



Article

Singapore as Science 'Scape and Ethnoscape

Philip S. Cho ^{1,*} and Dave Valler ²

¹ Underwood International College, Yonsei University, UIC 422 Veritas Hall C, 85 Songdogwahak-ro, Yeonsu-gu, Incheon 406-840, Korea

² School of the Built Environment, Oxford Brookes University, Headington Campus, OX3 0BP Oxford, UK; dvaller@brookes.ac.uk

* Correspondence: kexue@alum.mit.edu; Tel.: +82-010-231-49107

Received: 27 September 2017; Accepted: 19 November 2017; Published: 20 November 2017

Abstract: As a state project to locate the nation within the global knowledge economy, Singapore's Technology Corridor has acted as a testbed for experimenting with different models of an international scientific community. Its landscape, from garden-style science parks modelled after Silicon Valley to monuments for multidisciplinary research such as One North, reflects the dynamic interaction among various political and ideological aspirations—ideoscapes—driving the built environment. Through both documentary research and semi-structured interviews of scientists and entrepreneurs, we examine how mostly foreign expat and some Singaporean researchers have experienced Singapore's unique science 'scape and adapted to a hybrid work and living environment. Testimony of the scientific sojourners of Singapore's diverse ethnoscape—from China and India to Europe and the United States—reveal the blending of different styles of scientific work and the interconnected flows of intellectual labour.

Keywords: Singapore; science; technology corridor



1. Introduction: Science 'Scapes and Ethnoscapes: Theoretical Themes

Major science and technology parks have become vital elements of economic and development strategy in societies across the world. These spatial imaginaries find expression in government policy across scales and are an important aspect of political discourse, projecting the dynamism of national, regional and local economies. Considerable research attention has been paid to how effectively such

spaces have promoted economic competitiveness and innovation. We focus on how science spaces also operate as a locus for transnational flows of technological know-how, development practice and symbolic capital. In this context, they may be conceived as “imagined spaces”, in particular among three axes based on Arjun Appadurai’s [1] diverse landscapes of modernity: (i) as physical and technological forms, or ‘technoscapes’, reflecting the global circulation of built environment and technological formats; (ii) as science diplomacy, or ‘ideoscapes’ projecting soft power; and (iii) as patterns of transnational mobility and knowledge transfer, or ‘ethnoscapes’.

As physical and technological forms, or what we might loosely term ‘technoscapes’, science spaces have emerged in varied forms across highly diverse national and global-regional contexts. In the forerunner case of the United States the distinctive ‘international-campus-garden-suburb’ format of science and technology parks represented an acceptable post-war political compromise within the extensive suburbs growing in contiguous fashion around major cities [2,3]. Yet the model has proved highly mutable, subject to re-articulation in the face of alternative political frames and regulatory regimes. In the UK, for example, a similar logic of dispersal of R&D laboratories and defence was part and parcel of more scattered non-contiguous urban sprawl [4] to essentially rural settings of villages and market towns in the South East of England. In France, grander state urban and regional planning projects sought to re-distribute economic activity with scientific installations often at the heart of such endeavours: Sofia Antipolis remains as perhaps the most conspicuous attempt to fashion a new settlement space—a ‘retreat’—thought suitable for fostering major contributions to industrial research and science [5]. Elsewhere, notably in ‘developmental state’ national contexts such as Korea and Japan, science parks have been fully planned as new urban spaces from the outset. In yet others, including China and India, they appear to have grown organically as part of, or extensions to, booming extended city-regions as with the case of Beijing’s Zhongguancun science and technology zone. International technological and developmental flows thus combine with national and regional political projects to produce patterns of both homogeneity and heterogeneity in the physical expression of science spaces and complex relations with forms of urbanization.

Secondly, the physical accomplishment of technoscapes has been intimately bound up with varied national political ambitions and the projection of scientific diplomacy via ‘ideoscapes’. While international scientific endeavours were influential in post-war US foreign policy, gradually helping to improve relations with the Soviet Union and subsequently with China, more recently China has begun to deploy its own science-park models abroad in a sustained programme of ‘science diplomacy’. As Hvistendahl [6] documents, China has funded foreign investments in Russia, Singapore, the UK and the US, as well as initiatives involving ‘South-South’ cooperation with developing countries in Africa, Latin America and Asia. Such initiatives, led by the Ministry of Science and Technology, exert critical ‘soft power’ [7] by emphasizing the economic and cultural strengths of China on a global stage. In other contexts, science spaces have diverse and ambiguous positions in relation to regional and national economic policy agendas. In the UK, the role of science parks has been integrated into national discourse somewhat after the event, while in Japan and South Korea, science parks are clearly integrated into significant national policy agendas for promoting economic competitiveness. Elsewhere strong national agendas are more cultural in orientation. In Malaysia, for example, science and technology parks are ‘cities for nations’—new settlement spaces that are explicitly aimed to project national modernity [8]. Clearly, then, science spaces exert significant symbolic power at a global scale and in some cases, have been actively cultivated as explicit political and diplomatic projects.

Third and of particular relevance here, global science spaces attract highly internationalised workforces. A 2011 study by the Royal Society found that cross-border scientific collaboration was increasing, that it disproportionately involved scientists with diaspora ties and that it holds potential to improve the quality of science [7]. Diasporas have always been a potent economic force but their value is further extended in this highly mobile, globalised arena [9]. For example, highly skilled migrants can provide additional collaborative reach by virtue of their individual personal histories, their enhanced sensitivity to local circumstances and their capacity to establish relations of trust [10]. At the same time, technoscapes are complex assemblages of global enterprises, international labour,

national and international research institutes, SMEs and other organisations working across multi-scaled governance jurisdictions. Understanding these spaces therefore requires sensitivity to processes of transnational mobility and linkage and the mechanisms for knowledge transfer.

Beyond these established dimensions in the literature on transnationalism and science spaces, questions of culture per se have remained relatively underplayed. Indeed, issues of cultural identity, perception and experience particularly amongst migrant scientific labour represent a notable lacuna, despite occasional insights mostly in the literature on high-tech migration and brain circulation especially associated with Silicon Valley [11,12]. In this paper, we therefore develop this distinctive conceptual vantage-point through a focus on a single case-study—Singapore—as science ‘scape and ‘ethnoscape.’ Appadurai—the author of the ‘scapes notion in characterising diverse global flows—elaborates the ambiguous notion of ethnoscares in two key dimensions; he explains them as follows:

“It refers, first, to the dilemmas of perspective and representation [...] and it admits that (as with landscapes in visual art) traditions of perception and perspective, as well as variations in the situation of the observer, may affect the process and product of representation. But I also intend this term to indicate that there are some brute facts about the world of the twentieth century that any ethnography must confront. Central among these facts is the changing social, territorial and cultural reproduction of group identity. As groups migrate, regroup in new locations, reconstruct their histories and reconfigure their ethnic projects, the ethno in ethnography takes on a slippery, nonlocalized quality, to which the descriptive practices of anthropology will have to respond. The landscapes of group identity—the ethnoscares—around the world are no longer familiar anthropological objects, insofar as groups are no longer tightly territorialized, spatially bounded, historically unselfconscious, or culturally homogeneous.” ([1]: 48 emphasis added).

Ethnoscares are thus ‘landscapes of group identity, no longer bound to certain territorial locations’ [13] (p. 754), thereby directing our attention towards the construction of identities amongst international scientists and the extent to which we can identify new identities and meanings, cultural hybridity, the diverse experiences of international scientific work, distinctive perceptions of spatial imaginaries and built form. Hence, we follow Appadurai in adopting a dual focus on distinctive international perceptions of the ‘technoscape’ (Section 3.1 below) and on the nature of international scientific identities in Singapore (Section 3.2).

With this framework, the objectives of the current research were to:

- (i) To describe and characterise the evolution of the physical form of Singapore’s science spaces.
- (ii) To understand how these global science spaces played a role in constructions of national identity and political and economic strategy.
- (iii) To explore the experiences of international labour as intellectual sojourners in Singapore and abroad.

Methods associated with each objective comprised the following:

- (i) Detailed survey of literature and reports tracing the historical evolution, development process, identity and image and physical form of research spaces in Singapore.
- (ii) Review of policy documents at various governmental scales and marketing/publicity material.
- (iii) Semi-structured interviews with international scientists, engineers and entrepreneurs to draw out perceptions, culture and identities.

Twenty semi-structured interviews were conducted in 2016–2017 by approximately 45 min to an hour discussion and correspondence. As work styles and experiences might vary depending on discipline and location, these interviews were divided as 7 in the sciences, 7 in engineering and 6 science and engineering entrepreneurs distributed across different spaces including the National University of Singapore, Nanyang Technological University, One North and Science Park. Technopreneurs were included because of Singapore’s emphasis on developing a synergistic relationship in the flow of people and knowledge between the research community and commercial start-ups. Companies are spun off from the research institutions and incubator and co-working spaces were intentionally clustered with research institutions during the development of Technology

Corridor. Respondents were mostly expat researchers who ranged from primarily principle investigators, CEOs and doctorates to masters postgraduates (3 respondents) for a variety of social level and career perspectives. Three native-born Singaporeans were also included as an essential part of diverse international community, especially to understand how local identities change when moving abroad.

Some of the aims of the interviews were to examine:

- a. How does international scientific labour specifically perceive the respective spatial imaginaries and built forms in their host spaces?
- b. Do the perceptions of international labour accord with the image/identity of the site projected in national discourse or the perceptions of national/regional/local actors?
- c. What kinds of identities do expatriate scientists construct? How and why are they constructed in this way? To what extent can we identify cultural hybridity and new identities/meanings?
- d. To what extent is the experience of scientific work differentiated amongst diverse global science space contexts?

2. Building a Scientific Community: Changes in the Ideoscape, Technoscape and Ethnoscape

Since the 1990s, 'Technology Corridor' has been Singapore's test-bed for experimenting with different models of a scientific community. Its landscape reflects the dynamic interaction among various political and ideological aspirations—ideoscapes—driving the design of the built environment, the plan for developing intellectual talent and the everyday work and lives of researchers and budding tech-entrepreneurs. Underlying this multifaceted discourse is the surging flow, both inward and outward, of international intellectual labour. In reviewing how this landscape has evolved we reveal the design of the built environment for research such as Science Park, One North and the university campuses as largely driven by top-down imaginings of how scientists work and the role of foreign talent in the national discourse. Our research finds that many researchers, including native Singaporeans, are drawn to the multicultural and cosmopolitan environment. While some have settled their families, others are drawn by a desire to eventually return to their countries or seek additional opportunities abroad, where they could leverage their experience and connections in Singapore. This reflected a trend among highly mobile scientists and 'technopreneurs' and poses challenges and opportunities for policymakers in building a vibrant scientific community in Singapore.

The 1991 Concept Plan of the Urban Redevelopment Authority originally earmarked two technology corridors, one a 15 km rectangular stretch along the southwest and a second along north-east [14]. These were to integrate 'science habitats', business parks, research facilities, universities and especially housing and recreation facilities. According to the plan, Technology Corridor will foster coordination and cooperation among scientists, businessmen and the community. They will provide an environment that will positively promote the exchange of ideas and innovations and mix them with the entrepreneurial forces already at play within Singapore' [14] (p. 21).

Technology Corridor was planned to incorporate Science Park I, which had been started in 1981 on a 30 ha plot next to the National University of Singapore (NUS). The 1991 Concept Plan expressly noted the lack of Science Parks' integration of work, home and recreation facilities. In 1992, Science Park II (\$291 million) was set up on a 20.3 ha plot and in 2002, Science Park III (\$600 million) on an additional 15 ha of land between Pasir Panjang Road and South Buona Vista Road, both situated closer to housing and recreation. The research complexes of One North (Figure 1 and frontispiece), spelled out by the newly established National Science and Technology Board in 1991, were later developed in 2001 on 200 ha as the primary anchor for the Agency for Science and Technology [15]. NUS and Nanyang Technological University (NTU), flank the corridor with Singapore Polytechnic and Ngee Ann Polytechnic in the middle. Holland Village and the later development of the mega-church, shopping mall and rock studio at the Star Vista (Figure 2 below) and the upscale dining at Rochester Park were all to provide a range of entertainment and lifestyle options.



Figure 1. One North, Singapore. Source: author photo.



Figure 2. Star Vista. Source: Author photo.

On this canvass, the Singaporean government and its people have sought to shape different national identities as an international hub for scientific research and innovation. From the 1980s through 2010, this identity has been youth-centred and Western-oriented. To become an educational hub, Singapore sought to create partnerships with (Western) world-class universities while recreation areas were to cater to western lifestyles [16,17]. Science parks I, II and III were explicitly designed to emulate Western technopoles such as Silicon Valley. Great emphasis was placed on preserving the natural rainforest greenery and campus atmosphere. The proximity of NUS and new research facilities were to provide all the alchemical ingredients to spontaneously generate a creative intellectual milieu. Youth-oriented campaigns were to attract and nurture the first generation of young Singaporean scientists who, for the first time in the island nation's history, could pursue scientific research as a viable profession. A*STAR (the Singaporean Agency for Science, Technology and Research) official yearbooks focused on maritime metaphors of adventure and discovery with

Star Trek and Treasure Island as favourite themes (see A*STAR Yearbook 2001–2002 for Star Trek illustrations) [18].

As a projection of the nation's nascent scientific development, Singapore's young scientists were depicted as guppies who were to swim alongside and learn from famous foreign scientists, depicted as whales (see A*STAR Yearbook 2006/07 for Whales and Guppies illustrations) [19,20]. Singaporean universities were likewise to bootstrap themselves by partnering with foreign world class universities, in an effort to rebrand local higher education. This vision of a youthful creative class following in the footsteps of foreign mentors was embodied in Holland Village. It was to be a space where creative young scientists, artists and entrepreneurs could break from the norm with a new sense of cosmopolitanism, yet be buffered from disturbing the heartland. While the nation as a whole was to embrace Asian values, those in the creative community could have the liberty to experiment with new Western lifestyles, culture and entrepreneurial spirit.

However, the Western Silicon Valley model on which Science Parks I, II and III were built did not initially spark a triple-helix synergy among research institutes, universities and industries. Remarking on these, Philip Yeo noted, "The buildings all stand alone, nobody talks to each other". Some felt that the campus model of Silicon Valley, designed for calm pleasant weather needed to be adapted to Singapore's natural and work environment. This sentiment spurred new architectural designs for research spaces. Drawing on the analogy of a beehive, Philip Yeo noted, "It's how you design the facilities so that people don't have to run around from building to building, place to place. You make it as compact as possible. In a high-rise building, most people know the people on top, people below. If you want them to interact socially, network wisely, you want to build literally in clusters" [21].

As Singapore's scientific community matured, a new ideation of the nation's science 'scape emerged. The ideoscape of harmonious multidisciplinary and multiculturalism was reified by the built environment of the technoscape in the form of One North (Figure 3). One North was a microcosm of an aspiration to integrate a diversity of people and disciplines into a harmonious and creative unity. Cross-bridges between buildings at different levels were to foster multi-disciplinary interaction. Fusionopolis, for example (Figure 4), had layered cores for residential, office and commercial zones. A direct elevator went to a sky garden and public service floor. Underneath, the MRT provided rapid transit and connections to the rest of the city-state [22].



Figure 3. One North urban form. Source: Author photo.



Figure 4. Fusionopolis. Source: Author photo.

Zaha Hadid—the architect of One North—explicitly expressed this goal. Explanation of the design concept of the One North echoed this sentiment:

One North generates a strong sense of identity... unity in difference... integrating heterogeneity... a built fabric which permits the mediation and integration of heterogeneous urban grids. All differences are absorbed and harmonized with One North's curvilinear pattern. Ultimately all there is here is flexibility without chaos—a morphological system which allows for infinite variation within the bounds of a strong formal coherence and lawfulness [23].

Her words about unity in difference as an emergent identity for the scientific community seemed to echo those of Rabindranath Tagore about seeking unity from diversity through racial harmony—a Singaporean ideal.

Here Aryans, non-Aryans, Dravidians, Chinese
Sakas Hunas, Pathans. Moguls in one body, lo, were united...
From the short of the sea of Bharat's Great Harmony! [24]

One metro stop away, the newly constructed Star Vista was a monumental biblical arc. In the shape of a boat, the top three floors housed the mega New Creation Church and Christian rock production, while the lower floors had an upscale shopping mall. This provided a more community and even family oriented infrastructure in contrast to the earlier constructed, more youth-centred or bohemian style Holland Village. This new community oriented environment accommodated the increasing number of foreign scientists and their families who were settling in Singapore.

With names such as Fusionopolis and Biopolis, these monuments of the ideoscape in the technoscape were to be a space in which a diverse scientific and entrepreneurial community could come together to drive innovation. In terms of the ethnoscape of the scientists themselves, one respondent interestingly noted how the built environment was important. However, more informal discussion on problem solving of work in progress would also be useful.

"Those spaces are a necessary but insufficient condition. The way those spaces are designed in order for cross pollination for serendipity to happen—it needs to be accompanied by human behaviour. Any type of cross pollination come from presentations. But that doesn't really help in terms of getting you to think about your work differently or getting you to think about how your work links to someone else's. It becomes too formal. You can't just have a casual conversation about it. By the time you have given your presentation the whole thing is done already. You want to have those conversations... in the process of being worked on. As much as there are formal avenues for that interfacing to happen, it isn't happening at the time when it needs to happen. I would much rather have a conversation about 'what are you working on now and what problem is the biggest for you?' So, you end up having just a causal conversation and in the back of my mind I am also thinking about my own work. It is very different in that stage. What you want is transfer of tacit knowledge

rather than formal knowledge. What you really need is diversity is in terms of problem solving approaches. That never gets translated when you only get the end product.” [11/2/2017].

3. International Perceptions and Identities

3.1. Perceptions of the Built Environment

A number of authors have described the evolution of Singapore’s science ‘scape as the embodiment of a purposeful state strategy aimed at relaunching the city in the new, knowledge-based economy [12,25]. Without re-tracing this established ground in detail, it is clear that the supposed ‘ideals’ of the new economy have underpinned the development of Technology Corridor and its constituent elements in various phases since the 1980s. Hence the commitment to creative and high-technology industrial development and associated cultural values of entrepreneurship, creativity and flexibility initially in the 1980s and subsequently reinforced following the Asian financial crisis in 1997 [12] (p. 73).

This (re)articulation of new-economy rhetoric in turn produced material spatial effects in terms of planning interventions into the national space economy to help put in place the idealised links among the cultural, the technological and the economic domains. The creation and/or valorisation of sites at which such links may be generated and/or enhanced included industrial and business parks providing facilities and amenities tailored to the needs of the high-technology sectors, perhaps most famously the Singapore Science Park which was developed in phases starting in 1980 and the designation of a civic and cultural district in the downtown area, for the development of museums and venues for the arts such as the Esplanade Theatres on the Bay, a performing arts centre which opened in 2002.

Subsequently, *One North* and its biomedical component *Biopolis* represent a further step in the creation of an intellectual and cultural milieu devoted to knowledge-based development, combining high-tech industries and access to key university and government institutions with flexible and attractive residential options and a vibrant cultural scene [12] (p. 76).

Throughout this project, a critical dimension has been the attraction of ‘global talents’ to augment the indigenous Singaporean population and ‘to leaven the allegedly conservative Singaporean scientific culture with the adventurous spirit of global technoscience [25] (p. 10). As Waldby states, the move to a global knowledge economy involved a radical internationalisation of Singaporean science, increased emphasis on global collaboration and the importation of foreign expertise [25] (p. 7), leveraging on its strategic geographical position and its traditional role as transport hub and point of international exchange. Waldby quotes Ong [25] (p. 6), as follows:

The city-state has displayed flair in its experiments with an elastic sense of the scale of the nation and the possibilities for configuring an ‘effervescent ecosystem,’ a far-flung informational network that links disparate sites of intellectual and creative production. Planners assembled foreign institutions, global companies, mobile experts and authoritarian politics to create a milieu of intellectual upgrading, accumulation and production. The tiny nation re-casts itself as an exceptional island of intelligence in an archipelago of low-tech development. A constellation of so-called ‘world class’ institutions—John Hopkins University, MIT, University of Chicago, INSEAD and Duke University—help transform Singapore into a ‘global schoolhouse.’ The central institution in this knowledge network is a science complex called Biopolis.

Alongside this, cultural development would be necessary to entice foreign researchers and scientists, with improved museums, galleries and nightlife and the ‘Little Bohemias’ such as Holland Village and Portsdown Road playing a vital role in drawing in these talents and facilitating creative interaction.

To date, however, relatively little has been written on international scientist’s perceptions and experiences of Singapore. It is interesting, therefore that international researchers we interviewed felt that the engineered aesthetics were important for branding Singapore as a cosmopolitan space for

science but less relevant to the everyday practice of scientific work. Remarking on the idea of Biopolis' bridges for fostering multi-disciplinarity (Figure 5).

Rather than functional relevance, researchers felt that many of the monumental science buildings and facilities added towards branding the nation as a vibrant cosmopolitan place for research. Indeed, many of the foreign scientists we spoke to, especially from India and China, were drawn to Singapore's international image as a culturally diverse and cutting-edge place for research that promised opportunities to develop professional networks with leading scholars in their field. One respondent argued here:

Singapore, because of its brand value, always... attracts people from outside. Singapore... attracts people's imagination. [12/2/17]

Our respondents expressed different cultural perspectives on the type of green spaces. While the lush greenery was highly appealing, one respondent expressed a different cultural aesthetic for unplanned spaces.

Singapore is green... it is done well... but [sometimes it feels like] not really natural green spaces... in some respects is too planned ... it will be "optimized". It is good in the middle of a built environment where there is nothing going on, like just [unplanned] grass with a few trees. [4/5/2017]

Commentators appreciated the design of the newer research facilities that had more space and windows. Buildings in the newer developments were perceived to be more like research institutes in Europe and the United States where the spaces were, "Not just more pleasing but also there is more space to work, where you can look outside; there is more space to think". [4/5/2017]



Figure 5. Biopolis bridges. Source: Author photo.

3.2. Perceptions of the Laboratory Life

Drawing scientists from around the world, the experience of Singapore's research landscape was multifaceted. The most important factor, noted by interviewees, was the principal investigator. Western and western-trained Singaporean principal investigators were often seen as more open to debate and collegiality. However, lead-scientists from some other Asian countries sometimes imported from their home countries a more rigid hierarchical culture in the lab. For an international workforce, this meant having to navigate a varied cultural landscape. The following quotes give some flavour of the context in this regard:

The laboratory atmosphere usually depends on the nature of Principal Investigator. One needs to make adjustment wherever he/she works. PIs in Asia may have more authority than in Europe or USA—at least it is perceived that way... This nature also reflects on the status of the PI. An early career PI is more stressed to attract funds as well as get tenured, therefore, more demanding to get his publications so that his position is safe. Whereas an established PI is more relaxed than the early career PI." [3/31/2016]

*Some of the PIs [from other Asian countries] might be pretty traditional in a way. [5/4/2017]
Even though most researchers who come to Singapore have worked in established laboratories before, we had to adjust to a different way of working method in Singapore. [3/21/2016]*

Nearly all the respondents noted work performance pressures on publication outputs and key performance indicators (KPI). Some respondents felt that this pressure made cultivating cross-disciplinary research more difficult because the outcomes of cross-disciplinary collaboration may be uncertain and long-term. One respondent remarked:

KPIs disincentivize people from doing cross disciplinary collaborative research because it is just horribly time consuming, it's the worst, so who would do that unless it is strongly incentivised? It's the career killer, right? It's just that. Unless there are incentives. [4/5/2017]

3.3. International Scientific Identities

With regard to international scientific identities, experience reflects the variety of the scientific sectors, from large-scale corporate R&D activity leveraging on Singapore's primary/gateway position within the Asian context, to basic research sponsored by the Singaporean state/Universities and smaller scale commercial spin-out and tech companies. Individual identities are constructed in distinctive ways in these different environments.

Both inside and outside the workplace, all the interviewees were highly enthusiastic about Singapore's cosmopolitan environment. This was a key attraction for many researchers to come to Singapore. Especially for researchers from other Asian countries, Singapore was an opportunity where they could meet, work and often socialize with other people from around the world. As intellectual sojourners, many felt free to explore different cultures in a way they were not able to at home. Research teams were usually a mix of local Singaporean and foreign researchers who often socialized outside the lab. This was a highlight of the experience of many of the foreign researchers.

There is one big difference compared to working in another Asian country. You always find, like in my office, there are colleagues from 4 different countries; 1 from the Philippines, 2 from Indonesia, 3 from China and 1 is Singaporean. When I interact with them, I always learn something new, something different. In terms of living style, yes, have changed. [4/12/2017]

The role of personal and professional networks is also perceived as a particularly distinctive aspect of the Singaporean science 'scape within Asia. Indeed, for nearly all our respondents, transitioning to living and working in Singapore was facilitated by a number of personal and professional networks in a cosmopolitan arena, easing the path to new social groups and friendships and mixing across different nationalities and cultures. As one respondent remarked:

When I came to Singapore I found so many friends. [A colleague] was from the same college. After a few weeks I was comfortable in Singapore. Many people came to Singapore, after I came to Singapore. ... There are so many social network groups. [4/12/2017]

Beyond this development of networks, however, there is a clear sense of the intellectual sojourner in the Singaporean context. When asked if they wished to settle in Singapore, for instance, some of our interviewees planned on moving either to the US or back to their home country. Reasons here varied from a desire to follow the “cutting-edge” in their field to more personal family reasons. As one interviewee honestly responded, “*I want to move back to India. I miss my family, I miss my friends. After few years, I will move back*”. [2/12/2017]

Interviewees from both Western and Asian countries alike felt that their time in Singapore and the cosmopolitan mix in the workforce had opened their eyes to new experiences and styles of working. Even though some planned to move back to their home country or yet another destination, most felt that this exposure would be an asset to their future careers. Yet alongside this there was a sense of the ‘scientific sojourner’, an awareness of difference and of the broad limits of cosmopolitanism.

Interestingly, one native Singaporean who had moved to Silicon Valley expressed an ambivalence towards being an intellectual sojourner—as both a longing for home and an opportunity for self-reinvention through emigration abroad.

“I love Singapore and still think of Singapore as my home... I think, we rely too much on credentials to prove you are capable of doing a job. Whereas here (Silicon Valley), it is much more like, ‘OK we are going to look at your resume but once you are good enough, maybe what you are given is some challenge or mini project as part of the recruitment process, which is way more important than your credentials.” [11/2/2017]

4. Launching Innovation and Entrepreneurship

Latterly, within the past five years, Singapore has focused on creating an entrepreneurial ecosystem to foster start-up tech companies [26]. The Prime Minister of Singapore outlined four strategies to foster start-ups: First, creating a suitable ecosystem for firms; secondly, providing adequate opportunities to start-ups in relation to funding; third, inviting foreign talents and ideas; and fourth, developing adequate infrastructure and environment for promoting STEM (science, technology, engineering and mathematics) in the society [27]. The government has acknowledged that (foreign) talent is critical for Singapore to be competitive in the global economic landscape [27] and has recently announced a fund of \$200 million to be kept specifically for enhancing start-up environment and promote innovations [28].

JTC, a physical infrastructure developer involved in the making of One North–Fusionopolis and the famous Block 71-recently developed three more building blocks, known as The Launchpad, in the One North region to cater to the increasing start-up firms, with a design focus on more collaborative work environment. This ‘cluster-based approach for ecosystem development’ [29] (p. 87) co-locates start-ups, investors and supporting incubators and accelerators and from its launch in 2011 it grew dramatically, with *The Economist* reporting in 2013 that the Launchpad was the highest-density hub of tech start-ups in the world [29].

As of November 2015, it was estimated that the Launchpad was home to 21 VC firms, 19 accelerators and incubators, 13 facilitators such as industry associations and government agencies and 220 resident start-ups, with dozens more in co-working spaces or incubation facilities. The situation is also dynamic as there is high frequency of new start-ups entering the Launchpad and incumbent start-ups leaving as they grow and require more space.

According to Lyon Poh at KPMG Asia, The Launchpad is seen as the Silicon Valley of Asia for start-ups. Despite this, however, as Menkhoff and Evers [26] (p. 15) note, cultural and institutional challenges remain part of the cultural fabric in Singapore:

Singapore is shifting gears towards a less hierarchical (and more entrepreneurial) societal system. The situation in the start-up companies was seemingly much more level. As one employee

noted, *“Everyone is boss here”* [4/12/2017]. The intensity of work created a more level work environment for mutual learning. Despite the fast-paced environment, respondents felt, *“Singapore has a better work life balance compared to [some other Asian countries]... Singapore has a good salary, good work style and good work life balance”*. [4/7/2017]

Beyond the architectural and cultural styling, Singapore’s emergent start-up culture links the country to transnational networks of expertise. Interviews with the CEO and employees at three start-up tech companies spun-off from Singaporean universities revealed, for example, a nascent start-up environment which has rapidly developed into a springboard for local entrepreneurs to then move to larger markets in the United States. Both companies followed a general trend of moving their headquarters, product development and management to the US, while basing their engineering and technology divisions in Singapore. In one company, a third branch in India oversaw quality control and was established largely because of problems obtaining visas to the United States. This distribution of labour was primarily driven by two factors: (i) proximity to customers and investment and (ii) peer networks for recruitment and retention of technical talent. In particular, proximity to customers was the primary reason for relocating companies to the US. The interviewees felt that Singapore’s data sciences were rapidly developing. However, local demand for specialized data science products that required in-depth research was simply not high enough to make profit and the market remained relatively small-scale:

The Singapore market is really small. They don’t need some of the more advanced products.

American companies are ... willing to try new products... [4/19/2017]

Most data science jobs in Singapore need someone who can play around with datasets and tools and find insights to boost sales, retain customers... they do not need customised solutions... Data science jobs in the US require an actual scientist to build customised solutions which do not yet exist as off the shelf products anywhere. [4/7/2017]

Yet, these respondents noted that the situation was changing rapidly with the recent influx of companies such as Google and Microsoft. Start-up heads also contrasted the investment climate in Silicon Valley to Singapore. In Silicon Valley, angel investment came from organizations with experienced, serial entrepreneurs, who also mentored and opened doors for first-timers. In Singapore, investment was seen as mostly coming from government offices with less first-hand experience, so that *“... expectations may not be aligned”*. [4/19/2017]

Two technopreneurs also felt there was an aversion to risk by some investors in Singapore, where performance results were imperative.

“The difficult thing is that the whole endeavour of entrepreneurship is risk seeking but... they want something that is tried and proven. You cannot use that model for a knowledge economy.” [11/2/2017]

“People are only interested in funding companies that are copying something else... if it is something totally new, then it is very unlikely. It is a tried business model. If you try to do anything really innovative it is very difficult to raise money.”

On the other hand, the highly competitive environment in Silicon Valley makes it extremely difficult to attract quality tech talent there, leaving scope for support from Singapore where high quality talent was more readily available to peer networks. One CEO noted:

“[We depend on] our hiring network, we hire all our engineers from Singapore. Hiring through our peer network turned out to be an incredible boon for us”. [4/19/2017]

Because of this companies spun-off from Singaporean universities and now located in the US have maintained close ties to Singapore and focus their engineering and analysis in Science Park. When seen from the broader international perspective, Singaporean companies in Science Park have become fully integrated with local universities through their entrepreneurial headquarters in the US.

5. Conclusions

In this paper, we have examined how science spaces in Singapore have been imagined and experienced as science 'scape and ethnoscape. Following a broad outline of the development concepts and form, we have sought to characterise international perceptions/representations and emergent international scientific identities and as two key inter-related dimensions of the ethnoscape. Thus, Singapore's science 'scape is primarily identified with the explicit state project to locate the city-state within the wider global knowledge economy and the physical and developmental forms that have resulted. International identities tend to reflect the cosmopolitan context of Singapore globally and in Asia, albeit alongside some sense of the scientific sojourner.

The conceptual standpoint adopted here highlights the multiple dimensions in which science spaces are imagined and the interactions between them. It also emphasises the importance of transnational flows—of architectural styles and technological forms, of political symbols and messaging and of international labour and knowledge—in constituting such spaces. And crucially here, the approach sensitises analysis to differentiated perspectives on these forms and flows and in particular the distinctive experiences and identities of migrant scientists, thereby elaborating new insights into the cultural experience of scientific work in this context and sharpening a sense of the 'international-ness' of Singapore as science 'scape.

Clearly there are challenges in deploying the conceptual apparatus around Appadurai's notion of 'scapes, particularly given the multiple and fluid interactions at play. Associated research requires careful design in theoretical and empirical terms to distil key themes and important inter-relationships, as well as a good degree of cultural sensitivity in teasing out distinctive identities and perceptions. And even in the best-case scenario concrete research faces the inevitable limitations of resources and access, such that empirical material will be necessarily selective and insights as a whole will remain somewhat impressionistic. However, there is little doubt that further work on comparative scientific ethnoscares would be valuable in illuminating potentially radical differences in the experience of scientific enterprise in different global regions.

Acknowledgments: Research was partially funded through a Leverhulme Trust grant for the project Global Science 'Scapes: Dimensions of Transnationalism.

Author Contributions: Philip Cho and David Charles Valler jointly researched and wrote this paper. Philip Cho conducted the interviews.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Appadurai, A. *Modernity AL Large: Cultural Dimensions of Globalization Minnesota*; University of Minnesota Press: Minnesota, MN, USA, 1996; Volume 1.
2. Forsyth, A.; Crewe, K. Suburban Technopoles as Places: The International Campus-Garden-Suburb Style. *Urban Des. Int.* **2010**, *15*, 165–182.
3. O'Mara, M.P. *Cities of Knowledge: Cold War Science and the Search for the Next Silicon Valley*; Princeton University Press: Princeton, NJ, USA, 2005.
4. Clawson, M.; Hall, P. *Planning and Urban Growth: An Anglo-American Comparison*; The Johns Hopkins University Press: Baltimore, MD, USA, 1973.
5. Wakeham, R. (2003) Dreaming the new Atlantis: science and the planning of Technopolis, 1955–1985. *Osiris* **2003**, *18*, 255–270.
6. Hvistendahl, M. The Chinese Are Rolling Out Science as a Tool for Foreign Policy. Available online: http://seedmagazine.com/content/article/global_science_park/ (accessed on 20 November 2017).
7. Royal Society. *Knowledge, Networks and Nations: Global Scientific Collaboration in the 21st Century*; RS Policy Document 03/11; Royal Society: London, UK, 2011.
8. Bunnell, T. Cities for nations? Examining the city—Nation-state relation in Information Age Malaysia. *Int. J. Urban Reg. Res.* **2002**, *26*, 284–298.
9. Saxenian, A.L. *The New Argonauts: Regional Advantage in a Global Economy*; Harvard University Press: Cambridge, MA, USA, 2006.

10. Filatotchev, I.; Liu, X.; Lu, J.; Wright, M. Knowledge spillovers through human mobility across national borders: Evidence from Zhongguancun Science Park in China. *Res. Policy* **2011**, *40*, 453–462.
11. Saxenian, A.; Hsu, J.Y. The Silicon Valley–Hsinchu connection: Technical communities and industrial upgrading. *Ind. Corp. Chang.* **2001**, *10*, 893–920.
12. Wong, K.W.; Bunnell, T. ‘New economy’ discourse and spaces in Singapore: A case study of one-north. *Environ. Plan. A* **2006**, *38*, 69–83.
13. Salazar, N.B. *Theory in Social and Cultural Anthropology: An Encyclopedia*; McGee, R.J., Warms, R.L., Eds.; Sage Publications: Thousand Oaks, VA, USA, 2013.
14. Urban Redevelopment Authority (Singapore), Living the Next Lap, 1991. https://www.ura.gov.sg/uol/publications/research-resources/plans-reports/Concept%20Plan%201991/living_the_next_lap_1991 (accessed on 24 August 2014).
15. National Transportation Safety Board (NTSB). *Science and Technology: Window of Opportunities—National Technology Plan*; SNP Publishers: Singapore, 1991.
16. Vidovich, L.; Yap, M.S. The ‘Global Schoolhouse’: A cautious confluence of privatization and internationalisation policies in Singaporean education. In Proceedings of the Australian Association for Research in Education Conference, Fremantle, Australian, 25–29 November 2007.
17. Sidhu, R.; Ho, K.C.; Yeoh, B. Emerging education hubs: The case of Singapore. *High. Educ.* **2010**, *61*, 23–40.
18. A*STAR Yearbooks 2001–2002. Available online: https://www.a-star.edu.sg/portals/0/media/yearbooks/yearbook_2001-2.pdf (accessed on 24 August 2014).
19. Yeo, P. (And they call it) guppy love. *Nature* **2007**, doi:10.1038/nj7138-948a.
20. A*STAR Yearbooks 2006/07. Available online: https://www.a-star.edu.sg/Portals/0/media/yearbooks/Yearbook_2006-7.pdf (accessed on 24 August 2014).
21. Yeo, P. “Just Do it.” Centre for Livable Cities (Singapore). CLC Lecture Series. Available online: <https://www.clc.gov.sg/documents/lectures/2011/philip%20yeo%20lecture%20report.pdf> (accessed 20 November 2017).
22. Kisho Kurokawa Architect&Associates. Fusionopolis One-North Development Singapore. Available online: <http://www.kisho.co.jp/page/253.html> (accessed on 20 November 2017).
23. Zaha Hadid Architects. One North Master Plan. Available online: <http://www.zaha-hadid.com/masterplans/one-north-masterplan/> (accessed on 20 November 2017).
24. Tagore, Rabindranath (1975 [1910]). Bharat Tirtha, Geetanjali, Sanchayita. Translated by M.R. Chatterjee. Calcutta. Available online: homepages.undayton.edu/~mchatterjee1/sadhaka.html (accessed on 1 March 2011).
25. Waldby, C. Singapore Biopolis: Bare life in the city-state. *East Asian Sci. Technol. Soc.* **2009**, *3*, 367–383.
26. Menkhoff, T.; Evers, H.-D. Singapore: From Knowledge City to Start-Up ‘Hub’. Available online: http://ink.library.smu.edu.sg/cgi/viewcontent.cgi?article=5888&context=lkcsb_research (accessed on 27 September 2017).
27. Sim, R. Singapore can do much more when it comes to adopting new technology: PM Lee. *The Straits Times*, 26 February 2017.
28. Chan, S. 200m to help fund local start-ups. *The Straits Times*, 23 March 2017.
29. Cheah, S.; Ho, Y.P.; Lim, P. Role of Public Science in Fostering the Innovation and Startup Ecosystem in Singapore. Available online: https://www.researchgate.net/profile/Sarah_Cheah/publication/310806678_Role_of_Public_Science_in_Fostering_the_Innovation_and_Startup_Ecosystem_in_Singapore/links/5838659408aed5c614885817/Role-of-Public-Science-in-Fostering-the-Innovation-and-Startup-Ecosystem-in-Singapore.pdf (accessed on 27 September 2017).

