-constitutive relations between society and technology, sociotechnical imaginaries are articulated by Jasanoff as “collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology” (Jasanoff 2015a: 4). Implicit within such an approach is a close attention to the interpellation of Chinese publics (both human and non-human), whose affective and economic participation is essential to long-term development.<sup>4</sup>

According to Jasanoff, one of the central quandaries entailed in any approach to theorising sociotechnical imaginaries is how to reconcile the inherent multiplicity of actors, mediations and conflicting visions that coexist and constantly proliferate within any given social context. In recent studies of Chinese sociotechnical imaginaries, given the degree of state control over domestic political discourse, this problem has given rise to debates surrounding the relative dominance of state-sponsored versus grassroots imaginative practices (Huang / Westman 2021). Rather than treating these two modalities as discrete components of one imaginary whole, we focus instead on a historically comparative approach, to comprehend the two sets of technological and cultural practices, enacted by state and civilian actors, that render new material realities from political imaginaries.

In an investigation of air pollution in Zhejiang province, Mette Hansen and Zhaohui Liu (2018) have specifically explored the concept of “ecological civilisation” in China as a “top-down” imaginary. In their account, this framework can be figured as a “state-guided initiative”, circulating via a combination of “traditional and social media” channels and thus providing the basis for new forms of “environmental consciousness” that appear in diverse guises.

In the context of Chinese waste disposal economies, Yvan Schulz and Anna Lora-Wainwright (2019) have further discussed the extent to which top-down imaginaries can coexist with local ones, in ways that might align, contradict or partially overlap to varying degrees. Similarly, anthropologist Jerry Zee (2017) has taken anti-desertification campaigns in China as processes through which

3 Reports have detailed some of the alleged strategies used by China to mask harmful environmental practices, in order to maintain the illusion of fulfilling international sustainability commitments, e.g. the “outsourcing” of pollutant industrial operations to partner countries via the Belt and Road Initiative. See Li et al. (2014).

4 William A. Callahan’s China: *The Pessoptimist Nation* (2010) provides further context regarding the affective engagement of Chinese citizens in popular and state-based narratives of national humiliation and renewal.

experimental political forms interact with environmental futures across a range of spatial and temporal scales. We build upon these contributions by bringing a comparative framework of sociotechnical imaginaries to bear upon Chinese terraforming projects, broadly construed. This also follows recent moves in the growing field of SCS studies that historicise ongoing upheavals in the region (Chubb 2021). Our intervention thus aims to shed new light upon the dynamic historical creation of Chinese space and its contingent social worlds. In taking as our object of inquiry the processes by which islands are formed and sustained in their habitability, we aim to elucidate some of the distributed means by which sociotechnical imaginaries might engineer the material bases for their own existence and evolution (Jasanoff 2015a).

## Chinese terraforming: Imagination and materialisation

Ecological civilisation, as a Chinese sociotechnical imaginary, aims to construct a moral dichotomy with Western “industrial civilisation”, casting the latter as a dystopian corollary to the former, which by the PRC government’s account looks instead to “a socialist-ecological future with Chinese characteristics” (Hansen et al. 2018). Likewise, Chinese ecological civilisation stands in putative opposition to so-called “Western traditional philosophy”, presupposing instead a Chinese tradition of ecological thought that spans several millennia, from ancient Confucian teachings to post-Maoist writings on “socialism with Chinese characteristics”, in addition to the recent future-oriented pronouncements by President Xi Jinping (Pan 2006). All of this is to say that ecological civilisation is inextricable from a PRC nationalist project, and is linked to a constellation of master narratives and civic ideologies – notably the “China Dream” and “Building a Beautiful China” – which, though prominent since before the 2008 Summer Olympics, have proliferated and intensified across PRC political discourse since the start of Xi Jinping’s presidency.<sup>5</sup>

At the Third Plenum of the 18th National People’s Congress in November 2013, President Xi unveiled his ambitious plan of “comprehensively deepening economic reforms”, at the same time noting in particular that “ushering in a new era of ecological progress and building a beautiful China is an essential element of the China Dream” (Marinelli 2018). Indeed, from existing slogans such as Xi’s famous “clear waters and green mountains are like mountains of gold and silver [*lǚshuǐ qīngshān jiù shì jīnshān yīnshān*]”, a common genesis

5 The “China Dream” accelerated in popular discourse as a notable slogan used by newly-elected Xi Jinping in November 2012, when he proclaimed a collective longing for “the great rejuvenation of the Chinese nation” (Callahan 2017). “Advance Ecological Civilization and Build a Beautiful China” comprises a section of Xi Jinping’s self-titled book, *Xi Jinping: The Governance of China* (Beijing: Foreign Languages Press, 2014).

can be inferred among these rhetorical projects of national rejuvenation (Beijing Review 2019). Their entwined pronouncements of social and economic value exemplify how political imaginaries may, in Jasanoff’s words, “encode not only visions of what is attainable through science and technology but also of how life ought, or ought not, to be lived; in this respect they express a society’s shared understandings of good and evil” (2015a: 4).

Extensive scholarship has documented the rhetoric of statecraft through which “ecological civilisation” has been enunciated, as well as the tangible policy outcomes that can be traced back to its implementation (Schmitt 2016). Such investigations, we contend, might be extended by heeding Sheila Jasanoff’s call to bring “performance back into the realm of political theory”, as a means of refocusing upon “science and technology as key sites for the constitution of modern social imaginaries” (2015a: 10). To this end, we borrow the term “terraforming” from the conceptual archive of science fiction and scientific futurism, as it specifically allows us to synthesise two material instantiations of this Chinese sociotechnical imaginary – island-building in the South China Sea and biosphere habitat construction on the moon – which we show to be linked as representational, political and bio-geophysical performances of state-building.

Scholars have identified the extent to which the (spatially) horizontal dimensions of the Chinese technosphere, for example in SCS commercial shipping, have come to interact in increasingly intimate ways with the vertical dimension of the technosphere, for example the Beidou satellite network (Chubb 2017). We contribute to these analyses an explicit focus on the reinforcing relationships among Chinese publics and the extension of life-supporting and sustaining technological systems across those horizontal and vertical dimensions. To do this, we map a particular genealogy of the concept of terraforming.

“Terraforming” demonstrates the rich feedback loops that conjoin scientific and cultural discourse. In the first instance, “terraforming” as a science-fictional phenomenon has often historically referred to planetary adaptations aimed at rendering the environmental conditions of alien planets fit for habitation by lifeforms from Earth. This definition follows science fiction tropes depicting the human colonisation of space, refashioning new worlds in the literal image of Earth. However, after the Second World War, notions of engineering radical changes to planetary landscapes began to appear closer to home (see for example Hamblin 2013). Western dreamers of a future on an eminently alterable Earth positioned “hydrospace” as the place where those dreams would be realised, and terraformation projects were conceived and proposed on gigantic scales, from fertilising seas to creating artificial coastal upwelling zones through the strategic placement of nuclear reactors (Rozwadowski 2019). At the same time, the oceanic “Inner Space”, as well as Outer Space, transformed into a Cold War theatre for the movement of technoscientific (particularly nuclear) objects and ideas (Oreskes 2014, 2021).

Visions of Earth as a planetary whole after the late 1960s, from James Lovelock and Lynn Margulis's Gaia Hypothesis to Buckminster Fuller's popularisation of Spaceship Earth, came to view the world as a complex network of feedback loops that might be changed and redirected through geological and biological alteration, for example of nutrient cycles, greenhouse gases and albedo effects. Later, as anxieties around anthropogenic climate change and the viability of future planetary survival grew over the latter part of the twentieth century, the concept of terraforming evolved from these sets of linked concerns and in turn grew rhizomatically among scientific communities. In both speculative media and also scientific discourses, intensifying global environmental crises after the mid-twentieth century gave rise to a new mythos of geoengineering and bioengineering as interdependent solutions – via the practice of terraformation – to the Earth's rapidly changing biogeological conditions.<sup>6</sup>

In 1982, NASA planetary scientist Christopher McKay wrote: "it is becoming increasingly clear that humanity is already engaged in both deliberate and inadvertent global modifications of at least one planet – Earth" (Pak 2016: 2). A new definition of the verb "terraform" was added to the *Oxford Dictionary of Science Fiction*, dated to 1997, which read simply: "to modify the Earth's environment." Ostensibly, these two modes of terraforming appear fundamentally at odds with one another. The former deals with the remaking of alien landscapes in line with Earthly environs. However, as literary scholar Chris Pak asks: what does it mean to alter Earth to make it more closely resemble itself? We propose that the heuristic of terraformation – referring to a plurality of interfacing aspirations and practices that seek to recover for the future an idealised Earth located in a liminal temporality – corresponds usefully to these simultaneous materialisations of Chinese self-imagination within and beyond its borders.

Our focal points here are ongoing Chinese island-building in the South China Sea and the Chinese Lunar Exploration Program (also known as the Chang'e Project). These case studies evince the social and technoscientific processes by which a Chinese state is constructed, both as artificial islands in the Paracel, Spratly and surrounding archipelagos, and as the lunar biosphere project to sustain terrestrial life on the far side of the moon. By tracing the imbricated histories of Chinese infrastructural megaprojects in the South China Sea and on the moon, we examine how these practices also tap into popular fantasies of China's place in the world, while engineering these visions into global reality.

6 See Conde-Pueyo et al. (2020). This genealogy of terraforming suggests that there is a relationship between collectively held visions of Earth's potential futures and our (or its own) capacity to affect biogeological change toward realising those visions. Indeed, the ways in which histories of engineering Earth systems processes have interacted with histories of theorising planetary change broadly over the 20th century remain historiographically underexplored. We propose that the argument presented in this paper might contribute to stimulating thought on these historical intersections in a new context.

Chinese terraforming manifests as attempts to reclaim spaces by prefiguring them as part of a sociohistorical Chinese imaginary. In doing so, these spaces are at once refashioned in accordance with an imagined Chinese past and an idealised Chinese future. Whereas Jasanoff relates her “sociotechnical imaginaries” in terms of a “Future Imperfect”, referring to the inherent tensions between competing visions for social development and the “shared fears of harms that might be incurred through invention and innovation, or of course the failure to innovate” (Jasanoff 2015a: 5), Maurizio Marinelli (2018) notes that the rhetoric of Chinese eco-civilisation repeatedly evokes an undivided future that can and will be manufactured to perfection.

In this register, according to Marinelli, the PRC enacts “a recurring projection of perfection into an allegedly perfect future [...] China *will* respect and protect nature; It will remain committed to the basic state policy of conserving resources and protecting the environment; We *will* leave our future generations a working and living environment of blue skies, green fields and clean water” (Marinelli 2018: 368–80). These visions of utopian possibilities are inextricable from carefully curated readings of a Chinese collective past in an ongoing state of revision and refinement.

A closer look at the machinations undergirding terraformation throws the unevenness of Chinese political time into sharp relief. This has been demonstrated by Zee (2017: 217), whose examination of landscape engineering around the Gobi Desert interprets these projects as “chronopolitical experiments [...] where state practice does not merely have temporal dimensions but is indeed explicitly conceived and practiced as action on time, a catching-up to History”. The work of terraformation as part of a larger state agenda of ecological civilisation is therefore to reconcile these temporal, imaginative and material disjunctures.

Transcending geopolitical borders and planetary orbits, the spaces we examine are technologically and culturally remade as Chinese, together telling a unique story about the making of Chinese eco-civilisation. Moreover, these two examples are notable for the ways in which the investment and interaction of broader Chinese publics are summoned and sustained, in ways that are both conducive to and attainable by large-scale technopolitical projects – as tourists being shuttled to and from the new islands, and as an audience participating in the technical and imaginative dimensions of China’s astronomical forays.

Knowledge about the ocean is techno-politically mediated, meaning that cultural imaginations of ocean spaces and technologies are central to understanding the history of ocean places (Rozwadowski 2019, Ratté 2019, Helmreich 2009). The same is true of outer space, which is often constructed in recursive refraction with and through ocean space. Scholars including Andrew Chubb (2017) have argued convincingly that Chinese civil technologies, from fishing vessels to cell phone signals, interface to performatively enact territorial sovereignty; to these studies we add the study of making and sustaining life itself.

Aspirational Chinese terraforming projects that seek to construct the conditions of biological habitability out of the ocean and on the moon, enacted among both citizens and state apparatuses, speak through one another synergistically in their imaginative and material dimensions. What becomes increasingly clear, now more than ever, is that the geographical and historical delimitations of China are subject to fluidity and contestation. To study Chinese terraforming, then, is to map concretely the extension of China beyond itself.

## Extra/terrestrial islands: The historical bedrock of a terraforming imaginary

Though scholarship has tended to emphasise the novelty and rapidity with which China has achieved an “unprecedented land-to-sea conversion”, analyses that centre comparative historical frames have identified a rich and contentious history of island-building and usage in the South China Sea (Chubb 2017, 2021; Hayton 2018). China’s 1974 seizure of the Paracel (Xisha) islands from South Vietnam was materially founded on the fact that, in 1956, the PRC established a permanent presence on the largest Paracel island: Woody (Yongxing) Island had been demarcated in 1953 by the Chinese State Council as a county-level administrative division. In 1984, the administration of the islands was transferred to Hainan, designated in 1988 as the Hainan Province Paracels, Spratlys and Zhongsha Islands Authority.

At the same time, the occupation, seizure and progressive development of the islands has been founded more profoundly on the ideological basis that they were always Chinese. To substantiate this notion, official claims suggest that the archipelago had been used by Chinese people and was Chinese territory since ancient times. This narrative has been complicated of late, with historians questioning the validity and continuity of these claims across time. A more fractious image of historical territorial control in the islands of the South China Sea has consequently emerged that has lent weight to similar historically-rooted claims to island territories from Vietnam, Malaysia and the Philippines.<sup>7</sup> Whether

7 Bill Hayton (2018) finds that it was only in 1907 that Qing officials became interested in offshore islands, after learning of entrepreneurial activities on Pattas island. Hayton also says: “a 1909 article by the Australian newspaper *The Examiner* tells us that foreigners, two Germans, one Japanese, and several Malays (China and Her Islands 1909, p. 8), had begun mining operations on Hainan Island without the authorities finding out until much later. It also records the presence of foreigners on the Paracels themselves who’d carved their names into trees” (Hayton 2018: 10). Hayton presents a historical vision of the South China Sea that saw China as mostly disinterested in the archipelagos throughout the late 19th and early 20th centuries, even choosing to forgo opportunities to claim territory in the SCS in 1933. Hayton finds that the Chinese government undertook efforts to historicise claims to SCS territory by furtively depositing dated stone markers on islands in 1937, and by revising place-names from simple English transliterations to Chinese descriptors in 1947. All of this points to the SCS as being virtually ungoverned, particularly by China, through the mid-20th century.

or not the history of occupation, use and inhabitation of the SCS islands was ever Chinese to begin with, or at all, the ideological groundwork had been laid for a sea of islands, visited haphazardly by fishermen, that was always already Chinese – to be filled in with permanent residents and infrastructure later (Bonnett 2020).

Nonetheless, earlier histories, written and rewritten by China at several points in the 20th century, were easily taken up beyond China by the time of the first English-language analyses of territorial disputes in the South China Sea in the 1970s. In 1988, when UNESCO sought to build a weather station in the South China Sea, they turned to China, who obliged and began the first major terraformation of a Spratly (Nansha) island on Fiery Cross Reef for this purpose.<sup>8</sup> Stung by prior defeat in the Paracel islands, Vietnam sent ships and materials to commence their own construction project, before being promptly sent away by Chinese naval forces.

Yet the PRC’s usage of islands in the South China Sea began prior to 1988. The indigenisation of technologies related to remote seawater sensing underwent periods of intensive research at the Chinese Academy of Sciences’ Institute of Oceanology at Qingdao between 1965 and 1966 and between 1970 and 1977.<sup>9</sup> These periods saw the development of the hydrometeorological buoys and satellite receivers that would later be central to the functionality of scientific research that formed some of the justifying ideological bedrock for early island-building projects.

Though work on marine instrumentation was substantial before 1984 – by which time Qingdao had amassed a collection over more than 1,000 related devices – these projects still did not form the bulk of Chinese oceanographic innovation. Oceanographer Qin Yunshan reported in 1995 that a particular focus of scientific effort since 1958 had been the development of seawater desalination technologies (Qin 1992). Resulting in a cadre of more than 3,000 specialists, research included studies on ocean thermal energy conversion to drive distillation processes, reverse osmosis systems and theorising processes by which salinity gradients might be exploited for the production of energy. Observing the interrelated crises in “society, economy and ecology” spurred by freshwater insecurity, Qin noted the potential of technologies like reverse osmosis to supply the world, and particularly small islands (like Malta, whose cooperation with China on research projects he mentions), with freshwater.

In fact, by 1981 the Institute of Oceanology had completed a seawater desalination station on Woody (Yongxing) Island: an experiment and demonstration project that filtered 200 tonnes of seawater daily. These efforts, aimed at getting

8 We use the Chinese and English names for these islands interchangeably. For more on the relationships among UNESCO, oceanography and developing over the mid-to-late 20th century, see Torma 2016.

9 Qin Yunshan, “The State Oceanic Administration, Beijing”, in Elisabeth Mann Borgese (ed.), *Ocean Frontiers: Explorations by Oceanographers on Five Continents*, New York: Harry N. Abrams Inc Publishers, 1993, p. 203.

ahead in “a new area of marine technology development that may well be of crucial importance for the future”, laid the groundwork for infrastructure and habitation to come (Qin 1992: 203).

As the Space Race between the Soviet Union and the United States reached its apogee on the moon, Mao Zedong and Zhou Enlai decided in July of 1967 that China would not be left behind. A Chinese manned mission to space was conceived for the first time. The following two decades saw a series of many failures and some successes, as well as the transition under Deng Xiaoping from PRC-named projects to mythologically-inspired nomenclatures (a new generation “Long March” carrier rocket, for example, became a “divine arrow” or *shenjian*).<sup>10</sup> In 1992, Project 921 was devised, which would produce the Shenzhou series of four uncrewed flights and two crewed missions. Shenzhou 1, launched in 1999, orbited the Earth fourteen times uncrewed. As the millennium approached, China was technologically and politically poised to send organised missions of humans, among other organisms, to sites far afield, from archipelagos to near-Earth orbit, and soon, the moon.

## Teeming with lively engagements: Towards a future China in the 21st century

Near the end of the final decade of the 20th century, a dog attempted to swim out to sea from Yagong Island in the Paracels. After finding nowhere to go, the dog returned and died, lonely and depressed. At the time, Yagong was still a stopover for fishing boats with a few semi-permanent fishing residents managing a difficult existence where “the dazzling sun grilled the corals” (Liu 2016b) and the dog, whose grave is marked today on the island, was likely the only dog in the South China Sea. Meanwhile, around the same time, a Chinese dog was rumoured to have entered space for the first time.

Shenzhou 2 apparently launched 19 species of biological organisms into orbit, among which were rumoured to be mollusks, a rabbit, a monkey, and ... a dog (Burgess / Dubbs 2007). Today, Yagong Island bustles with life of many kinds. By 2000, the civilian population of the Paracels, particularly on Woody (Yongxing) Island, was growing. By 2006, Woody Island had created internal subdivisions that were set to work on building infrastructure in what was then a census-town. In 2007, it was announced that a city would be established on Woody Island, to be administered logistically via Wenchang on Hainan. In 2012, Sansha

<sup>10</sup> Hayton tells us that the same process of re-imagining nomenclature transpired in the SCS during transitions from the ROC government to the PRC. Scarborough Shoal first appeared on Chinese maps as *Si-ge-ba-luo*, a transliteration, before being renamed *Minzhu Jiao* (Democracy Reef) by the ROC and then *Huangyan* by the PRC in 1983.

became China’s newest city, by far the smallest in land area – yet paradoxically the largest in total geographical area taking into account surrounding waters – and the least populated city in the country (Rowen 2018).

In 2003 meanwhile, Shenzhou 5 sent Yang Liwei into space, making China the third nation to put a human into orbit, celebrated as China’s first taikonaut (from the Mandarin word for “space”, *taikong* 太空; also known in Chinese as *yuhangyuan* 宇航员). State news agency Xinhua was quick to draw comparisons with Wan Hu, a 14th century man who died while attempting flight using gunpowder-filled rockets attached to a bamboo chair (Siddiqi 2010). The present, refracted through the historical past, enabled the visualisation of a Chinese space-faring future.

In the same year, the NASA Space Shuttle Columbia broke up upon re-entry, carrying in addition to astronauts a payload of experiments sourced from school-children around the world. China, via Beijing Jingshan Middle School, had sent silkworms (NASA’s John F. Kennedy Space Center 2003). After the disaster, the experimental design lived on, and a copy of the experiment was sent into space aboard the 22nd Fanhui Shi Weixing retrievable satellite launched in late 2005. For China, recoverable satellites had long been foundational to the production of knowledge about biology in space, with dozens of experiments probing organism metabolism and development carried out over several such missions (Harvey 2013). Silkworms were now full-fledged participants in the Chinese space programme.

In 2007, China turned to the moon, establishing the Chinese Lunar Exploration Program (CLEP). The orbital probe Chang’e 1 completed a mission to map features of the surface of the moon. Chang’e 2, launched in 2010, mapped the moon in greater detail in preparation for a lunar soft landing before leaving lunar orbit to explore the asteroid 4179 Toutatis and test China’s deep-space tracking systems. At the same moment when Chinese citizens and scientists could first visualise the moon using Chinese technologies, China also turned to the developing world, marketing itself as the primary benefactor of space technologies and resources for a world mostly left behind in space exploration (Hansen 2008).

China, in the first decade of this century, was accelerating in multiple directions across seas, terrains and atmospheres. Where the Paracels had very recently hosted only itinerant fishermen and solitary dogs, there were now subdivisions of permanent residents with county-level authority administering the Paracel, Spratly and nearby archipelagos. Where half a century ago the USS Pargo had shelled and decimated all life on Japanese-occupied Woody Island, China constructed a living city (Hayton 2018). China also entered the post-Cold War tradition of space exploration in part by sending into orbit, aboard retrievable satellites and Shenzhou rockets, a variety of organisms – from mouse embryos

to Chinese cabbage, from silkworms to humans (Solomone 2006). The material and infrastructural work involved in these projects, from island date-marker stones to orbiting silkworms, was essential to the enduring permanence of a China oriented toward space and the South China Sea.

Moreover, these technological undertakings served as crucial reiterations of the China Dream and related ideological projects, enkindling visions of a future that would be – and had always been – as Chinese as the past, in the eyes of practitioners and proponents of state discourses (Anagnost 1997). In 2006, when NASA sent astronaut and biochemist Shannon Lucid on the administration's first trip to China, she returned remarking, “their enthusiasm [for space exploration] seems authentic, and no mere invention of the communist state” (Dick 2008: 115). James Hansen (2008) traced the emergence of this putatively genuine enthusiasm through the mythic status accrued by the figure of the taikonaut, namely, as both an everyman and instrumental agent of historical Chinese aspirations of technoscientific progress and exploration.<sup>11</sup> The taikonaut, as both individual and idea, represents just one such material and imaginative conduit through which political time and space is reconfigured, extending Chinese past, present and future into new territories in the process.

Mary Ann O'Donnell writes that, “in the PRC, the future has not been a time but rather an ongoing project to reclaim the country's rightful place in the world” (O'Donnell 2018: 247). A Chinese future is already everywhere, manifested in the historical past and waiting to be enacted vis-à-vis new instantiations of the China Dream, including most recently Xi Jinping's vision for “Beautiful China” and “eco-civilisation”. China's future is also rendered multifarious and liable to change, dissipating some visions and aspirations and foregrounding others in the process. Scholars such as those mentioned above have emphasised that what this construction reveals above all is the instability of the political present (Anagnost 1997, Zee 2018, Marinelli 2018).

Here we can observe the cyclical motions of what Yomi Braester (2016) conceives of as a Chinese “politics of emergence”. Fishermen, taikonauts, silkworms, humans, animals – a diverse cast of characters moves in both distant and intimate relation to one another, “populating the present with specters of past and future temporalities [in a manner that] serves the dominant economic and political powers” (Braester 2016: 17). Looking toward the third decade of the 21st century, territorial space and political time are effectively collapsing together in the cosmic and archipelagic weaving of China's future.

11 Hansen (2008) likens this material-imaginative linkage as akin to that produced to justify human space-flight under the Apollo 11 mission in the USA.

## Terraforming Beautiful China I: “Everyone’s heart has a sea like this”

In 2013, satellite images of Yagong Island began to display the blooming of terrestrial greenery. Ye Xingbin, village head of Yagong, was supplied with 120 tonnes of soil and 300 tonnes of fresh water, as well as with coconut fibre (to lock moisture in the soil), in order to forest the barren sun-baked island. Each tonne of water apparently cost RMB 100 yuan to transport from Hainan (approximately USD 16.30 at the time), and altogether each of the 400 trees growing on Yagong in 2013 cost around 20,000 yuan (roughly USD 3,260).<sup>12</sup> A suite of new equipment followed the year after, including a desalination device, solar panelling, generators, satellite infrastructure and even public toilets, each of the latter costing in the range of what it would cost to construct an entire village on the mainland (Liu 2016b).

The terraforming of Yagong joined similar projects on other Paracel islands, including nearby Silver Islet, as well as projects in the Spratly Islands, including most famously on Fiery Cross Reef. By the close of 2014, as part of a multi-pronged effort to encourage Chinese citizens to establish permanent residency in the archipelagos, simple tin-roofed housing and commercial structures laid on coralline foundations had gone high-tech, each with the capability to desalinate water and generate solar electricity in order to produce and sustain human, among other, life.

In 2015, the cruise ship *Coconut Princess* embarked on a maiden voyage from Sanya on Hainan into the Paracel islands. Ian Rowen, tracing tourism as a strategy of creative territorialisation in the disputed territories through the Chinese tourism blogosphere, found a post on Hainan International Travel Airways website that positions the destination of the advertised four-day cruise into the Paracels as “heaven, half of water, half of fish”, before going on to state that “everyone’s heart has a sea like this. What a pity that most people will never arrive in their lifetime” (Rowen 2018: 67–68).

Throughout 2015, *Coconut Princess* transported hundreds of tourists to several destinations in the islands twice monthly, including Yagong. Tourism as a “creative territorialisation strategy”, in Rowen’s terms, is a process contingent upon the participation of multiple unique groupings of actors. Different people need to find the sea in their hearts in distinct, synergistic ways. By 2013,

12 Though perhaps not on its face a staggering figure for cost per tree, each tree cost around eight times the average annual earnings of an agricultural worker on the mainland, and about one third of the annual earnings of residents in Huaxi, Jiangsu Province, another village where state-sponsored tourism initiatives and agricultural futurism had conspired to create a “village of the future” (Lim 2006). Bearing in mind that Ye Xingbin’s first round of trees imported from Hainan to green Yagong island died due to high temperatures and a lack of irrigation infrastructure, and another round of more drought- and heat-tolerant coconut palms and Casuarina trees needed to be imported (along with rich soils and fertilisers) to the island, the cost of terraforming Yagong has indeed been very high.

as Yagong was seeing its first greenery, tourist cruises began regularly visiting the island and for the first time, villagers could both purchase groceries from ships and sell seafood and handicrafts to visitors.<sup>13</sup> Tourism also adjusted the rhythms of life in the islands, with seafood catches being adjusted to coincide with tourist visitation.

Cruise ships became essential infrastructure in the making of Chinese life in the islands beyond the majorly populated civilian and military centres. In order to make the South China Sea a destination to which only Chinese can arrive, all the while pitying all those others who can never do so (including, on a rhetorical level, claimant countries such as Vietnam, which in 2015 also announced cruises to their claimed Paracel islands), tourists and settlers and corresponding industries needed to imagine and materially create the islands as precious – as heavenly places, liable to disappear under too much pressure, and worthy of many kinds of protection.

Indeed, well before environmental damage and responsibility came to the fore in international arbitration, new infrastructure projects in the Paracel and Spratly islands were being cast by local state actors as nodes in a networked system of ecological protection (Hui 2014). Where the greening projects that terraformed inhabited islands were framed as anti-erosion and windblocking efforts that also attracted diverse seabird species, new wastewater treatment and solid waste collection plants doubled in value as they not only made the islands “livable” but also “eco-friendly”. The comfort of island residents was twinned with minimising their own environmental impacts. By 2014, the city of Sansha’s ecological protection plan, which interfaced with “dynamic marine monitoring systems” and “ecological protection stations” across the South China Sea archipelagos, was completed under its own department of land resources and environmental protection (Hui 2014).

2016 was a watershed year for the Chinese position in the South China Sea and by extension in the world. In 2013, the Philippines had lodged an arbitration case against China concerning the legality of their nine-dash line claims<sup>14</sup> to SCS territory under the UN Convention on the Law of the Sea, with a ruling expected in mid-2016. Fresh satellite photos of the Spratly islands from 2015 showed the appearance of a 3,000-meter-long airfield on Fiery Cross Reef, building the island up to eleven times its 2014 size. For China, terraformation was a project meant to catch up China’s presence in the SCS with those of other claimant countries, most of which had built island airstrips decades before.

13 In 2016, the Coconut Princess was replaced by the much larger and newer Star of Northern Bay, which greatly increased the capacity of the system, “bringing not only tourists eager to taste seafood delicacies and buy dried fish from the islanders, but also transporting supplies like fresh vegetables and cigarettes to the villagers and taking away household waste” (Liu 2016a).

14 The nine-dash line refers to the cartographical convention used by PRC (and previously ROC) state agencies, by which China asserts territorial claims to large contested regions of the South China Sea.

Outside of China, the island-building was seen as destabilising to regional maritime security, with China far outpacing any other claimants with the magnitude of the project (Hansen 2015, Storey 2015).

Along with revealing construction above water, satellite photos also revealed the signatures of underwater change. University of Miami marine biologist John McManus told *The Guardian* in 2015 that “strands of white silt streaming visibly into the [Fiery Cross] lagoon were evidence of the mucus emitted by millions of dying corals smothered by sediment” (Allen-Ebrahimian 2016). Swirling in the green and blue hues of satellite imagery were new forests, suspected surface-to-air missiles, deepwater ports and messages from coral – all of which had come to take on a range of ideological valences.

In the months leading up to the impending 2016 Hague ruling, it was time for the rhetoric of ecological civilisation to take centre stage. On 6 May, Ministry for Foreign Affairs spokesman Hong Lei had this to say:

As owners of the Nansha Islands, China cares about protecting the ecological environment of relevant islands, reefs and waters more than any other country, organization or people in the world. China’s activities on the Nansha Islands strictly follow the principle of conducting green projects and building ecological islands and reefs. Based on thorough studies and scientific proof, China adopts dynamic protection measures along the whole process so as to combine construction with ecological environmental protection and realize sustainable development of islands and reefs (Hong 2016).

A Chinese approach to building green projects in the archipelagos would follow the idea of “natural stimulation” of wave action from natural storms that redistributes biological and geological material, in the process gradually evolving an “oasis on the sea” while leaving the impact on coral reefs limited. Deputy Director-General of the Ministry Wang Xining elaborated four days later the notion of green projects to visiting journalists, explaining that land reclamation in the SCS “is carefully designed, carefully built, [to] try to minimise ecological effect” (Allen-Ebrahimian 2016). On 25 June, Sansha City announced the designation of funds toward a maritime ecological protection fund. The city’s environmental protection bureau announced that the funds would add to the already more than 30 million yuan (~USD \$4.5 million) spent in four years on coral reef and islet restoration, as well as the captive breeding and release of reef fish, mollusks and sea turtles (China Daily 2016).

Still, less than two weeks later, the Hague ruled in favour of the Philippines, stating on the subject of China’s environmental responsibilities that large-scale land reclamation on seven features in the SCS had caused significant damage to reef ecosystems, and that China had failed in its obligation to protect the habitats of endangered species, including sea turtles and corals (Robles 2020). China had already declared the arbitration claim null and void in 2014, but this did not mean that the ruling was without impact. The ruling intensified the sentiment in China that not only were the islands Chinese, but also that an important way to emphasise this inalienable relationship was through a distinctly

Chinese approach to ecological stewardship alongside terraforming islands and building island environments.

More than 10,000 Chinese tourists had been to the Paracels by June of 2016, with enthusiasm for SCS tourism only growing after the ruling. Tourism surged into 2017, as Hainan and China Southern Airlines sought to establish commercial flights to the Paracels (Wong 2017). Alongside private companies, Chinese state-owned enterprises including China Cosco Shipping Corporation and China Service Travel Group had begun seeking opportunities to expand tourism in the SCS to connect the islands not only with ports on Hainan, but also in Taiwan and other states as part of a Maritime Silk Road cultural tour (Xue 2016). On Silver Islet in the Paracels, 2016 saw 22 permanent residents acquire desalination equipment and solar panels, in addition to a vegetable greenhouse. As Conde-Pueyo et al. (2020: 6) remark in the context of planetary terraformation, plants join humans in partnerships of ecosystem engineering, where “coevolution between biological and environmental properties pervades the creation of habitats suitable for the maintenance of complex and diverse life forms”. Within the systems that support both tourists and residents across the South China Sea islands, terraformation designates the ongoing coordination of a variety of humans, nonhuman organisms, nutrients and technologies.

Still, tourism, while a tool for “sustaining inhabitation”, has hard limits. The islands are seen as too ecologically fragile for the construction of accommodation facilities (Liu 2016a). Visitors can see and touch but not take, unless they become pioneering residents. The establishment of ecological civilisation here sees the islands as taking on two potentially competing, but ultimately constitutive, identities. Despite being built environments, they are positioned as vulnerable places to be ecologically protected (Rice et al. 2016). At the same time, they are spaces to be settled by Chinese pioneers and inhabited using complex life-sustaining technologies.

After the arbitration tribunal ruling, with the islands taking on fresh identities as mouldable spaces in which to enact Chinese visions for the future, Beijing – via state-owned enterprises – regarded them as nodal points within the wider constellation of sites on the Maritime Silk Road. In 2017, Xinhua live-streamed a documentary on Robert (Ganquan) Island to YouTube, where one such “ecological protection station” was constructed in 2014.<sup>15</sup> The documentary was part of a series covering the Belt and Road Initiative, denoted by the hashtag #BeltandRoad.

The episode on Ganquan Island focuses on material and ideological linkages between the Ancient Belt and Road and the contemporary Belt and Road Initiative. In the film, a presenter clutching bleached corals and seashells combs the shore for ancient Chinese pottery shards that, she is told, once spilled from ship-

15 “Secrets of Ganquan Island in South China Sea” (2017), available at [https://www.youtube.com/watch?v=hrj3YZX0\\_3Y](https://www.youtube.com/watch?v=hrj3YZX0_3Y) (accessed 8 September 2020).

wrecks to litter the fringing reef. She accompanies a state scientist across coral-line beaches and on paths through young vegetation, advertising the island as simultaneously an escape from city life, in nature and without cell phones, while also boasting high-speed wireless internet coverage, “to stay connected with family while on holiday” (New China TV 2017).

Meanwhile, in orbit, Chinese silkworms were weaving silken cocoons aboard a Chinese space station. A week after docking with Tiangong-2, Shenzhou 11 taikonauts Jing Haipeng and Chen Dong reported via live video feed on the silkworm experiment designed by Hong Kong middle school students. Andrew Jones writes that although taikonauts face extraordinarily difficult odds of being selected for a mission, the silkworms have it worse, with the six aboard Shenzhou 11 selected for optimal silk-weaving from among 4,000 specifically bred candidates (CENAP 2016).

The space station Tiangong-2 had enabled China to send humans into prolonged orbit, granting access to space to the Chinese public via video feed and by participatory experimentation. A system emerged that allowed pioneering taikonauts, as well as silkworms and other experimental organisms, to venture far afield to a fragile but habitable celestial palace (*tiangong*) and that invited the participation, alongside them, of the Chinese public via livestream. This system was paralleled back on Earth in the cruise ships carrying goods to islets in the South China Sea. Through the generation of ecosystems necessarily maintained via complex organisations and systems from the Chinese mainland, China could place its future in spaces far removed from itself.

## **Terraforming Beautiful China II: Blooming on the far side of the moon**

In April 2018, as Western accusations against China of militarising the SCS islands continued to mount and China conducted its largest naval review in the SCS to date, a quieter statement was made in Beijing (The Economist 2018). A biological payload to be sent aboard the Chang’e 4 mission, intended to make the first soft landing on the far side of the moon, was announced. Selected from among a reported 300 crowd-sourced entries in 2016 and built by the Chongqing University Space Biology Research Team in collaboration with 27 other Chinese universities, Chang’e would take to the lunar farside a 3-kilogram biosphere, equipped with water, air, a nutrient solution, living seeds, yeast, insect eggs, a camera and data transmission systems to relay the progress of the experiment back to Earth (Song 2018).

The hope was to make the first life blossom on the lunar surface; a difficult goal to actualise. Wildly fluctuating temperatures on the lunar surface would

need to be kept within a narrow range inside the biosphere, and light would need to be concentrated for plant growth. According to chief designer of the container Zhang Yuanxun, if abiotic parameters could be kept within range, then seeds would germinate and eggs would hatch, setting into motion the self-regulating nutrient and gas exchange among plants, insects and fungi characteristic of a potential “simple ecosystem on the moon” (Graham 2018).

Chang’e 4 landed on the lunar farside on 3 January 2019, and the biosphere system immediately began watering dormant seeds. Four days later, footage from inside the biosphere displayed a new green leaf, showing for Xie Gengxin, chief designer of the experiment, that China had “sprouted the first bud on the desolate moon” (Westcott / Xiong 2019, Jones 2018, Zheng 2019). Five days and 170 still shots of the living interior later, the experiment was remotely shut down. Head of the experiment Liu Hanlong and Xie Gengxin both reported that temperatures inside had grown too erratic to sustain life, and that the biological matter would be left to decompose slowly in the long lunar night (Xiong / Westcott 2019). That the experiment failed to reach completion was immaterial to its larger goals. An Earth-like Chinese island had been cultivated on the moon, and China was already looking beyond rudimentary ecosystems and organisms to schemes for human habitation. Chang’e 4 sailed gently toward deeper space. Progress had been achieved.

## Earthly means to imaginary ends

Here we find it prudent to address the scope of what we refer to as terraforming as it iterates from island-building to biosphere construction. Scholars of Earthly terraformation point to stark differences between efforts of geo- and bio-engineering, such as the attempt by Canadian scientists to fertilise waters off the coast of British Columbia using a massive quantity of iron, and biosphere projects, like the famous Biosphere-2 in Oracle, Arizona. Chris McKay describes the latter as entirely unrelated to terraforming, and more like “biologically-based life support” (McKay 2015, Press Association 2012).

We see this distinction as a fair one, but we also see both SCS islands and the lunar micro-ecosystem as constructed along the same temporal continuum and operating within tightly related spatial-logistical dynamics. Both projects can be seen, through the lens of ecological civilisation for the China Dream, as systems contingent on intense techno-management that are positioned ideologically in a future always on its way, yet already here. As Valerie Olson finds in the context of US space programming for experimental closed-loop system habitats like BIO-Plex, while systems seem inextricable from social reality, they are also technologies of reality (Olson 2018). We concur with Marinelli and

others that contemporary Chinese realities are transposed onto the rhetorical future, and as a consequence find elasticity in defining terraformation more broadly to include the lunar micro-ecosystem as well as SCS land reclamation in its definitional purview. Doing so allows us to draw attention to the contours of the closed-loop systems of transhabitation that see the exchange of life-supporting systems, essential nutrients and Chinese human and nonhuman life across atmospheres and oceans in the pursuit of the China Dream.

Liu Hanlong emphasised the importance of the biosphere for the prospect of sustaining life in space and on the moon, saying “We have given consideration to future survival in space. Learning about these plants’ growth in low-gravity would allow us to lay the foundation for our future establishment of a space base” (Stewart 2019). Lie Jinzeng, of the National Astronomical Observatory, noted that the briefly flourishing “moon garden” was a key first step towards human life on the moon (Zhang 2019). Xie Gengxin similarly echoed, “although it is a biological payload for popularizing science, it laid a foundation and technological support for our next step, that is, to build a lunar base for living” (Bullard 2019).

More so than serving as a precursor to a potential Chinese human lunar mission, Liu Hanlong also stated that “the interest in scientific research enhances people’s awareness of environmental protection” (Zheng 2019). Indeed, a large number of Chinese citizens and especially young people participated in Chang’e 4, from submitting to contests for payload designs (including the biosphere) in the “creative moon probe load design collection campaign” to viewing live streams of the lander and the biosphere experiment, to the more than 100,000 people who wrote down their names and hopes for lunar and space exploration, to be carried with the Chang’e 4 relay satellite into deep space upon mission completion (Song 2018).

Two days before the biosphere landed on the moon, the Chinese Ministry of Natural Resources announced plans to begin coral reef restoration at facilities constructed on Fiery Cross, Mischief and Subi Reefs, the three largest of the seven Chinese terraformed Spratly Islands. The Ministry proclaimed that “to protect the coral ecological system is the key to ensuring the ecological security of the Spratlys as well as the entire South China Sea” (Liu 2019). On 4 January 2019, as Chinese seeds soaked up water in a metal tube on the lunar surface, the Ministry of Natural Resources announced that facilities had been launched for the protection and restoration of ecosystems on Yongshu, Zhubi and Meiji Reefs in the Nansha Islands, stating that experiments toward developing methods and technologies would be tailored to the local ecological characteristics of the archipelago and would employ natural, as well as artificial approaches to restoration.

Chen Hong, director of the Hainan South China Sea Institute of Tropical Oceanography, lauded progress made through cooperation between govern-

ment and industry in creating a real awareness around care for the environment and protection of ecological systems. Having already led a team in planting 30,000 corals in the Paracel islands, he looked to plant a million in total across the SCS by the end of 2020 (Ma 2019). When asked about reef-building projects in the SCS, Assistant Professor of Marine Biology at the University of Hong Kong David Baker noted: “One of the things I think comes in concert with China’s sovereign claims over the South China Sea is also environmental stewardship. What really worries me is that the island building is also happening” (Zhen / Ng 2019).

In fact, both processes are contextually inextricable from one another, and for environments to be stewarded in the Chinese SCS, they must have already been made Chinese. Indeed, these processes press on. In April 2020, Sansha City on Woody Island was granted approval from the State Council to generate two new administrative districts, Nansha and Xisha, administering from Fiery Cross Reef and Woody Island the entirety of China’s claims to the Paracel, Spratly and Eastern (Zhongsha) archipelagos (Panda 2020b, Wang 2020).

## **To be composed of an archipelago: The prospects of Chinese island-building**

Spectators, analysts and policymakers outside of China view Chinese efforts at conservation in the South China Sea with scepticism (Liu / Ng 2019). This is a familiar view, extending genealogically from earlier contentions surrounding the purpose of SCS island terraforming in the first place. These misgivings have circulated widely in the West, where Chinese claims in the SCS tend to be perceived as both acts of historical revisionism and violations of international law (Davenport 2022). The terraforming project is said to antagonise, coerce or else threaten its southern neighbours, to say nothing of upsetting wider geopolitical stability. Such perspectives have only seemed to gain further traction in popular narratives, thus widening the rift between China’s self-positionality and its positioning by the West (Panda 2020a, Mastro 2019).

That the expansion of a Chinese presence beyond mainland China, from the SCS to outer space, is bound up in militaristic goals with implications for security is not only a banality, however, but also an oversimplified explanation of these phenomena. The more than 3,200 square kilometres of terraformed islands in the South China Sea are more than simple performances of militarising antagonism, and more than “symbolic outpost[s] in a brackish backwater” (Moss 2012), as China’s turn to biologising space is about more than creating an oppositional facsimile of Western space exploration. Rather, the vegetables presently germinating on Silver Islet, the silkworms that spun exemplary cocoons

on Tiangong-2, the *Arabidopsis* leaf that unfurled before cameras on the moon and corals mounted to artificial reefs in the Paracel islands all tell a more nuanced story.<sup>16</sup>

Non-Chinese understandings of the “global” are presently being rewrought along the winding paths travelled by Chinese materials, laborers and financial investment in pursuit of ever-expanding Silk Road Economic Belt and the Maritime Silk Road initiatives. The combined Belt and Road Initiative (BRI) springs from hopes of the China Dream, and thus flows out into infrastructural projects the world over, linking ports, industrial parks and other nodes through energy pipelines, railways, roads and shipping channels. In response, observers and stakeholders outside of China have increasingly parsed the relative significance of these efforts beyond making claims around purported goals of military dominance and toward consideration of the complex creation and maintenance of BRI lending economies, and the integration of vast and heterogenous geographical areas through multifaceted infrastructural development.

The conditions and consequences of island-building and lunar surface infrastructures examined in this paper point to more spaces wherein China’s global extension might be wrought anew. Evolving discourses of eco-civilisation for a beautiful future China are enacted materially through wide public participation in constructing and developing islands and biospheres as dynamic spaces to be visited, inhabited and manipulated by a range of Chinese bodies, yet simultaneously as delicate (eco)systems to be protected using uniquely tailored Chinese methods. For Chinese publics, terraformed islands and lunar biospheres are sites where ecological civilisation comes to synergise with other facets of the China Dream that extend across new Silk Roads in new spheres of influence. Taken together and framed within Chinese political rhetorics and public futures, these cases suggest that both physical distance and historical time are mediated and relativised by state and public-driven (re)production of material-imaginative links among locations on and beyond Earth.

Our inquiry thus far has engaged principally with processes of “embedding” and “extension” (Jasanoff 2015a: 28). By the former, we refer to the “deployments of labor and capital” through which ecological civilisation has been engineered into the material world, as well as the “group reflection by publics and other nonstate actors on remembered pasts and desired futures” (Jasanoff 2015b: 328). By the latter, we refer to the ways in which “scientific and technological ideas acquire dominion over time and territory” (ibid.: 333), thus becoming capable of translating into new sociopolitical domains. Yet returning once more

16 Historians attending to this nuance have increasingly sought out alternative genealogies for island-making in the South China Sea. Jennifer Gaynor, for example, studying land reclamation projects in Southeast Asia, articulates these projects and Chinese island-building as sharing an inheritance with the land reclamation via sedimentary dredging in East and Southeast Asia. See Gaynor (2020) for a rich discussion of the social and technological relations shared among large infrastructural projects of canal-building, island-making and more in the region.

to Jasanoff's four-part theory of sociotechnical imaginaries, there remain the much-debated questions of both "origins" and "resistance": where exactly do these imaginaries come from, and what happens when their internal contradictions and external complications stretch their symbolic and tangible meanings beyond recognition?

These critical lenses indicate in brief the degree to which these stories of China's terraforming remain untold. An analysis of developments around projects, both physically realised and aspirationally rhetorical, of Chinese exploration in "inner space" (the deep-sea) for example, especially in contraposition to outer space, remains a fascinating avenue for further research. Moreover, it warrants qualifying that our enquiry is necessarily partial insofar as it concerns itself primarily with state-sponsored media reportage and other published accounts of these projects. It is our hope that by delineating some initial lines of connection between these processes of terraforming, further comparative studies will continue to yield more important findings that emerge from a breadth of alternate standpoints on Chinese infrastructural megaprojects.

Interwoven projects of island terraformation and lunar exploration urge a reading of the shifting nature of the "global" that takes seriously the meaning-making potential of rhetoric across states and publics, and that reaches beyond real and imagined anxieties around coercion, antagonism and competition that so often characterise international views of these cases and the BRI generally, in the service of productively reconciling disparate perspectives on China's global positionality. On the moon and in the sea, terraforming projects (re)make life and its attendant conditions in the spirit of Chinese state orientation towards a potentially perfectible future.

What kind of approach to nationalism, or nativism, or anti-traditionalism this system might yet engender is a subject for essential further research (Zheng 1999, Hansen 2008). Likewise, the continued extension of Chinese infrastructural megaprojects will undoubtedly warrant ongoing attention. Recent studies increasingly question the place of islands within the Belt and Road Initiative's Maritime Silk Road, Polar Silk Road, and Ice Silk Road projects. They have pointed on the complex multiplicity of effects felt both on islands near and far afield and within China itself as China reaches beyond itself.<sup>17</sup> Ecological civilization discourse not only has implications for the management of islands themselves; it interfaces, in these scattered islands, with other discourses of the China Dream with wide geopolitical and economic import. For now, though, we maintain that a comparative approach to terraformed islands and lunar biospheres as related material-symbolic instantiations of ecological civilisation with Chinese characteristics offers greater analytical purchase for placing China in the South China Sea, in outer space and in the world.

17 See for example Woon (2020); also the November 2020 thematic section in *Island Studies Journal* entitled "Silk Road Archipelagos: Islands in the Belt and Road Initiative", especially Grydehøj et al., "Silk Road Archipelagos".

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