Starting up biology in China: performances of life at BGI

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BGI (*hua da ji ying* ; 华大基因 ; "China Great Gene") counts among the world's largest and wealthiest institutions for biomedical research. Located in Shenzhen, the new megacity in southern China, BGI is now a critical site for understanding the relationship between biomedicine and the economic development of China. As Winnie Wong has suggested, the rise of Chinese science, especially biomedicine, "requires us to consider configurations of 'Asian' biotechnology and capital that as yet remain uncaptured by US-centric descriptions."[1] What do such configurations look like? And how can we understand them on their own terms?

What we read about BGI, in the Western press at least, revolves around an almost irresistible analogy: the factory. "Now, as the world's scientists focus with increasing intensity on transforming the genetic codes of every living creature into information that can treat and ultimately prevent disease, Shenzhen is home to a different kind of factory: B.G.I., formerly Beijing Genomics Institute, the world's largest genetic-research center."[2] The "factory" represents western fascination with China's rapid development, western fears about China's rise (taking away manufacturing jobs, Dickensian treatment of workers), and an implicit derogation of China as a place of "copying" and imitation. The ubiquitous

[1] Wong, Winnie. 2017. "Speculative Authorship in the City of Fakes" *Current Anthropology* 58, supplement 15: S103-S112. Quotation p. S109. Wong is here echoing Aihwa Ong and others' call for attention to the new modes of biotechnology in Asia. See: Ong, Aihwa. 2016. *Fungible life: experiment in the Asian city of life*. Durham, NC: Duke University Press; Ong, Aihwa and Nancy Chen, eds. 2011. *Asian biotech: Ethics and communities of fate*. Durham, NC: Duke University Press. Sunder Rajan, Kaushik 2006. *Biocapital: the constitution of postgenomic life*. Durham, NC: Duke University Press.
[2] Specter, Michael (2014). "The Gene Factory" *The New Yorker*, 6th January. Available at: http://www.newyorker.com/magazine/2014/01/06/the-gene-factory.

"Made in China" label serves as a constant reminder of the massive presence and productivity of China's factories.

Instead of starting with the "factory," this essay draws on a set of tools from performance studies. Building on the work of Erving Goffman and Victor Turner, since the 1970s, performance studies has deployed a range of methods for examining practices beyond the theater, including rituals, political speeches, sports, and other cultural events.[3] This work has drawn attention to the fact that performances cannot be understood in isolation from their broader contexts and – borrowing from gender studies and queer theory – it has also highlighted the "performativity" of everyday acts – building identity through doing and speaking.[4] In science and technology studies, the notion of performance (and performativity) has been mobilized to analyze the performance of bodies, to draw attention to action (rather than words or text), and to explore the ways in which scientific theories and models can generate or shape elements of reality.[5] Following Latour, others have examined how scientists "stage" or "direct" their findings to scientific or public audiences.[6]

Here I will be less concerned with self-conscious performances to a given audience (a conference presentation or a courtroom, for instance) but rather to the performative aspects of everyday speech and work, not just within the lab, but outwards to the world. The setting, the costumes of workers, speeches, posters, advertisements, machines, and so on are all aspects of a "performance"

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[3] Turner, Victor. 1986. *The anthropology of performance*. PAJ Publications; Goffmann, Erving. 1959. *The presentation of self in everyday life*. Anchor Books. See also: Turner, Victor and Richard Schechner. 1983. *Between anthropology and performance.* New York: Routledge; and Schechner, Richard. 2006. *Performance studies – an introduction*. 2nd Ed. Routledge.

[4] On performativity see in particular: Austin, John L. 1962. How to do things with words. James O. Urmston and Marina Sbisà, eds. Oxford University Press; and Butler, Judith. 1988. "Performative acts and gender constitution: an essay in phenomenology and feminist theory." *Theatre Journal* 40, no. 4: 519-531.

[5] Landecker, Hannah. 2006. "Microcinematography and the history of science and film." *Isis* 97: 121-132. Myers, Natasha and Joseph Dumit. 2011. "Haptic Creativity and the Mid-Embodiments of Experimental Life" In: *A Companion to the anthropology of the body and embodinments*, Frances E. Mascia-Lees, ed. Chichester: Blackwell: 239-261; Karen Barad. 2003. "Posthumanist performativity: Toward an understanding of how matter comes to matter" *Signs: Journal of Women in Culture and Society* 28, no. 3: 801-831.

[6] Latour, Bruno. 1987. *Science in Action: How to Follow Scientists and Engineers Through Society*. Harvard University Press; Hilgartner, Stephen. 2000. *Science on stage: expert advice as public drama*. Stanford University Press.

that communicates the laboratory's intentions, ideals, and hopes. Turning to BGI's "performances" opens up several modes of analysis. First, BGI's geographical location, appearance, architecture, and relationship to Shenzhen become evidence of its self-presentation. Second, it allows us to attend to BGI's own speech about itself (its slogans, advertisements, media appearances, etc.) as evidence of its efforts to create a specific kind of work and vision. Third, "performance" calls attention to the importance of BGI's attempts to create certain kinds of institutional spaces and certain kinds of workers. The "performativity" of laboratory speech and acts demonstrates how BGI and its employees are actively attempting to shape a future, not just for the lab itself, but for China and Chinese citizens.

I label these performances, "performing *shanzhai* (山寨)" The notion of "*shanzhai*" (literally "mountain stronghold") has, as we shall explore in more detail, a complicated set of meanings. Although at first taken to denote low quality "copycat" goods produced in Shenzhen, *shanzhai* has gradually become associated with notions of creativity, innovation, and Chinese national pride. In performing *shanzhai*, then, BGI is enacting a particular vision of China's future: one rooted in the copy, but ultimately generative of surprising, new, and original elements. *Shanzhai* creates a vision in which China is seen to be ultimately able to surpass its rivals through a particular combination of imitation and innovation.

BGI begins as a place of the copy. BGI has built its worldwide reputation largely on DNA sequencing. This work involves extracting DNA molecules from living things (humans, animals, plants, viruses, cancer cells, etc.) and processing them such that they can be digitally "read out" as a series of letters (A, G, T, or C) that comprise the genetic code. DNA molecules are composed of two complementary strands: they are fundamentally structured as a *double* helix. This structure allows organisms make near-identical copies of its genes that can be passed on to all the cells in a body and to the next generation. It is precisely this property – its "copyability" – that also allows biologists to read, edit, and manipulate DNA. But BGI is not engaged in *mere* copying. The success of its work – institutional, social, and scientific – relies on subtle recombinations and

hybridizations that allow it to make *better copies*. This is copying with a (helical) twist.

By understanding BGI in terms of "performing *shanzhai*," we can see how this laboratory poses a challenge to traditional modes of understanding technoscience. This marks an attempt to understand BGI, its work, and its workers on their own terms, or at least on local terms. Just as *shanzhai* challenges our notions of originality, BGI's hybridity challenges our notions of where and how scientific knowledge is produced. Not merely performing as a "laboratory," but also, and at the same time, as a "factory," and a "company," BGI is an unfamiliar kind of hybrid scientific-industrial-commercial-governmental-philanthropic space that draws it repertoire from its very particular regional, national, and local-urban circumstances.

This account is based on ethnographic fieldwork at BGI and in Shenzhen between 2014 and 2017. This included interviews with scientists, visits to the laboratory (the headquarters in Yantian, the China National Gene Bank in Dapeng, and the labs in Hong Kong), and attending conferences, workshops, talks, and other activities at the lab. This work occurred during several visits to Shenzhen including an extended visit (two months) in 2017. Although BGI has permitted significant access to its sites, it is in part a private (and more recently, public) company and access is thus necessarily restricted and incomplete in some respects. As such, the ethnography here is supplemented by media sources and interviews; for the purposes of this work, these form a valuable set of primary sources that provide a wider range of information than could be obtained by ethnographic work alone.[7]

I begin with a section describing the context in which BGI has developed, examining the history of Shenzhen itself. The second part examines the various meanings of "copycatting" and *shanzhai* in Shenzhen's factories and electronics markets. The third and central part of the text turns to BGI's work in more detail, examining BGI's various performances: of laboratory, of factory, and of company. I conclude by reflecting on how BGI's performances of *shanzhai* are not only

[7] In some cases, too, I have cited media sources where they corroborate evidence from ethnographic fieldwork and interviews.

critical for its own work, but also for understanding how biomedicine, and even technoscience more broadly, is developing in China.

Setting the stage

BGI was founded in 1999 in order to coordinate China's contribution to the Human Genome Project. Although their eventual 1% contribution brought the lab considerable attention, by the middle of the 2000s they found their funding dwindling and began to search for a new home. After a brief stint in Hangzhou, BGI moved to Shenzhen in 2007. Why did BGI's leaders choose Shenzhen? What kind of place was it, and what did BGI hope to achieve by moving there?

The city is now a metropolitan area of over 20 million people in Guangdong province. Most widely known for its electronics manufacturing industry, this region is now sometimes called the "Silicon Valley of China."[8] In 1980, Shenzhen became China's first Special Economic Zone (SEZ). The SEZ was part of Deng Xiaoping's attempt to open China up to foreign investment. To achieve this, the Shenzhen government adopted a range of policies including the creation of special tax incentives for foreign investment, granting greater independence in international trade, encouraging development sponsored by foreign capital, encouraging Sino-foreign joint ventures and partnerships, promoting the manufacture of products for export, and the creation of policies that allowed market forces to prevail.[9]

This opening up meant, at first at least, largely garment manufacturing. During the 1980s and 1990s thousands of small and medium-sized factories making shoes, clothing, and toys opened their doors. Many were owned by Hong Kong or Taiwanese-based investors often connected through family networks – overseas Chinese supplied capital to their relatives in the SEZ, who could gain

[8] This phrase recurs across a variety of media and popular outlets. See, for instance: Whitwell, Tom (2014) "Inside Shenzhen: China's Silicon Valley" *The Guardian*, 13th June. Available at: http://www.theguardian.com/cities/2014/jun/13/inside-shenzen-china-silicon-valley-tech-nirvana-pearl-river

[9] Yueng, Yue-man, Lee, Joanna, and Kee, Gordon, eds. (2009) "China's Special Economic Zones at Thirty" *Eurasian Geography and Economics* 50(2) (Special issue).

access to cheap land and cheap sources of labor.[10] These factories attracted migrants from the Chinese countryside, coming to Shenzhen (and other cities in southern China such as Dongguan and Guangzhou) to escape farm and village life and make their economic futures. Almost all of these migrants workers were young, and the majority of them were women.[11]

This migration has had several kinds of impacts on Shenzhen. First, it transformed the area from a large number of villages on the Pearl River delta (inhabited by about 300,000 people) into a massive, sprawling metropolis. In the 1990s and 2000s, Shenzhen was one of the world's fastest growing cities, and it is now China's third largest after Beijing and Shanghai. This population growth was matched by growth in infrastructure.[12] In the 1980s and early 1990s, Shenzhen built more skyscrapers than any other Chinese city, including some of the world's tallest.[13]

The overwhelmingly migrant population lends the city a unique vibe.[14] Young people who have come from all over China make Shenzhen a dynamic and increasingly cosmopolitan city. The antiquated Chinese household registration system (*hukou*) means that many of the residents remain "unofficial" – unregistered, uncountable, often unable to obtain health care, a driver's license, or to send their children to school.[15] The result is a high degree of transience, impermanence, and uncertainty amongst much of the population. Migrants have come to make their fortunes in a place where, often, they know no-one and the

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[10] Smart, Alan (1999) "Flexible Accumulation Across the Hong Kong Border: Petty Capitalists As Pioneers Of Globalized Accumulation." *Urban Anthropology and Studies of Cultural Systems and World Economic Development* 28(3/4):373–406.
[11] Chang, Leslie T. (2009) *Factory Girls: From Village to City in a Changing China.* New York: Spiegel and Grau; Ngai, Pun (2005) *Made in China*: *Women Factory Workers in a Global Workplace*. Durham and London: Duke University Press.
[12] On the early development of Shenzhen see Vogel, Ezra. 1989. *One Step Ahead in China: Guangdong Under Reform*. Cambridge, MA: Harvard University Press, especially pp. 125-160.
[13] Cox, Wendell (2012) "The Evolving Urban Form: Shenzhen" *New Geography*, 25th May. Available at: http://www.newgeography.com/content/002862-the-evolving-urban-form-shenzhen.
[14] See Chen, Xiangming and Tomas de'Medici. 2010. "The 'Instant City' coming of age: production of spaces in China's Shenzhen Special Economic Zone." *Urban Geography* 31, no. 8. http://dx.doi.org/10.2747/0272-3638.31.8.1141
[15] Ngai, *Made in China*, p. 5.

rules of the game have to be made up as they go along. There is money to be made, but the risks involved for individuals are high.[16]

The location of Shenzhen is also critical to its flavor: the city is separated from the Hong Kong "Special Autonomous Region" by the Shenzhen river. There are several checkpoints in Shenzhen through which tourists, workers, and businesspeople can enter directly into the New Territories. The proximity of Shenzhen to Hong Kong has no doubt contributed to its success.[17] Hong Kong has long been an international city where foreigners have established commercial relationships and feel comfortable visiting and doing business. From there, extending connections a few miles into the "mainland" has proved relatively easy; bosses from Hong Kong can easily supervise operations across the border. The Shenzhen-Hong Kong border, then, provides a kind of "window" from the People's Republic of China to the rest of the world.[18]

Shenzhen's geographic location has also influenced its political climate. Close to Hong Kong, but far from the central government in Beijing, the city has also become a place notable for the loosening of central authority. As the Beijing government searched for ways to promote economic development, Shenzhen "emerged out of a period of illicit (and often outright politically unapproved) experimentation."[19] More recently, in 2010, the "small government, big society" political experiment initiated by Premier Wen Jiabao allowed local government to scale back its influence in civil society. This has led to flourishing of nongovernment organizations, many of which are funded by the city government to help deal with social problems such as mental health, migrant worker education, or factory suicides.[20] Such changes proceed slowly and cautiously, but

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[16] Although, by developed-world standards, factory wages are very low. See Siu, Kaxton (2015) "The Working and Living Conditions of Garment Workers in China and Vietnam." In: Anita Chan, ed. 2015 *Chinese Workers in Comparative Perspective*. Ithaca: Cornell University Press, pp. 105-131. Figures, p. 109.

[17] Cheng, Joseph Y.S. et al., eds. (2008) *Shenzhen and Hong Kong: Competitiveness and Co-operation in Technology*. Hong Kong: City University of Hong Kong, p. 199.

[18] See Cheng et al. *Shenzhen and Hong Kong.*

[19] O'Donnell, Mary Ann, Winnie Wong, and Jonathan Bach. 2017. "Introduction: Experiments, Exceptions, and Extensions." In: *Learning from Shenzhen: China's Post-Mao experiments from Special Zone to Model City*. O'Donnell, Mary Ann, Winnie Wong, and Jonathan Bach, eds. Chicago: University of Chicago Press: 1-19. Quotation p. 3.

[20] Simon, Karla W. 2013. *Civil Society in China: The Legal framework from ancient times to the "new reform era."* New York: Oxford University Press. "Small government, big society" is part of a broader project of reform initiated by the central government in 2004.

they have opened up possibilities for new kinds of organizations playing new kinds of social roles in China.

This history suggests that Shenzhen itself is *shanzhai*, a copy. Borrowing from Hong Kong, China's leaders set out to emulate the financial success of that city. But of course, Shenzhen could never become an *exact copy* of Hong Kong; for one thing, political liberalization was not supposed to go along with economic freedoms. Indeed, as Jun Zhang has argued, the CCP also used the more authoritarian city-state of Singapore as a model for Shenzhen. As such Shenzhen aimed to reproduce aspects of both cities, recombining and tweaking them to make something new.[21]

Shanzhai

Since the 1980s, Shenzhen's economy has gradually shifted away from garments and towards electronics and information technologies. Beginning in the 1990s, the Shenzhen municipal authorities adopted the policy of "utilizing high-technology industry as the 'dragon head' or pacemaker in the construction of an international metropolis."[22] Between 1991 and 2002, the value of "high-tech" industries (including computer hardware, telecommunications, microelectronics, mechanical and electrical integration, new materials and new energy, and biotechnology) in Shenzhen grew from 8.1% of the city's total economic output to over 35% of total output. In 2002, revenue from "high tech" products had increased to over RMB 80 billion, with over RMB 30 billion contributed by the telecommunications giants Huawei (华为) and ZTE (中兴).[23]

Shenzhen's "high-tech" industries have been particularly visible in the west because of Foxconn, the company contracted by Apple to assemble iPhones and iPads. Foxconn is trade name of Hon Hai Precision Industry Co. founded in Taiwan in 1974, opening its first plant in the Longhua region of Shenzhen in 1988. The "Longhua Science and Technology Park" is a "walled campus" that

[21] Jun Zhang. 2012. "From Hong Kong's capitalist fundamentals to Singapore's authoritarian governance: the policy mobility of neo-liberalising Shenzhen, China." *Urban Studies* 49, no. 13: 2853-2871.
[22] Cheng et al., *Shenzhen and Hong Kong*, p. v.
[23] Cheng et al., *Shenzhen and Hong Kong*, pp. 2-5. Huawei was founded in Shenzhen in 1987 to produce phone switches and it is now the largest telecommunications manufacturer in the world.

employs more than a quarter of a million people and covers just over one square mile. About one quarter of the factory workers live inside the walls of "Foxconn City." Apart from fifteen factories, the complex encloses worker dorms, a swimming pool, its own fire brigade, its own television network, grocery stores, bank, restaurants, bookstores, and a hospital. Foxconn makes not only iPhones for Apple, but its customers include Acer, Amazon, Cisco Blackberry, Dell, Google, Nintendo, Microsoft, Motorola, Sony, Toshiba, Nokia, and Chinese companies including Huawei and Xiaomi (小米).

But Shenzhen's electronics industry is hardly confined to Foxconn. As well as other foreign firms from Taiwan and Hong Kong and some of the largest electronics and telecommunications companies in China (Dingoo [丁果], Hasee [神舟], Netac, Skyworth [创维], and Coolpad [酷派] as well as the Internet giant Tencent [腾讯][24]), Shenzhen (and the surrounding cities and towns) host a massive network of small to medium-sized factories and suppliers, mostly geared towards the production of specific products (digital cameras, phone cases, tablet screens, and so on).

This cluster of high-tech electronic manufacturing has made Shenzhen into a center of hardware innovation. This is driven by the large numbers of young people flocking to the city in search of work or moving in and out of the large number of companies. The best evidence of this can be found at the Huaqiangbei electronics markets, by some accounts the largest in the world. These markets sell not merely finished products but also a range of electronic components necessary to assemble almost any device. As one Western journalist explains, "In Shenzhen, you have everything you need to turn a sketch on a napkin into 100,000 smartwatches, bike lights, or drones…The mood here feels like the pre-boom Internet of the late 1990s: a lot of excitement and a few big deals."[25]

The markets, located near downtown Shenzhen, stretch for several blocks. Different shopping mall-sized buildings specialize in different kinds of items: one in power cables and power supplies, the one adjacent to that in

[24] Tencent's business includes e-commerce, e-payments, multiplayer online games, and instant messenger services (QQ) as well as China's most popular social media platform, WeChat. See: http://www.tencent.com/en-us/index.shtml
[25] Whitwell, "Inside Shenzhen."

mobile phone screens, and the one across the road in LED lights. Vendors are densely packed into floors and floors of small booths, sitting behind benches piled high with microchips or coaxial cables or digital cameras next to ubiquitous flasks of tea. A diverse crowd of shoppers roams the spaces; many carry long lists of components required for building their own devices. Huaqiangbei is a complete ecosystem for making and selling electronics for the global marketplace.

It is this culture that has given rise to the local hardware hacking scene now known as *shanzhai*. This term is sometimes translated as "copycat electronics."[26] And indeed, there is a great deal of copying of many of the international and Chinese electronics brands, especially mobile phones.[27] However, blatant copying has also given way to tweaking, improvement, and innovation. Although *shanzhai* violates intellectual property laws and flouts safety testing, it has developed into a sharing, collaborative, economy. Design files for smartphones, smart-watches, and tablets are shared online, and can be assembled from the components on sale at Huaqiangbei. Many such phones and other devices include features for specialized markets (such as dual sim cards (for those crossing the Hong Kong border frequently) or a built-in compass (for Muslims needing know the direction of Mecca). Such devices are often priced to sell to customers in the developing world (either within or outside China).

It is easy to dismiss the activities of Huaqiangbei and *shanzhai* as *mere copying*, or a kind of piggybacking on western (especially Silicon Valley) innovation. But there is something more complicated and more interesting occurring here. As Bunnie Huang notes in his guide to Huaqiangbei, "'fake' is not an all-or-nothing concept." Huang goes on to list various ways in which products at the market may be "fakes": genuine parts with old date codes; factory remainders sold as genuine; parts re-labelled with a more reputable brand; sub-assemblies of authentic quality but usually not allowed to be sold separately;

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[26] The word also has connotations of peasant work equivalent to the English word "tinker." The word also sounds like "Shenzhen."

[27] Some estimate that *shanzhai* now makes up 25% of the global market for mobile phones. Lindtner, Silvia, Greenspan, Anna, and Li, David (2014) "Shanzhai: China's Collaborative Electronics-Design Ecosystem" *The Atlantic*, 18th May. Available at: http://www.theatlantic.com/technology/archive/2014/05/chinas-mass-production-system/370898/.

lower spec labelled as higher; recycled or refurbished components; pre-production prototypes; and so on.[28] *Shanzhai* functions precisely in and because of these ambiguous middle zones.[29]

The meanings of *shanzhai* are multiple, complex, and even contradictory. Some Chinese dismiss such goods as low class, low taste, and representative of Chinese inability to be original. For brand name electronics manufacturers, *shanzhai* has cut into market share and profits.[30] For these more established companies – both Chinese and foreign – *shanzhai* poses a threat and a scourge. "Counterfeiting," remains illegal in China and, at least for large parts of the establishment, remains a derivative, "low," and sometimes dangerous activity.

On the other hand, especially amongst the young, the unique kitsch of *shanzhai* phones expresses a hip, cool, artistic, and rebellious vibe.[31] In the Chinese novel *Shui Hu Zhuan* (水浒传; The Water Margin), the rebels fighting against the Song dynasty government are described as residing in *shanzhai*.[32] Such outlaws or rebels, like Robin Hood in the West, are also heroes. With respect to electronics, the term has also enjoyed a rehabilitation, having come to be associated not only with mimicry and fakery, but also with originality,

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[28] Huang, Andrew "Bunnie." 2015. *The essential guide to electronics in Shenzhen*. Singapore: Sutajio Ko-Usagi. pp. 15-18.

[29] It is interesting to compare here *shanzhai* with "Dafen Artists' Village." At Dafen, on the outskirts of Shenzhen, artists produce a large fraction of the world's reproduction oil paintings. Although this is portrayed by western media as "Van Gogh From the Sweatshop," Wong argues that "the repetitive work of painting in Dafen was never simply the antithesis of originality, authenticity, or creativity, nor is 'copying' always the same and simple activity… I found little reason to presume that any Dafen painter may *not* be considered an 'artist' working within the same spectrum of aesthetic concerns and limitations as any contemporary artist." Wong, Winnie Won Yin (2013) *Van Gogh On Demand: China and the Readymade*. Chicago: University of Chicago Press, p. 25. See also: Paetsch, Martin (2006) "China's Art Factories: Van Gogh from the Sweatshop" *Spiegel Online,* 23rd August. Available at: http://www.spiegel.de/international/china-s-art-factories-van-gogh-from-the-sweatshop-a-433134.html; Fallows, James (2007) "Workshop of the World: Fine Arts Division" *The Atlantic*, 19th December. Available at: http://www.theatlantic.com/technology/archive/2007/12/workshop-of-the-world-fine-arts-division/7859/.

[30] Lin, Yi-Chieh Jessica. 2011. *Fake Stuff: China and the rise of counterfeit goods.* New York: Routledge, pp. 18-19.

[31] Yang, Candy and Lisa Li (2008) "Decoding Shan Zhai Ji" *China Youthology* 17. See also, Chubb, Andrew. 2015. "China's Shanzhai culture: 'Grabism' and the politics of hybridity" *Journal of Contemporary China* 24, no. 92: 260-279; Keane, Michael and Elaine Jing Zhou. 2012. "Renegades on the frontier of innovation: the shanzhai grassroots communities of Shenzhen in China's creative economy." *Eurasian Geography and Economics* 53, no. 2: 216-230.

[32] Lindtner, S., Greenspan, A., Li, D. (2015) "Designed in Shenzhen: Shanzhai Manufacturers and Maker Entrepreneurs."*Proceedings of the Fifth Decennial Aarhus Conference on Critical Alternatives*. Aarhus, Denmark, 17-21 August: 85-96.

innovation, and creativity. *Shanzhai* has been embraced, especially by Chinese youth, as a unique Chinese mode of making and doing that will be central to Chinese technological and economic development. Through *shanzhai*, some claim, China will be able to challenge the dominance of global brands such as Samsung and Apple, developing their own products and brands.

In other words, *shanzhai* has become a political tool and even an expression of "a new wave of democracy."[33] For reformers within China, this new mode of expression might even signal a new mode of resistance to the central government.[34] But the form has also been at least partially embraced by the government as a true expression of socialist creativity. *Shanzhai* manufacturers are, after all, producing "working class" information technology products suitable – in price and functionality – for the average (relativity poor) Chinese citizen. Binjie Liu, a communist party official from the National Copyright Administration, argued that, "*shanzhai* shows the cultural creativity of the common people." There are numerous examples of state-sanctioned and state-led "copying" in various forms.[35]

Within the last decade, the line between *shanzhai* and "legitimate" has also become increasingly blurred. Some formerly *shanzhai* brands have transformed into legitimate companies (eg. K-touch/Tianyu [天语]).[36] The concept of *shanzhai* allows electronics makers simultaneously "guerilla" and legitimate, "cool" and establishment, creative and imitative, and rebellious and orthodox.

Performing Shanzhai

[33] Lin, *Fake Stuff*, p. 61.
[34] For example, *shanzhai* cultural events, broadcast on TV have threatened the state's monopolistic control over cultural content. Lin, *Fake Stuff*, p. 63.
[35] On the rehabilitation of "imitation" by the central Chinese government see: Wong, Winnie. 2017. "Shenzhen's model bohemia and the creative China dream." In: *Learning from Shenzhen: China's Post-Mao Experiment from Special Zone to World City*. Mary Ann O'Donnell, Winnie Wong, and Jonathan Bach, eds. Chicago University Press: 193-212.
[36] Wallis, Cara and Jack Linchuan Qiu. 2012. "Shanzhaizi and the transformation of the local mediascape in Shenzhen." In: *Mapping Media in China: Region, Province, Locality*. Wanning Sun and Jenny Chio, eds. Routledge: 109-125.

The remainder of the essay describes how BGI can be understood in *shanzhai* terms. I do this by considering various "performances" each related to a different aspect of the term. My aim is neither to celebrate BGI as an innovator or entrepreneur in biomedicine, nor to portray it as a factory or "copycat" institution. Rather, understanding BGI as "performing *shanzhai*" affords us a sharper view of what it might mean and represent to China, to Shenzhen, and to its own employees.

i) Performing the laboratory

BGI's most foregrounded performance is that of a laboratory, a scientific space. In science studies, laboratories have been described as places that exert careful control over inward and outward flows of people and information; such control affords labs particular authority over knowledge of the natural world.[37] Part of this authority derives from claims to "openness": in the ideal, the work of a lab (if not the lab itself) is open for others to inspect or verify. Although they may not be public spaces, the knowledge labs produce is usually published in "open" academic journals. Reflecting the "communalist" ethos of science, even laboratories belonging to private companies often share their findings.[38] Although individual examples don't always live up to this model, laboratories usually perform "openness" in various ways.

The manufacturing economy of Shenzhen is also reliant on openness. It is the sharing of knowledge and designs that that facilitates "Shenzhen speed." The rapid design, prototyping, and production processes are enabled by cooperation between suppliers, designers, and factory owners. The *shanzhai* economy, then, is one in which designs, hardware, and software are shared (often in violation of intellectual property rules). This, of course, fits very well with a "hacker" or

[37] See, for instance, Shapin, Steven. 1988. "The House of Experiment in Seventeenth Century England" *Isis* 79: 373-404; Ophir, Adi and Steven Shapin. 1991. "The Place of Knowledge: A Methodological Survey" *Science in Context* 4, no. 1: 3-21. On the control of information within science, and especially in genomics see Hilgartner, Stephen. 2012. "Selective flows of knowledge in technoscientific interaction: information control in genome research" *British Journal for the History of Science* 45, no 2: 267-280.
[38] Merton, Robert. 1973. "The Normative Structure of Science." In: *The Sociology of Science: Theoretical and Empirical Investigations.* Chicago University Press.

western "open source" ethos and for this reason it has attracted "makers" from around the world to Shenzhen.[39] But in Shenzhen, philosophical motivations are overshadowed by the practicalities of getting new products to market cheaply and rapidly; such "open" approaches are an indigenous development, not a western import. There is a certain playfulness to this spirit too – the emphasis on speed and newness often leads to fun and quirky tweaks on phones, wearables, and other electronic devices.

BGI too performs such openness and playfulness. Like other labs, access to BGI is carefully controlled. Journalists and other visitors (like myself) are usually welcomed (on one day, a film crew from *Vice* was shooting inside the lab) but access to space and people is choreographed by a small "communications" department. Within BGI's headquarters and at the China National Gene Bank (CNGB), a visitor finds exactly what one would expect to find in a lab: large, white-walled rooms, laboratory benches scattered with pipettes, and white-coated workers tending to samples or to large arrays of machinery. Significantly, this work takes place largely behind glass – internal windows along the corridors of the headquarters provide a view into the laboratory spaces proper. At CNGB, too, large glass windows provide a vista from the public spaces onto row upon row of DNA sequencing machines. The laboratory is "on view," open for employees and visitors to see, and simultaneously inaccessible.

But BGI signals its openness in other ways too. A critical part of the organization is BGI's journal, *Gigascience*. The journal has been a leader in promoting open sharing of scientific data.[40] Like others in the "open science" and "open access" movements, the *Gigascience* team believe that traditional scientific publishing models are inadequate. In particular, it suffers from the problem that many scientific journal articles are behind paywalls and remain accessible only to an elite handful of academics. Even if the *content* of scientific articles is available, often the data on which the findings are based remain unavailable (this means no-one can re-use the data, nor can the findings be adequately verified or

[39] Lindter, Sylvia (2014) "Making Subjectivities: How China's DIY makers remake industrial production, innovation, and the self." *Journal of China Information* 28 (Special issue: "Political Contestation in Chinese Digital Spaces"): 145-167.
[40] Stevens, Hallam (2014) "Gigascience: A Science Journal That Provides Full Data Sets" SmartData Collective, Blogpost, 13th August. Available at: http://www.smartdatacollective.com/hstevens/221646/gigascience.

replicated). With BGI's funding, *Gigascience* has established itself as a leader in promoting open access to their journal articles and open access to data. Most significantly, it was the first journals to "publish" data sets.

An important part of *Gigascience*'s mission is ensuring that all BGI-generated data becomes available to the scientific community. Both *Gigascience* and BGI stress the importance of this openness: widely distributed data will allow the worldwide scientific community to take the utmost advantage of BGI's work and to potentially build on their work to generate further advances in biomedicine and health. Editors at *Gigascience* told me how making BGI's rice genome data public had allowed it to be used by agricultural scientists around the world who were working closely with farmers to improve rice varieties.[41] Gigascience's and BGI's commitment to open data and open access play a key role in BGI's publicity. On one visit to BGI, I received a *Gigascience* branded bottle opener with "Open Everything" stenciled on the side.

BGI has also developed products such as "Genebook Tipsy" that tap into the playful hacker spirit of *shanzhai*. "Tipsy" – packaged to look like a hardback book – is actually a "spit kit" (figure 1). The customer fills the enclosed vial with his or her spit and sends it to BGI for genotyping; BGI will report whether the customer has mutations in genes associated with alcohol metabolism, including the "flush reaction." This is supposed to be light-hearted, but BGI intends to use any profits from the sale of such "kits" to fund other health research projects. This mixture of fun, novel technology, openness, and serious science suggest how BGI "performs *shanzhai*" through its appearance, its work, and its products.

The performance of openness is critical to BGI's image as a laboratory. But BGI's openness derives only partly from traditional scientific values (such as "communalism"). Rather, the kinds of "openness" articulated by *Gigascience* and BGI's leaders owes more to the *shanzhai* spirit of hackers and sharers. By articulating a radical or total openness, BGI offers a critique of existing (western) models of scientific practice and publication. Implicit in BGI's work is the idea that its science, like *shanzhai* electronics, offer a chance for China to catch up to or surpass the west. Wide sharing of data, especially data from rice or other food

[41] Interview with *Gigascience* employee, Hong Kong, 19 July 2014.

crops, is depicted as a "socialist" science that can bring benefits to ordinary people.

ii) Performing the factory

It is factories that actually produce the *shanzhai* products found in markets in Shenzhen and elsewhere. Such goods may be produced in "ghost shifts" of the factories that produce "real" products, or, more likely, in other small-scale factories around Shenzhen.[42] To what extent does BGI perform the work of a "factory"? Factories (like Foxconn city) are often extremely closed spaces. Like laboratories, they tightly control flows of people, knowledge, and materials, although their aims are very different. In the production of goods for a profit, factories perform speed, efficiency, and worker discipline.

There are some immediate similarities between BGI and the factories of the Pearl River Delta. Like Foxconn and other factories, BGI has grown rapidly and scaled-up quickly to move into leading position in genomics. The lab, too, has attracted young workers from all over China who mostly come to live in a campus-like environment (although BGI's is not nearly as closed as Foxconn's). Staff eat together and sleep in dorms or apartments nearby the lab. BGI also looks rather factory-like. It is located in an industrial zone and the eight-floor main building used to be a shoe factory. BGI headquarters lie eastward from the center of Shenzhen itself – Yantian sits about twenty-five minutes by car from downtown. The area, surrounded by steep mountains, is dominated by crisscrossing freeways and a large port complex.

Like Shenzhen's factories, location is important; BGI's proximity to Hong Kong (where it also has laboratories and offices) allows an important conduit to the outside world. BGI also benefits from the kinds of subsidies and tax breaks that have attracted other factories to Shenzhen's Special Economic Zone. BGI was

[42] Factory bosses may pay workers for "off the book" extra shifts to produce surplus inventory not ordered by the customer; thus "fake" goods may actually be produced in "ghost shifts" of the same factory in which "real" goods are produced. See Huang, Andrew "Bunnie." 2015. *The essential guide to electronics in Shenzhen*. Singapore: Sutajio Ko-Usagi. p. 16.

enticed to Shenzhen by a $US12.8 million grant from Shenzhen's municipal government as well as free rent for three years.[43]

Perhaps most importantly, BGI's work also performs "production." The lab has (and is) focused on high-throughput aspects of biology, especially DNA and RNA sequencing. The process of "sequencing" involves extracting DNA from living cells and "reading out" its genetic code. "Reading" a molecule – even a large one like DNA or RNA – requires reproducing it millions of times in order to produce a large enough signal to be detected by a sequencing machine. These machines usually make use of biology's own tools, repurposing enzymes such as DNA polymerase to perform the copying required for sequencing. Despite the involvement of machines, large-scale sequencing requires significant amounts of repetitive labor: extracting DNA, preparing samples, loading machines, and analyzing the data. Large-scale DNA sequencing deploys factory-like labor to enable such molecular duplications.

Many kinds of biological and biomedical work now involve DNA or RNA sequencing. For example, distinguishing different types of cancer cells, identifying different pathogenic bacteria, understanding the differences between varieties of plants (such as rice), and identifying genetic diseases in human embryos all involve sequencing. Such sequencing work can be "outsourced" by sending cells or DNA off-site. Like other "outsourcing," large-scale, highly-automated DNA sequencing offers economies of scale. It is this "production" sequencing work that BGI's reputation is largely built on – it advertises itself as such and makes money by selling large-scale sequencing services. Customers send their cells or samples to BGI and BGI sends back thoroughly analyzed, high-quality DNA (or RNA) data. For BGI, DNA sequencing has become its commodity product.

In some cases, BGI is happy to receive credit instead of cash. If scientists external to BGI are conducting high-profile work that requires DNA or RNA sequencing, BGI may do the sequencing in exchange for co-authorship on the resulting scientific papers. As Winnie Wong has argued, this has led to the

[43] Larson, Christina (2013) "Inside China's Genome Factory" *MIT Technology Review*, 11th February. Available at: https://www.technologyreview.com/s/511051/inside-chinas-genome-factory/

perception that BGI is a "factory" for scientific journal articles, especially those in highly-ranked publications such as *Science* and *Nature*. Significantly, the framed covers of these publications are prominently displayed in the "museum" at BGI headquarters side-by-side with BGI's sequencing machines. Some within the scientific community perceive this as an illegitimate "copy-catting" of "real" scientific work. In other words, this gaming of the academic publication system has gained BGI a reputation for "faking" science.[44]

BGI has certainly done a lot of DNA sequencing, including participating in the Three Million Genomes Project, the Rice 10,000 Genome Project, the Earth Microbiome Project, the 1000 Genome Project, and the 10,000 UK Genome Project.[45] But BGI has also expanded to all kinds of other domains including proteomics and cell biology, cloning, bioinformatics and big data analysis, biobanking, reproductive health, pharmacogenomics, cancer therapy, metabolism and cardiovascular research, geriatrics, agricultural biotechnology and breeding, low-carbon economy research, marine organism breeding, epidemic surveillance, SARS research, and women's health. In fact, it is hard to think of any area of medical and agricultural-related research they are not now involved with. Nevertheless, much of this work is also based on DNA and RNA sequencing; that is, these other domains are explored through sequencing more and more DNA, faster and faster.[46] Speed, efficiency, and consistent, high-quality output are highly valued.

But in sequencing DNA, BGI is not only performing imitative work. For example, BGI scientists also spoke to me about their development of a non-invasive pre-natal genetic screening program conducted in Shenzhen (called NIFTY).[47] The lab worked with the local public health authorities in Shenzhen to develop low-cost tests that could be covered under social insurance schemes. Although tests for many pre-natal diseases already existed, these tests were

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[44] Wong, Winnie. 2017. "Speculative Authorship in the City of Fakes" *Current Anthropology* 58, supplement 15: S103-S112.
[45] (2011) "BGI Unveils Significant New Global Research Collaborations at the 6th International Conference on Genomics" Press release, 16th November. Available at: http://www.genomics.cn/en/news/show_news?nid=98952
[46] For example, BGI's primary work on cancer involves developing cheaper, faster, less invasive, and more sensitive tests that can be performed by detecting tumor DNA in a patient's blood via sequencing.
[47] Interview with BGI employee, Shenzhen, 17 July 2014.

either expensive, or invasive, or involved a lengthy wait for results. BGI's work involved developing versions of the test that could be performed quickly on sequencing machines from a routine maternal blood test. These platforms utilized existing sequencing technologies and deployed existing knowledge of genetic diseases. However, development of the tests involved putting these technologies and knowledge to work in novel ways: speeding up the sequencing process, making it cheaper, making it accessible to more people.[48] Such work is both novel and valuable in multiple ways: economically valuable for BGI's owners, scientifically valuable for BGI's workers, and biomedically valuable for Shenzhen's citizens. It enacts a form of "socialist" science – a science specifically directed towards the people.

BGI places the DNA double helix at the center of its branding. A 20-foot high mural near the entrance to the laboratory depicts an Orwellian hand gripping (crushing?) a helix (figure 2). The helix motif appears on T-shirts, coffee cups, and stationary. Part of BGI's performance, then, is one of copying – copying of DNA, copying of models of scientific publication, and copying the model of the factory. Like *shanzhai*, BGI depends – historically, economically, and institutionally – on the copy. But like the mobile phones at Huaqiangbei, BGI's copies are not mere copies, carrying meaning beyond that of "imitation" or "fake." Like *shanzhai* phones, too, BGI's products are produced in a hybrid space: BGI recombines elements of factories and laboratories, open and closed, automation and innovation, production and invention. It values *both* traditional scientific production (publication) as well as the kinds of speeding up, efficiency, and control over space and people that is associated with factories. Many commercial laboratories in China and elsewhere combine science with for-profit enterprise. But "performing *shanzhai*" draws attention to the unique ways in which BGI promiscuously mixes imitation, automation, speed, socialism, and commodity production with more traditional forms of scientific knowledge-making.

iii) Performing the startup

[48] For example, see: Xu, J. et al. (2015) "Haplotype-based approach for noninvasive prenatal tests of Duchenne muscular dystrophy using cell-free fetal DNA in maternal plasma" *Genetics in Medicine* (Feb 5) doi: 10.1038/gim.2014.207.

If factories form the foundation of Shenzhen's *shanzhai* economy, then the superstructure consists of small-scale electronics entrepreneurs. The markets at Huaqiangbei are populated by thousands of small entrepreneurs trying out new designs and building new devices. The innovativeness of these individuals stems partly from their ability to work outside the rules, recombining, reappropriating, and hybridizing without borders. It is therefore partly a renegade set of practices. It exists largely in grey zones and grey markets; its institutional loci are multiple and ambiguous. It is effective partly *because* of its semi-legitimacy. BGI mimics such performances. Borrowing from both local models (*shanzhai*) and foreign (Silicon Valley), BGI acts out the model of a kind of "startup." In Silicon Valley, startups offer disruptive innovations that aim to remake entire industries through information technology. Startups have also become zones of organizational experimentation, refiguring the work and lives of their employees in novel ways. In Shenzhen, such technological and cultural disruption intersects with the "renegade" performances of *shanzhai*.

BGI certainly has a Silicon Valley-style garage start-up myth. In September 1999, BGI was founded as a "dysfunctional adjunct" to the Chinese Academy of Sciences Institute of Genetics. Participating in the Human Genome Project was a radical idea in China and BGI remained a small enterprise with fifty employees, limited capital, and a few sequencing machines. China's slow start in genetics and biotechnology meant that BGI was largely on its own.[49] In the early days, the operation was crowded into an apartment in Beijing: "Their furniture consisted of the cardboard shipping boxes that had contained their new equipment."[50] Later, the company moved to a warehouse near the Beijing airport.[51] These oft-repeated stories form an important part of the ethos of BGI: Huanming Yang and the other founders were mavericks who defied normal (Chinese) scientific practices, taking risks that ultimately paid off.[52]

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[49] Schneider, Laurence. 2005. *Biology and Revolution in Twentieth Century China*. Routledge: chapter 9.
[50] Specter, "The Gene Factory."
[51] See BGI's website: http://www.genomics.cn/en/navigation/show_navigation?nid=2946
[52] All BGI's founders were educated outside China, returning in the 1990s as partial outsiders.

BGI took a further risk by divorcing itself from the Chinese Academy of Sciences and moving away from Beijing. This shift has allowed BGI to portray itself as "renegade," eschewing what BGI leaders perceived as the slow-paced science and moribund bureaucracy of the capital and moving to the "frontier" of the SEZ. The move to Shenzhen became a way for BGI to free itself of political constraints and government influence. In the words of one investor speaking to the *Financial Times*: "Shenzhen is as far from Beijing as you can get."[53] In statements such as this, BGI makes a enacts a distance from the Beijing government and from the more established centers of Chinese science.

This distance has given BGI the opportunity not only to engage in different and new kinds of scientific work (namely, genomics) but also to construct different (and particularly more capital-oriented) ways of practicing science. After its move to Shenzhen, BGI was labeled "the first citizen-managed, non-profit research institution in China"; a new type of institution.[54] "We represent a new model of an international Chinese organization" Wang Jun (BGI's former chief executive officer) has said, recognizing possible tensions between business and basic research: "If we are too commercial, we lose sight of the future,… But if we are only thinking of the future, that isn't suitable either."[55] BGI's leaders recognize the need to adopt and mix-up multiple roles – academic, industrial, commercial, and non-profit.

BGI's funding and revenue model is also start-up-like. Although BGI has made some money selling products and services, it has also succeeded in establishing lucrative research partnerships and contracts with corporations, governments, and non-government organizations. This includes money from universities, pharmaceutical companies, the Chinese central government, local governments (such as Shenzhen's), and from international organizations such as the Bill and Melinda Gates Foundation and even investment from the Silicon Valley investment venture capital firm Sequoia Capital.[56]

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[53] Sender, "Chinese Innovation."
[54] The original source of this phrase is unclear, but it has been widely circulated.
[55] Quoted in Sender, "Chinese Innovation."
[56] BGI has received significant funding from the state-operated China Development Bank (http://www.genomics.cn/en/news/show_news?nid=98698). The Gates Foundation and BGI have an ongoing collaboration in the fields of global health and agricultural development (http://www.genomics.cn/en/news/show_news?nid=99229). This has included funding for the

In many ways, BGI's the organization of people and work performs the start-up image. Workers report little factory-like discipline within the organization. Most of the staff are free to come, go, and work according to flexible schedules. For those working with high-throughput experiments their days revolve largely around the rhythms and cycles of the machines themselves (the "runs" of a DNA sequencing machine, for example). For bioinformatics staff, it is not unusual to find them coding late into the night and sleeping through the mornings, or napping at their desks during the day. A sort of anti-hierarchy is enforced: business suits are forbidden at headquarters. Flexible teams are convened to work on specific projects that need not be initiated or led by scientists with PhDs; individuals are judged by their ability to work together to produce good publications or good technologies to deadlines.

The BGI staff I spoke with emphasized the "openness" and "flatness" of their organization.[57] They stressed how bosses were accessible and people worked and talked across projects. While these claims may have been exaggerated, the kinds of spaces and interactions I observed seemed to support this notion of flatness. The internal laboratory spaces are characterized by open plan offices, frequent face-to-face interaction, and ample space for informal gatherings.

BGI attempts to create a specific institutional culture, intervening in its employees lives. Social lives are dominated by the lab. Extra-curricular activities (including various team-building exercises and a thriving basketball league) form a central part of the day-to-day life of the staff (figure 3). In their time off, workers organize English conversation classes, or hikes up the steep mountains behind the lab: "we work together and we play together" one member of staff told me.[58] A senior member of the lab stressed how important this was for young people in a society where many had come from single-child families and were not necessarily used to playing well with others. BGI's employees present

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10K International Rice Project (http://www.genomics.cn/en/navigation/show_navigation?nid=2679) . On Sequoia's investment see Sender, Henny (2015) "Chinese Innovation: BGI's Code for Success" *Financial Times*, 17th February. Available at: https://next.ft.com/content/9c2407f4-b5d9-11e4-a577-00144feab7de

[57] Interview with BGI employee, Shenzhen, 28 June 2017.

[58] Interview with BGI employee, Shenzhen, 17 July 2014.

themselves as team workers, community-minded, and enthusiastic for their work and mission.

Posters on the walls of the lab exhorted workers to take part in myriad activities, both as a means of fostering teamwork, but also as a means of keeping healthy. Contributions to global biomedicine required, one poster noted, "first making yourself healthy." Between meals, employees could find healthy snack foods distributed at various "bars" located on each floor. The fruit and other items are provided at a nominal cost (staff were supposed to pay by putting money in a box next to the food). The elevator in the eight-floor headquarters building had been reprogrammed to stop only at floors 1, 5 and 8 in order to encourage employees to walk between floors. Even more dramatic were posters encouraging the use of a monitoring device called "GeneBook" that would feed data about employees' blood pressure, cholesterol and other health information into an app (figure 4). Such monitoring was again in the name of keeping employees healthy.

Google is famous for providing, at its Googleplex in California, a sort of work-play environment complete with free food, table-tennis, pool, and foosball tables, video games, gyms, and a variety of party and entertainment options in a spectacular campus-like environment designed to attract the best young (mostly American) talent.[59] BGI is not (yet) quite like the Googleplex.[60] But it is deliberately cultivating some of the same characteristics: the non-hierarchical organization, the merging of living and working, the intensive socialization, and the attention to health and play.

But beyond this Silicon Valley model, BGI also draws more concretely on the entrepreneurial culture that pervades Shenzhen. Although Huaqiangbei and *shanzhai* are centered on electronics, not biomedicine, the high-tech buzz of the city is important for attracting talented, technically-minded young people to Shenzhen. As BGI expands it business into sequencing machines, diagnostic kits, and bioinformatics, there is an increasing cross-over with computational and electronic domains. In 2015, BGI's former executive director Jun Wang left BGI to

[59] Levy, Steven (2011) *In the Plex: How Google Thinks, Works, and Shapes Our Lives*. New York: Simon and Schuster.
[60] In the near future it will certainly *look* a little more like Google: a new purpose-built "campus" for BGI will be completed in 2018.

form *iCarbonX* (碳云智能). The company plans to combine genomics, proteomics, metabolomics, and microbiomics with artificial intelligence in order to contribute to drug development, cosmetics, nutrition, and health predictions. One of its major funders is TenCent.[61]

This kind of work fits naturally into a city which is now considered the world capital of open hardware. This became particularly evident after BGI's acquisition of Complete Genomics (based in Mountain View, California). When BGI attempted to design its own sequencing machine based on Complete's technologies, it was able to recruit a crack team of hardware hackers and engineers to work in Shenzhen. Drawing on local expertise, the availability of raw materials, and rapid prototyping capabilities of the city, the team were able to produce the BGISeq 500 in six months.[62] Such "disruption" of the DNA sequencing industry emerged from a literal combination of Silicon Valley and Shenzhen know-how. Significantly, so far the machine is only for sale in China because some of its technology remains in patent disputes in the US and Europe.[63]

A startup model infuses the ideals and the mission of BGI too. This is a vision that comes from the top. In the Danish documentary *DNA Dreams*, BGI Chairman Huanming Yang is captured giving a rousing speech at the 2011 International Conference on Genomics: "I have a dream," he begins, invoking a famous renegade. If Martin Luther King's dream was one of racial justice and harmony, Yang presents his goals as no less socially and politically important. For BGI, the dream is a techno-humanist vision of solving the world's health and social problems through biomedicine. This vision inspires and animates many of those I met at BGI. Of course, BGI provided a stable (even prestigious) job with

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[61] (2016) "iCarbonX Becomes China's First Biotech Unicorn" *technode*, 14th April. Available at: http://technode.com/2016/04/14/icarbonx-becomes-first-chinas-biotech-unicorn-1-billion-rmb-series/; Taylor, Nick Paul (2016) "Ex-BGI CEO Startup Hits $1B Valuation in 6 months" *Fierce Biotech*, 15th April. Available at: http://www.fiercebiotech.com/it/ex-bgi-ceo%E2%80%99s-startup-hits-1b-valuation-6-months

[62] BGI had another team working concurrently at Complete's headquarters in California. They designed a much larger sequencing machine called "Revelocity" of which only a handful have been produced. See Yuzuki, Dave (2015) "BGISeq-500 debuts at the International Congress of Genomics 10" Weblog, 24 October. http://www.yuzuki.org/bgiseq-500-debut-at-the-international-congress-of-genomics-10/

[63] Robison, Keith (2015) "BGI Launches BGISeq 500" Weblog, 27 October. http://omicsomics.blogspot.nl/2015/10/this-weekend-brought-formal-launch-of.html

good pay, but many employees saw their work as part of a larger and important project. This ambition has socialist (improving health care), nationalist (securing China's economic future) and global dimensions (exporting its success).

Silicon Valley's dream, deeply rooted in the history of the Internet and the counterculture, revolves around the transformation of society through information and communication technology.[64] In particular, it sees technology as the means for spreading economic and political freedoms. Self-styled "disruptors" present themselves as renegades, railing against conventional wisdom and practice. BGI's rhetoric serves a similar purpose – it presents the company and its employees as outsiders, rebels, and heroes, battling against tradition, convention, and bureaucracy. This has a particular salience in Shenzhen, a city known not only for *shanzhai*, but also for its unorthodox capitalist and political experimentation. By mixing together elements of the laboratory, the factory, and the "renegade" startup, BGI produces an institution that is simultaneously imitative and innovative, "Californian" and Chinese, capitalist and socialist, open and closed.

Life as Copy

A visit to Shenzhen is not complete without a stop at its main tourist attraction – "Window of the World." Here, locals and tourists can see the Eiffel Tower (354 feet high!), the Pyramids, the Taj Mahal, the Acropolis, the Coliseum, Angkor Wat, Mt. Fuji, the Sydney Opera House, Mount Rushmore, and the White House all in one place. The theme park is Shenzhen's attempt to capture the wonders of the world for China. This theme park reminds us of the purpose of Shenzhen as a Special Economic Zone: to bring the world to China and China to the world. Each of "Windows" elements is, of course, a "copy"; but bringing these elements together in one place amounts to something different and something more. Ultimately, BGI's project should be understood on this scale and in this context – it is an attempt not merely to "copy" but make something new through taking

[64] For the history of these ideas see Turner, Fred (2006) *From Counterculture to Cyberculture: Stewart Brand, The Whole Earth Network, and the Rise of Digital Utopianism*. Chicago: University of Chicago Press. For a critique see especially Barbrook, Richard and Cameron, Andy (1996) "The Californian Ideology" *Science as Culture* 6.1: 44-72.

and combining elements from around the world. It is an attempt to dominate the world through replication and recombination.

"Performing *shanzhai*" suggests a variety of ways for understanding BGI and its multiple meanings for China, Shenzhen, and its own employees. It suggests how BGI can be understood as at once a space of copying/faking *and* a space of innovation, invention, re-creation, and openness. It suggests how it is drawing on Shenzhen's history, culture, and social environment, as well as on those of China more broadly. Here, the notion of performance – attending to space, costumes, buildings, setting, slogans, and publicity – sheds light on what BGI is attempting to be and do on its own terms. This framework seeks to avoid either celebrating or denigrating BGI's work, seeing it as neither "fake" or "copycat" nor a performance of science in the ways with which we are most familiar.

One corollary of this argument is that thinking about BGI as a factory only captures a small slice of what is interesting, important, and unique about it. BGI-as-factory underestimates its possibilities for transforming how we think about and do biological work. BGI draws on many kinds of models – start-up, NGO, industrial lab. Labeling BGI a "factory" is ultimately rooted in contemporary western notions of China as a zone of "copycatting." This label mischaracterizes what is actually occurring in *shanzhai*. In particular, it misses the innovative and creative aspects of "copying" work. The kind of labor that is performed may actually pose a challenge to contemporary categories of "originality."[65] As Eugenia Lean shows (this volume), China has long been portrayed as space of dangerous "copying." In the early twentieth century too, this reflected western anxieties about the limits of capitalist and colonial power in an era when intellectual property rules were very much in flux. But in this context too, "copying" was not slavish imitation. "Masterful copying" provided opportunities for innovation, invention, and creative rearrangement that had "virtuous" qualities. In Shenzhen, *shanzhai*, and BGI we see how "copying" is recast as variously "virtuous": anti-capitalist, nationalist, or altruist.

[65] Wong, *Van Gogh*, pp. 24-25.

In her book about Dolly, Sarah Franklin attempts to understand why the 1996 cloning of a sheep elicited such wide public excitement. Why do we fear the copy? Ultimately, Franklin suggests, we fear our own individuality and uniqueness may be called into question.[66] Copying threatens some (western, liberal) basic beliefs about human nature. No doubt such notions are also sharpened by western fears about loss of global economic power, manufacturing industries, and jobs. But this denigration of the copy is culturally and historically located. Historians agree that the dominant form of "making" before the middle of the nineteenth century in the west was the copycat; Philip Scranton has argued that American manufacturing between the Civil War and World War I consisted of small, flexible, specialists working in an ecology that seems similar in many respects to *shanzhai*.[67] And indeed in the west, in debates about music, movies, and especially software, the copy is being rehabilitated: *remix* is increasingly celebrated and legitimate (even virtuous) form of copying.[68] Copying – especially in the form of *open source* and *open access* – is a form of political resistance and a pushback on corporate power. This "hacktivist" spirit is partly what animates *shanzhai* and draws people to Shenzhen. BGI too, participates in this movement, explicitly embracing the rhetoric and practices of open source and open access. It too, seeks forms of "copying" that are virtuous: innovative, nationalistic, socialistic. In this sense, BGI is part of a broader movement that is forcing us to re-evaluate our moral indictment of the copy: not *mere copying*, but rather copying that is playful, copying as productive scaling-up, copying that includes novelty, copying for social good, copying as sharing. The DNA molecule is a symbol of both life and the copy; copying is necessary for life and for pursuing "life itself" in Shenzhen.

Beginning in California in the 1970s, the biotechnology industry reconfigured bioscience work in various ways. The modes of work that the biotech industry engendered were deeply influenced by the culture of Silicon

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[66] Franklin, Sarah (2007) *Dolly Mixtures*: *The Remaking of Genealogy.* Duke University Press.
[67] Scranton, Philip. 1997. *Endless Novelty: Specialty Production and American Industrialization, 1865-1925*. Princeton, NJ: Princeton University Press. Schwartz, Hillel. 1998. *The Culture of the Copy: Striking Likenesses, Unreasonable Facsimiles*. Zone Books.
[68] Lessig, Lawrence (2004) *Free Culture: The Nature and Future of Creativity*. Penguin.

Valley and Stanford University, even as biotech spread outward from there.[69] Labels like "commercialization" and "industrialization" do not capture the complexity of these transformations. Rather, historians and sociologists have turned to terms such as "biocapital," "nature, enterprised up," "biovalue," and "bioeconomics" to characterize the mixing of life science with regimes of production, consumption, capital and ownership.[70] But for BGI, and China, as the life sciences develop, such categories seem increasingly inadequate or incomplete. *Shanzhai* – with its connotations of the copy, the renegade, the socialist worker, and the entrepreneur – presents a new category that more fully reflects the kinds of work, ideals, and hopes that are being enacted at BGI. This is a biomedicine performed through imitation, industrial scaling-up, rampant capitalist ambition and speculation, socialist spirit, and nationalism. BGI is remaking "life itself" in the image of Shenzhen.

[69] Vettel, Eric J. (2006) *Biotech: The Countercultural Origins of an Industry*. Philadelphia: University of Pennsylvania Press.
[70] Helmreich, Stefan (2008) "Species of Biocapital" *Science as Culture* 17, no. 4: 463-478.