The London School of Economics and Political Science

China, India in Space and the Orbit of International Society:

Power, Status, and Order on the High Frontier

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Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

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I declare that my thesis consists of 99787 words.

To the memory of my friend Giannis Magalios (1983-2004)

Abstract

This thesis is about the space programmes of China and India, and space as international society. Drawing on key concepts of the English School theory, the argument of the thesis is twofold. First, employing international society as the central analytical idea, it suggests that it is possible to conceptualise space not merely as a system, but as an international space society with a distinct international social structure. This argument is developed by highlighting how the nature of space as a distinctive *sectoral* interstate society is manifested in the ways in which its primary institutions are differentiated from such institutions at the global level (war, sovereignty, law, diplomacy, balance of power, great power management, the market) in a historical and comparative context. This helps to highlight the constitutive impact of these institutions on China and India as emerging space powers. It also puts forward 'techno-nationalism' as a primary institution of international space society. Second, the thesis argues that the pursuit of China and India's space programmes has been informed by a particular understanding of techno-nationalism in a postcolonial context, what I call 'postcolonial techno-nationalism', which is centred on the development of space technology as a normative indicator of the state's power, status, and modernity. The enduring influence of postcolonial techno-nationalism reflects how technological advancement was seen to function as a sort of an informal 'standard of civilisation' during the expansion of the European society of states in the nineteenth century. Essentially, this thesis provides a useful range of innovative analytical tools to consider the relationship between technology and International Relations and how order is constructed, maintained, and contested in space. It also offers a new lens though which to consider the complex dynamics that shape China and India as rising space powers.

Table of Contents

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List of Abbreviations

AEC	Atomic Energy Commission
APSCO	Asia-Pacific Space Cooperation Organisation
ASAT	Anti-Satellite Test
ASLV	Augmented Satellite Launch Vehicle
CAS	Chinese Academy of Sciences
CAST	Chinese Academy of Space Technology
CD	Conference on Disarmament
CGWIC	China Great Wall Industry Company
CLEP	China's Lunar Exploration Programme
CNSA	China National Space Administration
COPUOS	Committee on the Peaceful Uses of Outer Space
COSPAR	Committee on Space Research
COSTIND	Commission of Science, Technology, and Industry for National Defence
CSSTEAP	Centre for Space and Science Technology Education in Asia and Pacific
DAE	Department of Atomic Energy
DoS	Department of Space
DRDO	Defence Research and Development Organisation
ESA	European Space Agency
GPS	Global Positioning System
GSLV	Geosynchronous Satellite Launch Vehicle
IADC	Inter-Agency Space Debris Coordination Committee
IAF	International Astronautical Federation
IGY	International Geophysical Year
INCOPSAR	Indian National Committee for Space Research
INSAT	Indian National Satellite System
IRNSS	Indian Regional Navigation Satellite System
IRS	Indian Remote Sensing Programme
ISRO	Indian Space Research Organisation
ISS	International Space Station
ITU	International Telecommunication Union
MOM	Mars Orbiter Mission
NASA	National Aeronautics and Space Administration

NDSTC	National Defence Science and Technology Commission
PAROS	Prevention of an Arms Race in Outer Space
PLA	People's Liberation Army
PRL	Physical Research Laboratory
PSLV	Polar Satellite Launch Vehicle
SITE	Satellite Instructional Television Experiment
SLV	Satellite Launch Vehicle
SSTC	State Science and Technology Commission
STEP	Satellite Telecommunication Experimental Project
TCBMs	Transparency and Confidence-Building Measures
TERLS	Thumba Equatorial Rocket Launching Station
TIFR	Tata Institute of Fundamental Research
UNOOSA	United Nations Office for Outer Space Affairs

Introduction

A number of interrelated emerging challenges have generated a renewed interest in the international politics of space and space security. These include, but are not limited to, the following: the increasing militarisation and even weaponisation of space, especially in light of the George W Bush administration's plans for the deployment of space-based missile defence systems and China's anti-satellite (ASAT) test in 2007; the US-China rivalry in space; the institutional deadlock on space arms control; the spread of space debris; the Asian space race, particularly between China and India; the issues of frequency interference, space traffic management, and space situational awareness (SSA), as space becomes increasingly crowded; the regulation of the limited spectrum of radio frequencies and orbital slots; and the long-term sustainability of space activities.[1] Therefore, there are concerns that space is transforming into a more 'congested, contested, and competitive' domain.[2] It is in this reconfigured context that the behaviour of China and India as the two key rising space powers is an important determinant of international space order and the focus of this thesis.[3]

As a consequence, building on International Relations (IR) theories, there has been a growing body of literature that seeks to highlight certain aspects of the international politics of space.[4] More specifically, realist accounts have called attention to the competitive aspects of space security, including balancing behaviour and power transition dynamics.[5] Seen against this backdrop, some observers have suggested the inevitability of a space arms race and even the possibility of a conflict in space

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1 For an overview of these issues, see the contributions in Kai-Uwe Schrogl et al. (2015).

2 The description of space as 'congested, contested, and competitive' was recently introduced by US Department of Defense officials. For an analysis of this description and its implications for US space policy, see Gallagher (2013).

3 In addition to their growing profile in space, there are other good reasons for grouping China and India together, including their remarkable economic growth, their growing influence in international society, their potential to become globally important powers, geographical size and vast population, their shared colonial experience and its legacy, shared aspirations for great power status, and civilisational identity. As Gaskarth (2015: 3) notes, these common characteristics clearly differentiate them from other emerging states.

4 Recent works on International Relations theory and space include: Sheehan (2007); Moltz (2008); Bormann and Sheehan (2009); Al-Rodhan (2012); Harding (2013); Mutschler (2013); and Wang (2013).

5 Part of this debate has also been the concept of space power. One of the most influential works in this regard is Dolman (2002). Drawing on realism and classical geopolitics, Dolman argues for a US strategy that ensures space dominance through military means. On space power, see also Gray and Sheldon (1999); Oberg (1999); Lambakis (2001); and Lutes and Hays (2011).

between the United States and China (Tellis, 2007; Seedhouse, 2010). Liberal perspectives have highlighted the importance of the cooperative and ameliorative features of space security with a particular focus on regimes and space arms control.[6] Recent constructivist studies have considered the constitutive role of identities, norms, and culture in the social construction of the politics of space security through processes of interaction and socialisation.[7] More recently, work has also been done from the perspective of securitisation, critical security studies, and critical geopolitics.[8] Likewise, the cases of China and India have also attracted much attention, especially in the context of discussing the Asian space race. In this regard, there is now a burgeoning literature that assesses the complex array of military, political, and economic factors, which has shaped the development of China and India's space programmes (Lele, 2010; Sheehan, 2010; Siddiqi, 2010c; Moltz, 2012; Lele, 2013).

While these studies are a welcome contribution to our understanding of space security and politics in general and of the space programmes of China and India in particular, however, this thesis proposes an alternative way of thinking about the international politics of space by relating space with the analytical idea of international society. The aim of the thesis is to explore one central question: *What insights, if any, can the English School theory offer to the study of the international politics of space generally and to the cases of China and India as rising space-faring states in particular?*

In addressing this question, the argument of this thesis is twofold. First, drawing on key English School concepts, it suggests that it is possible to conceptualise space not merely as a system, but as an international space society with a distinct international social structure. This argument is developed by highlighting how the structure of space as a distinctive *sectoral* interstate society is manifested in the ways in which its primary institutions are differentiated from such institutions at the global level (war, law, sovereignty, diplomacy, balance of power, great power management and so on) in a historical and comparative perspective. It also puts forward 'techno-nationalism' as a distinctive institution of international space society. In doing so, a sectoral

[6] For a recent regime theory analysis regarding space, see Aliberti and Krasner (2016).
[7] Works that build on constructivism include: Peterson (2005); Moltz (2008); Cunningham (2009); and Wang (2013).
[8] On the growing securitisation of space, see Peoples (2011). Also, see Sheehan (2015). Examples of critical geopolitics approaches are: Macdonald (2008); Sage (2008); Havercroft and Duvall (2009); and Zhang (2013).

framework helps to illustrate the constitutive impact of these institutions on China and India as constructs within international space order.

Second, the thesis argues that China and India's space programmes have been informed by a particular understanding of techno-nationalism in a postcolonial context, what I call 'postcolonial techno-nationalism', which is centred on the development of space technology as a normative indicator of the state's power, status, and modernity. The enduring influence of postcolonial techno-nationalism reflects how scientific and technological attainments were seen to function as a sort of an informal 'standard of civilisation' during the expansion of the European society of states in the nineteenth century. The concept of techno-nationalism links the two main arguments of the thesis by elucidating how historically rooted conceptions about the role of technology still influence contemporary ideas and practices in international space society. This adds historical depth to the study of the international politics of space that is generally lacking in the relevant literature.

Applying this framework, the thesis will also address a set of important and difficult questions in the subsequent chapters: How can we relate international society to technology? How did China's space programme emerge and succeed during the Cold War, given its limited financial and technological resources amid sustained political and social turmoil? How did India succeed in the pursuit of its space programme as a developing country? Are China and India great powers in space and how can we set a benchmark against which to assess that? The thesis addresses this set of questions with one principal audience in mind: scholars interested in the study of the international politics of space and space security.

In this regard, this thesis offers the innovative analytical concept of international space society that is attentive to the importance of history (including global space history) and change by illustrating the complex social constitution of international space order through the lens of primary institutions. Therefore, it provides a wide range of alternative analytical tools that can enrich the study of the international politics of space as well as our understanding of the behaviour of China and India as rising space-faring actors in terms of their interaction with international space society. This is an important consideration, not the least because most analyses on the international politics of space are largely descriptive and 'undertheorised'.

Although the main focus of this thesis is empirical rather than theoretical, it also speaks to the audience of English School scholars. It offers the straightforward concept of sectoral international societies by bringing technology and English School theory together. A sectoral approach adds a third crucial dimension to the study of international society at the global and regional levels by identifying how primary institutions are differentiated at the sectoral level. In a sense then, sectoral international societies cut across the global and regional levels. Despite the fact that my focus here is on the international space society, employing a sectoral analysis illuminates how certain technologies establish new domains of social interaction that are characterised by distinct international social structures, like the nuclear society of states and the cyber society of states.[9] But while my analysis builds on the non-materialist theoretical perspective of the English School, this conceptual move also calls attention to technology as a material-context factor that shapes and is shaped by international social structures.[10] Moreover, a sectoral approach offers new ways for relating English School theory with global governance and International Security Studies.

The thesis also speaks to those interested in the theoretical and empirical study of China and India's high technology projects. It does so by providing a more refined understanding of the concept of techno-nationalism that is more attentive to the colonial and postcolonial contexts of technological hierarchies in international society. This conceptual rethinking of techno-nationalism casts a revealing light on the ways in which history continues to influence contemporary conceptions about the role of science and technology as a principal marker of the state's power, status, and modernity in international society. This is in line with the argument that the 'global transformation' of the nineteenth century still influences key understandings of the relationship between state, modernity and technology in the context of international relations (Buzan and Lawson, 2015).

In light of the above, essentially, the analytical framework of the thesis provides a useful range of innovative analytical tools to consider the relationship between technology and International Relations and how order is constructed, maintained, and contested in space. It also offers a new lens through which to consider the complex dynamics that shape the space programmes of China and India. I will return to the contributions of the analytical framework of this thesis in the final conclusion. The

[9] Ayson (2012: 62) has introduced the expression 'international nuclear society' based on Bull's work on nuclear weapons and arms control.
[10] The material context of technology is one of the main themes in Deudney (2007).

rest of this introductory chapter will briefly outline some of the key English School concepts employed in the thesis, before identifying some of the most important problematic aspects of the literature that deals with the role of technology in International Relations. This is followed by a brief discussion of the concept of techno-nationalism. The final section will provide a brief overview of the subsequent chapters.

Key English School Concepts

There is no intention here of rehearsing debates about the place of the English School within International Relations as a discipline, but a few points are worth making about some key concepts employed in this thesis as they help to highlight what the English School can offer to the study of space politics and security.[11] The English School is usually associated with a distinctive perspective to the study of international relations by interlinking three concepts: international system, international society, and world society. In this sense, it is seen to occupy the middle ground between the mainstream theories of neorealism and neoliberalism and the more radical approaches such as critical theories and poststructuralism (Dunne, 2013: 133). Linklater (2005: 85-6) captures this location nicely when he notes that what the first-wave of English School scholars shared in common was the idea that there was 'more to international relations than the realist suggests but less than the cosmopolitan desires'. The starting point for this position is an account of international relations that privileges the idea of international society as the key English School concept (Dunne, 2013: 138). Bull and Watson (1984: 1) define international society as 'a group of states (or more generally, a group of independent political communities) which form a system, in the sense that the behaviour of each is a necessary factor in the calculations of the others, but also have established by dialogue and consent common rules and institutions for the conduct of their relations, and recognize their common interest in maintaining these arrangements'. In contrast, an international system 'is formed when two or more states have sufficient contact between them, and have sufficient impact on one

[11] On the English School, see, inter alia, Buzan (2004); Clark (2005); Bellamy (2005); Linklater and Suganami (2006); Hurrell (2007); Clark (2007); Navari (2009); Buzan (2014a); and Navari and Green (2014).

another's decisions, to cause them to behave – at least in some measure – as parts of a whole' (Bull, 2002: 9).

But although much attention has been paid to the concept of international society as the key contribution of the English School to IR theory, less attention has been paid to world society and how it relates to international society. Until recently, as Buzan (2004: 44) notes, the state of the concept of world society was underdeveloped. While in recent years there has been a burgeoning literature on the concept of world society, there is less agreement about its meaning both in normative and analytical terms. The understanding of world society is traditionally linked with moral cosmopolitanism, which is reflective of the normative commitment of promoting a universal community of humanity. Thus, whereas international society is based upon an order-focused society of states, the reference point of world society is individual human beings and the delivery of justice (Williams, 2014: 130-1).

In his influential *From International to World Society,* Buzan (2004: 120) has offered a major structural revision of the concepts of international society and world society by introducing a new trilogy of ideal types of societies each based on a different unit of interaction and a different social structure: a) an 'interstate society' that is constituted by states and, thus, describes the attributes of what usually refers to as an 'international society' in the English School literature b) a 'transnational society' that refers to non-state collective actors and c) an 'interhuman' society' that refers to individual human beings. In this revision, the concept of world society is redefined to describe the interplay between interstate, transnational, and interhunan types, whereby there is balance between the three domains and no one of the three is standing out as the dominant domain (Buzan, 2004: 202-3, 269). Building on Buzan's structural revision, others suggest that the world society concept retains its analytical purchase as a distinct level of analysis that focuses exclusively on non-state actors (Pella, 2015: 3; Pella, 2013). Equally, Clark (2007: 6) maintains that world society refers to the 'realm of the individual, of the non-official group or movement, and the transnational network of nongovernmental agents'.

Nevertheless, while some observers suggest that the concept of international society represents the distinctive character of the School's approach to international relations, others postulate that it should be seen as one of the three domains (and concepts) that constitute the world political system: the system, the inter-state society, and world society.[12] This thinking reflects the 'three traditions' of international thought espoused by Martin Wight (1991), identified as Machiavellian (realism), Grotian (rationalism) and Kantian (revolutionalism). This understanding is in line with a key methodological orientation of the English School that favours the development of taxonomies as ideal-types rather than positivist approaches (Keene, 2009). However, in the context of discussing these three key concepts, there is also less consensus about the extent to which the system/society distinction is analytically useful (Reus-Smit, 2013: 17-9).

A further line of argument related to these themes is the introduction of another pair of concepts: pluralism and solidarism.[13] Pluralists and solidarists disagree about the normative importance of norms, rules, and institutions that constitute the structure of contemporary international society. On the one hand, pluralists stress the importance of sustaining political tolerance and cultural diversity in international society as a precondition for the maintenance of inter-state order.[14] On the other hand, solidarists usually emphasise the need to transcend the state-systems or to move beyond the logic of coexistence to higher aims that accommodate concerns of justice in international society as a way to secure order. Solidarist thinking revolves around issues of justice, such as human rights and humanitarian intervention, which are mainly embodied in liberal cosmopolitan principles (Buzan, 2014a: 15-6).[15] However, it is not necessary to treat pluralism and solidarism as mutually exclusive positions, but rather as a conversation that is reflective of the normative tensions embodied on the importance of order and justice in international society as well as how to find the proper balance between the two (Buzan, 2014a: 16; Hurrell, 2007: 9; Weinert, 2011).

Another useful English School concept employed here for the purposes of this thesis is the 'institutions' of international society. Within the idea of international society, institutions are not international governmental organisations, but sets of 'habits and practices shaped towards the realisation of common goals' (Bull, 2002: 71). In his *Anarchical Society* Bull identifies the balance of power, the managerial role of great powers, diplomacy, international law, and war as the key institutions of international society that help to maintain order. Buzan (2004) has introduced the terminology of primary institutions and secondary institutions to highlight the constitutive and

[12] On this discussion, see, for example, Dunne (2013).
[13] For an overview of the pluralist/solidarist debate, see Buzan (2014a: 16, 83-167).
[14] Prominent examples of pluralist works are: Jackson (2000); and Mayall (2000).
[15] A key reference point on solidarism is Wheeler (2000).

fundamental nature of the former as a way to overcome the confusion related to the usage of institutions in mainstream International Relations approaches. Although there is less agreement among English School scholars about what should be counted as an institution,[16] there is more agreement that these are typically 'durable and recognized patterns of shared practices rooted in values held commonly by the members of interstate societies, and embodying a mix of norms, rules, and principles' (Buzan, 2004: 181). Thus, primary institutions are constitutive of the identity of the states and international society in the sense that they shape certain conceptions of rightful membership of international society and what is perceived as legitimate patterns of conduct among its members (Buzan, 2014a: 17). It is this recognition among states of being bound to core principles of legitimacy that defines the existence of an international society (Clark, 2005: 24). The usage of the term secondary institutions refers to how institutions are typically understood in regime theory and by liberal institutionalists. These are largely intergovernmental arrangements designed to attain specific functional goals, such as the United Nations and the space regime, and they are reflective of the primary institutions of a given international society (Buzan, 2004: 161-7; Schouenborg, 2014: 77, 80).

Part of this debate is also thinking about regional international society. In recent years, there has been a renowned interest in the formation of subglobal international societies, which has been largely generated by debates about the process of regionalism and regional cooperation.[17] Not surprisingly, perhaps, much attention has been paid to the study of the European Union, and of Europe as a whole, as a distinct subglobal international society.[18] However, other regions, including Southeast Asia (Quayle, 2013), East Asia (Buzan and Zhang, 2014), and Central Asia (Pourchot and Stivachtis, 2014) have attracted scholarly attention.

This raises the issue of how to identify the existence of regional international societies. One way is to analyse how regional primary institutions differ from the global pattern. It is in this context of differentiation that Buzan and Gonzalez-Pelaez (2009) have explored the extent to which the Middle East can be seen to constitute a regional international society with distinctive primary institutions that present different interpretations from the global level. Likewise, Schouenborg (2013) has

[16] On this point, see Wilson (2012).
[17] On the place regionalism in international society, see Hurrell (2007: 239-61).
[18] See, among others, Diez and Whitman (2002); Stivachtis (2008); and Stivachtis and Webber (2011).

argued that there is a Scandinavian international society with distinctive regional institutional developments. Another way is to consider the emergence of secondary institutions that foster international cooperation at the regional level. A focus on secondary institutions, therefore, serves to highlight the degree of regional integration and cohesion and, more generally, the intensity of intra-state relations (Pourchot and Stivachtis, 2014). Differentiation is analytically useful as its helps to illustrate the ways in which an international space society has emerged with distinctive institutions, as I explain in Chapter 2. A detailed analysis of the 'standard of civilisation' as an English School concept will be taken in Chapter 3.

Thinking about Technology in International Relations

Despite the fact that technology, broadly defined, seems to determine virtually every facet of global politics, there has been little effort to theorise about its role in International Relations.[19] Indeed, as Peoples (2009a: 559) observes, there is a tendency in International Relations Theory to 'treat technology and technological change as a taken-for-granted 'variable''. Thus, it is worth briefly highlighting a few problematic aspects of the literature. First, as Herrera (2006: 15-30) persuasively demonstrates, all of the mainstream theories of International Relations regard technology as exogenous to the structure of the international system. Put simply, although technology is assumed to be 'somewhere out there', when it enters the system it has the effect of generating specific outcomes, whether it is the change of the distribution of military capabilities in neorealism (Waltz, 1979), the increasing levels of interdependence in neoliberalism (Keohane, 1984) or the construction of identities in social constructivism (Wendt, 1999). This is because these theories focus only on the material attributes of technology and, thus, fail to incorporate technology inside the spheres of the social and the political. However, conceptualising the role of technology as important, but not political, is suggestive of a deterministic understanding of technology in international politics. As a result, mainstream International Relations theories do not account for the transformative qualities of technology as a constitutive part of the international system (Herrera, 2006: 15-30).

[19] Exceptions are: Skolnikoff (1994); Herrera (2006); Deudney (2007); Peoples (2009b); and McCarthy (2013).

On the other hand, one of the most influential contributions to our understanding of the nature of technology in science and technology studies has been provided by approaches that emphasise how technology is conditioned by social factors. This usually refers to how certain social actors and groups design strategies to shape technology according to their preferences, values, and goals. In contrast to deterministic approaches, the 'social shaping thesis' takes into consideration how technology has interpretive flexibility, in the sense that technologies can be understood in different ways by different users and social groups.[20] In this light, as technology matures, it leads to the stabilisation of its meaning, given that a dominant view of how to interpret its use becomes widely accepted. This means that technology is not only socially shaped, but also shapes its social contexts. Consequently, by focusing solely on the micro level, that is usually the laboratory, social constructivists downplay how certain technologies shape society at both the meso and macro levels (Brey, 2003: 50-4).

To understand the political and social effects of technology, therefore, it is necessary to recognise the potential importance of the stabilisation of meaning. This inevitably involves acknowledging that technologies are both 'socially constructed' (constructivism) and they have social effects (determinism) (Herrera, 2006: 34). Studying the role of the railways and the atom bomb, Herrera (2006: 31) suggests that these technologies are 'socially constructed' by social and political choices, preferences, interests, and power dynamics in the early phase of their development. In this respect, technological systems are both social and technical, as they contain a 'messy' web of connections among their technical, social, and economic components (Bijker, Hughes and Pinch, 1987). When these socio-technical systems are immature they are more easily subject to contingencies and human agency. But as they become more mature and demonstrate their ramifications, they emerge as 'an independent causal force' (Herrera, 2003: 579).

In turn, not only does this alter the sense of space and time and state-society relations, but it also alters the 'interaction capacity' of the system, which refers to the speed, scale, and intensity of interactions among states. Crucially, interaction capacity is not an attribute of the units, but it is a quality of the system. For example, an

[20] Key studies of the 'social shaping thesis' include: Bijker, Hughes and Pinch (1987); MacKenzie and Wajcman (1999). Mack (1990) builds on this approach in her study on the LANDSAT satellite system, and MacKenzie (1993) in his study on ICBMs.

international system that is based on horses and sailing vessels as the means of transportation/communication is essentially different from one that is based on global computer networks (Herrera, 2003: 583; Herrera, 2006: 40).[21] Another point to make is that each techno-social system has distinct characteristics and operations, and, thus, different implications for international relations. For example, not only do nuclear technology and the Internet constitute distinct techno-social systems with different complexes of social institutions, but also their implications for international relations are different in significant ways (Herrera, 2003: 564).

Notably, Herrera's study has the merit of recognising that the relationship of technology and international relations is an inherently political and social process with significant implications for the transformation of the international system (Herrera 2006). In doing so, the author provides a theoretical framework that accounts for systemic change. However, his study does little to dispel the idea that technology does not only affect the interaction capacity of the system, but also reconstitutes and reshapes the interests, preferences, and goals of the units of the system (Kocs 2009: 889).

This, of course, is not to say that technology alone can alter the nature of international politics or to reinvent the conduct and practice of foreign policy and diplomacy. But certainly the relationship between international relations and technology can transform the organisational and operational structure of the international system, change the character of the institutions of international society, establish new issue areas and strategic possibilities, and alter perceptions of power and shared identities at the unit level (Weiss 2005). As a result, a focus on the interaction capacity of the system does not take into consideration how the possession of specific technologies constructs distinctions between outsiders and insiders and, thus, defines political forms of hierarchy, power, and status in international society.

The general point to emphasise here is the need to move beyond the international system and to explore the possibility of relating the idea of international society to technology. As we shall see in chapter 2, it is in this context that the concept of sectoral international societies offers a useful way of bringing the dynamics of technology and international society together.

[21] The concept of 'interaction capacity' was first introduced by Buzan, Jones and Little (1993: 66-80).

Recasting Techno-nationalism

Samuels (1994: x) has defined techno-nationalism as 'the belief that technology is a fundamental element in national security, that it must be indigenized, diffused, and nurtured in order to make a nation rich and strong'. He also emphasises that Japan's techno-nationalist ideology, as a set of ideas and beliefs, has been 'highly contested and very plastic', but its endurance and relevance can be explained because its value has been renewed continuously across time (Samuels 1994: x). This is useful because it helps to capture the ideological basis of Japanese strategic thinking about the role of technology in linking national security with economic development. It also serves to highlight that the term should not be a misnomer for associating technological capabilities merely with nationalism or prestige considerations.

But while there is still much merit in Samuel's formulation of techno-nationalism, a few points are worth making here about how the concept is used in this thesis. First, Samuels (1994: 43) suggests that a key source of Japanese technology and security thinking has been the idea that Japan has to survive 'in a hostile, Hobbesian world'. Likewise, whereas Johnson-Freese and Erickson (2006: 13, 15) acknowledge that techno-nationalism might be the equivalent of developmental nationalism stemming from China's experience with colonialism, they seem to adhere to a techno-realpolitik approach to their analysis of China's space programme by emphasising the competitive nature of the international system.

Second, my understanding of the term, however, although accepts the crucial element of competition, it also focuses attention on how 'highly visible' projects, such as space programmes, are part of 'recognition games', which states play in order to acquire the status of a great power (Suzuki, 2008).[22] International Relations scholars have not been unaware of the possible importance of this crucial feature of techno-nationalism. For instance, in discussing the ideas that informed Chinese techno-nationalism associated with the strategic weapons programmes of the Mao-era, Feigenbaum (2003: 14) recognises the salience of 'China's relative standing on the international stage'. In this sense, my understanding of the term highlights that technology is not only material, but also social, political, and cultural, something

[22] The term 'highly visible technology' here refers to the demonstrative effect of some technologies, which allows for their celebration as great technological and engineering feats and consequently as an affirmation of national technological prowess. Nuclear and space technology can be seen in this context. Supercomputers might also be included in this category.

which points to the normative and ideational dimensions of technological prowess. In doing so, my formulation of the term also calls attention to the role of technological advancement as an informal standard of modernity and hierarchy in international society.

Third, building on Samuels' work, recent studies on the enduring significance of Chinese techno-nationalism acknowledge that its origins can be traced back to the second half of the nineteenth century and the efforts by the champions of the Self-Strengthening movement (Feigenbaum, 2003: 225-7; Cheung, 2009: 237; Kennedy, 2013: 910). But there is generally little consideration in the relevant literature of how the emergence of Chinese techno-nationalism was largely a consequence of the international social pressure from European international society to introduce technology as a normative marker of the state's modernity, power, and status. Equally, there is generally a curious neglect of the use of techno-nationalism as an analytical concept in the study of India. Significantly, my formulation of techno-nationalism emphasises the importance of China and India's colonial experience as a major factor in shaping an influential view about the role of technological achievements among Chinese and Indian policy makers. This is in keeping in line with a growing body of literature that focuses on the role of national identity and memory in international relations and illustrates the ways in which the legacy of colonialism still informs ways of thinking about Chinese and Indian foreign policy.[23] This is one of the key arguments that I develop in the following chapters.

Outline of Chapters and Main Arguments

The thesis is divided into seven chapters organised thematically rather than chronologically. Chapter 1 provides a brief overview of the key structural and agential factors that shaped the emergence of the Space Age as a key feature of power, modernity, and progress in the twentieth century. It traces the evolution of the development of rocketry and spaceflight by examining how key engineers, designers, and space enthusiasts, who had participated in the space movement of interwar Europe, played a crucial role in promoting the cause of spaceflight during the space race between the United States and the Soviet Union. The main focus of the chapter is

[23] See, for instance, Callahan (2010); Chacko (2012); and Miller (2013).

on the national security, prestige, and political considerations that not only defined the space race between the superpowers during the Cold War, but also shaped the emergence of the international social and normative structure of international space society. As we shall see, an analysis of the ways in which the two superpowers utilised space during this period has also comparative significance for making sense of the efforts by China and India to enter into the Space Age and to gradually participate in the creation of international space order.

Chapter 2 engages with the use of international society as a central analytical idea and how it can help to conceptualise international space order. It is here that my analysis introduces what is perhaps my most ambitious and original contribution: I argue that a possible way to relate technology to international society is to focus on international society at the sectoral level, while building on the key insights developed by English School scholars on differentiation. This involves identifying how a distinct international social structure is differentiated at the sectoral level. Consequently, the chapter briefly sketches out the primary institutions of the international space society. While my intention is not to offer a comprehensive and definite account of what may counted as a primary institution, I look specifically at the ways in which the institutions of war, sovereignty, law, diplomacy, balance of power, great power management, the market, and environmental stewardship are differentiated from international society at the global level. The chapter also suggests that there are good reasons for including techno-nationalism as a distinct primary institution.

Chapter 3 deals with the origins of techno-nationalism in international society. It first revisits the concept of the 'standard of civilisation' and examines how scientific and technological advancement emerged as a normative measure of the level of civilisation in international society during the expansion of the European society of states in the nineteenth century. The chapter illustrates how technological attainments were seen to operate as an informal standard of civilisation that indicated the cultural superiority of European civilisation and how China and India were differentiated as the 'uncivilised' Other based on the increasing links between civilisational and technological hierarchies. It suggests that the formative encounter of China and India with the expanding European international society still informs an influential variant of techno-nationalism in a postcolonial context that signifies highly visible technological projects as markers of the state's status, power, and modernity.

Chapter 4 explores the origins and development of China's space programme from the mid-1950s to the late 1980s. Most accounts of this period tend to highlight the impact of Mao Zedong, Zhou Enlai, and Qian Xuesen on China's space programme. However, the chapter's main focus is on Marshal Nie Rongzhen, who successfully articulated an influential postcolonial techno-nationalist vision that shaped the pursuit of China's strategic weapons programme, including the space programme. A key argument is that there was nothing preordained about the success of the Chinese space effort, especially given the political turmoil and limited financial resources in the Maoist era. But postcolonial techno-nationalism, as a composite and complex, but influential ideology rendered the development of space projects appealing to the Chinese political and scientific elites. Under Deng Xiaoping, postcolonial techno-nationalism was further consolidated in the mid-1980s, epitomised in the '863 High-Tech Plan'. Equally, during this period, China began engaging with the emerging international space society.

Chapter 5 examines the key external and internal factors that shaped the development of India's space programme from 1955 to 1989. It briefly discusses two key figures that had an important influence on the place of science and technology in post-independent India, Jawarharlal Nehru and Homi B. Bhabha, before considering the crucial role of Vikram Sarabhai, who is regarded as 'the father' of India's space programme. The chapter suggests that Sarabhai's version of postcolonial techno-nationalism exercised a profound and enduring influence on the direction of the space programme throughout this period, which largely explains the success of India's forays into space.

Chapter 6 considers China's engagement with international space society from 1990 to 2016. In particular, it considers China's interaction with the primary institutions of techno-nationalism, space militarisation, space diplomacy, balance of power, great power management and the space market. While most analyses about China tend to focus on certain civilian and/or military programmes, an analysis that relates space to international society sheds a revealing light on China's contribution to the process of maintaining international space order. The chapter argues that, although China's ASAT 2007 test undermined its credential as a responsible great power, there is evidence to suggest that it is more willing to play a constructive role in shaping international space order by accepting key responsibilities that are more in line with its growing influence and power. Consequently, this marks the emergence of China as a major power and a full-fledged member in international space society.

Chapter 7 focuses on India's engagement with international space society from 1990 to 2016. In this period, India's interaction with the key primary institutions of international space society has had a significant impact on its space behaviour. After examining in detail India's new emphasis on highly visible space projects, such as space exploration missions and its growing interest in enhancing its military capabilities, the chapter assesses its contribution to the maintenance and enhancement of international space order. The chapter argues that, while India is clearly an emerging space power as well as a responsible member of international space society, it is not a great space power yet. This is because India appears reluctant to accept great power responsibilities that are commensurate with its growing profile in space, at least for now.

In the conclusion, I will take stock of the main arguments highlighted above. I will summarise the key contributions of the various lines of argument put forward in this thesis and assess their relevance for the study of the international politics of space and China and India as rising space actors. In doing so, I will also briefly discuss a possible agenda for further research.

Chapter 1. The Emergence of a New Frontier: The International Politics of Space in Historical Perspective

One of the most important historical influences on the contemporary structure of international politics in space has been the interaction between the United States and the Soviet Union during the Cold War. A profound and enduring consequence of this period has been the establishment of a set of ideas, norms, and practices that shaped the existing order in space within which other space actors, including China and India, continue to pursue their space policies and activities, as latecomers to the Space Age. Yet, while it has become commonplace to acknowledge the role of national security considerations as well as the synergy between the development of nuclear, missile, and space programmes due to the inherent dual use nature of space technology, it is also necessary to take into account not only prestige considerations, but also the diffusion of norms and ideas about the utilisation and exploitation of space. In this regard, less attention has been paid to the intersection between processes of socialisation and learning associated with the social construction of space technology by the two leading space-faring states as a marker of global power status and modernity in international society.

Thus, to understand the impact of this key bilateral relationship on the complex nature of space politics and what its implications for the course of ideas, practices, and institutions concerning space utilisation are, we need to place this array of processes in its specific historical and strategic context. However, before looking at the distinctive set of strategic circumstances that led to the beginning of the Space Age with the launch of Sputnik and its significant impact on how the utilisation of space would be conceptualised for the most part of the Cold War, it is important to identify a number of key forces that made thinking about spaceflight to seem a less distant reality.

The Origins of the Space Age

One of the key aspects of the beginning of the Space Age has been the role of a number of space enthusiasts, amateur engineers, and science fiction writers who publicised the idea of spaceflight and made it seem feasible in the early twentieth century. The decisive impact of the early amateur rocketeers and amateur space societies on the promotion of the idea of space travel is established in the space history literature, but it has been somewhat neglected by International Relations scholars. It is worth making, therefore, a few observations as this period helps to illustrate the combination of structural and agential factors that defined the emergence of the Space Age as a key feature of Western modernity and progress in the twentieth century.

This period also helps to highlight how early attempts at imagining and conceptualising outer space were the product of a sort of a social movement embedded in social and cultural norms. This movement flourished in interwar Europe, outside the established scientific community and without the support of the state. This is an especially important consideration given that, although the United States and the Soviet Union recognised the strategic significance of missile capabilities soon after the end of the Second World War, a number of key engineers, designers, and space enthusiasts, who had participated in the space movement of that period, played a crucial role in promoting the cause of spaceflight during the space race between the United States and the Soviet Union.

Historically, the idea of space travel has captured the imagination of humankind for centuries. Indeed, the first known description of a voyage to the Moon and an encounter with lunar inhabitants can be found in the work of Lucian of Samosata (c. A. D. 120-180), a Greek novelist and rhetorician. Interest in the use of devices that employed the principles of rocket flight can also be traced back to ancient Greece, although the first use of 'true rockets' based on gunpowder was introduced by the Chinese in 1232. But it was the Copernican revolution, completed with the works of Joahannes Kepler (1571-1630), Galileo Galilei (1564-1642), and Isaac Newton (1642-1727) that changed the view of the universe, and, thus, laid the foundations for modern rocketry. This profound transformation had also the effect of capturing public imagination and interest in stories of space travel (Crouch, 1999:10-8). By the late nineteenth century, science fiction books, like Jules Verne's *De La Terre a La Lune* (From the Earth to the Moon, 1895) and *Autour de la Lune* (Around the Moon, 1870), and Herbert George Wells' *War of the Worlds* (1898), to name just a few, had already communicated the dream of spaceflight. This, in turn, had a profound influence on the pioneers of modern rocketry (McDougall, 1997: 20).

Three figures that worked independently from each other, but were aware of each other's work, stand out as the prominent pioneers of modern rocketry: Konstantin Tsiolkovsky (1857-1935), Robert Goddard (1882-1945), and Hermann Oberth (1894-1989). Born in Russia, Tsiolkovsky was a rural mathematics teacher driven by his vision of space travel. Tsiolkovsky's work epitomised the intersection of theory, science fiction, and popular science, which was so characteristic of the popular fascination with the cosmos in Russian culture during the late nineteenth century. In this regard, Tsiolkovsky approached fiction writing as a way of popularising scientific ideas of space travel, which was manifested in the three space fiction novels he wrote (Siddiqi, 2010a: 21-2). His theoretical work focused on the development of key ideas of space flight and orbital mechanics. As early as 1898, he was the first to demonstrate in a mathematical piece that the use of multi-staged rockets powered by a combination of liquid hydrogen and liquid oxygen would provide them with the necessary thrust to reach orbit. This was the first thorough examination of the possibility of space travel (Siddiqi, 2010a: 26-7).[24]

Although Robert Goddard was not aware of Tsiolkovsky's work, he shared his dream of space travel and he was also inspired by science fiction (McCurdy, 2011: 19). In contrast to Tsiolkovsky, who was a self-educated savant, Goddard had received three college degrees, including a PhD in physics from Clark University, in Worcester, where he spent most of his career as a professor of physics. In addition, unlike the Russian pioneer, who established his reputation as a theorist, Goddard concentrated on experimental research (Crouch, 1999: 32). In 1919, the Smithsonian Institution published his engineering study *A Method Reaching Extreme Altitudes*, in which he put forward the notion that a rocket could carry instruments in the upper atmosphere. The last pages of his treatise were dedicated on his innovative proposal of sending a multistage rocket to the Moon. But notwithstanding that Goddard had based his findings on the successful testing of his rocket engines, his ideas became the subject of mockery in the national press, a negative experience that distressed him (Crouch, 1999: 35). Yet, he designed and successfully launched the world's first liquid-fuelled rocket in 1926 (McCurdy, 2011: 20). What is noteworthy is that, although he remained a rather minor celebrity in the United States, his pioneering work had an impact on the other side of the Atlantic (Crouch, 1999: 41).

[24] On Tsiolkovsky's efforts to popularise spaceflight and his legacy, see Siddiqi (2010a: 43-73).

Goddard was not familiar with the work of Hermann Oberth, who wrote a letter to him in 1922 requesting a copy of his Smithsonian treatise. Born in the Transylvania region of Romania in 1894, Oberth shared with the other pioneers of modern rocketry the dream of space travel inspired by science fiction (Crouch, 1999: 36). Remarkably, although the University of Heidelberg rejected his doctoral dissertation on the possibility of spaceflight in 1922 because it was found to be impractical and eccentric, Oberth managed to turn his thesis into a short book with the title *The Rocket into Interplanetary Space* (Bainbridge, 1976: 30; Bille and Lishock, 2004: 9). The very fact that three editions of the book were published between 1923 and 1929 is a telling manifestation of the public interest it generated in Germany (McCurdy, 2011: 18).

Significantly, Oberth's work had the effect of inspiring the increasing popularity of spaceflight in Germany. The public fascination with space exploration in the Weimar Republic was evident in the formation of amateur societies by space travel enthusiasts. Of these, the most influential was undoubtedly the Society for Space Travel (VfR), which was established in 1927. Some of the key members of the society were Oberth, Willy Ley, a popular-science writer, and a university student named Wernher von Braun, who volunteered to assist with rocket experiments (Crouch, 1999: 47-58). What is noteworthy is that both Ley and von Braun would later become two of the most prominent advocates of human spaceflight in the United States (McCurdy, 2011: 24, 38, 41-54).

Nonetheless, it is important to recognise that the public fascination with space travel during that period was predominantly a social and cultural phenomenon, which encompassed a wide range of activities, such as books, magazines, films, experimental research, exhibitions, pamphlets, posters etch. Thus, to understand how the spaceflight movement developed, we need to give greater attention to the social context in which this cultural process occurred. This becomes significant when we think that the two most vibrant and influential space amateur societies were formed in Soviet Russia and Weimar Germany. More specifically, public fascination with cosmic travel in Russia at the turn of the century was an expression of the technological utopianism and mysticism that defined a transformative period in the history of the Russian society. The works of the Society for the Study of Interplanetary Communications, the world's first space advocacy group that was formed in 1924 in Soviet Russia, were illustrative of this curious effort to bridge the mysticism of the past with the technological utopianism and fetishism of the future associated with cosmic travel. This involved an effort to equate spaceflight with what meant to be modern, outside the parameters of the state and the established scientific community. Put differently, while for many centuries spaceflight was related to mythology, it was a vast network of amateur space enthusiasts that, after the 1920s, elevated space exploration to the sphere of science and technology, by seizing the language of modernity. Their conceptualisation of spaceflight as a marker of twentieth century modernity was also in line with the Bolshevik cause of transforming Russia into a modern, technologically advanced nation (Siddiqi, 2007: 536-7).

As far as the German space movement is concerned, it is plain that influential personalities, like Oberth, were crucial in animating the increasing appeal of spaceflight in the Weimar Republic. Moreover, the social insecurity and anxiety of the post-war period had the effect of defining the popularity of space exploration as a form of escapism. Neufeld (1990) identifies three cultural factors that have had a decisive impact on the public fascination with space travel: nationalism, the belief in technological progress, and the emergence of a modern 'consumer' culture, which was escapist in many respects. Yet, one might add that, like Germany's fascination with aviation, spaceflight also represented a powerful symbol of national self-assertion, modernity, and prestige in the competitive international environment of that period (Rieger, 2005; Fritzsche, 1992).

However, although it has become somewhat commonplace in the history of modern rocketry and astronautics to place the influence of Tsiolkovsky, Goddard, and Oberth on the early popularisation of spaceflight in their respective national contexts, it is necessary to recognise that the nature of the spaceflight movement was remarkably international. This has been manifested in the importance of international interaction and contacts that defined the spaceflight movement of the 1920s (Siddiqi, 2004; Geppert, 2008). Indeed, one of the most striking qualities of the spaceflight movement was the interaction of ideas between Tsiolkovsky, Goddard, Oberth, and the amateur space societies. For instance, as we saw previously, Oberh wrote to Goddard in May 1923 asking for a copy of his Smithsonian publication, when he discovered that somebody in the United States was working on rocketry. In turn, Goddard received a book from Oberth in 1923 and went back to continue his experiments determined to establish his authority in the field (Crouch, 1999: 42). It is also revealing that the work of Goddard had an important impact on the Soviet space movement (Siddiqi, 2004).

Although it is true that public fascination with spaceflight both in Soviet Russia and the Weimar Republic was striking and distinctive, a spaceflight movement had already emerged by the early 1930s, which was of an international and cosmopolitan character. The spaceflight movement developed through transnational contacts among space enthusiasts and space engineers, who shared a common belief in interplanetary travel. For example, following the foundation of the Soviet and the German amateur clubs, the American Interplanetary Society was established in 1930, and the British Interplanetary Society (BIS) in 1933. Smaller amateur space groups were also formed in other countries (Winter, 1983: 73-111; Geppert, 2008: 266).

What is noteworthy in retrospect is that the transnational contacts established during that period were resumed after the end of the Second World War. This renewed enthusiasm was morphed into efforts to institutionalise and internationalise further the spaceflight movement. These attempts culminated in the establishment of the International Astronautical Federation (IAF) in 1951, consisting of 14 rocket societies from 10 nations with the aim to promote international cooperation in space activities and foster dialogue among scientists (Geppert, 2008: 280-1). The IAF is today the world's leading space advocacy body with 246 members (societies, space agencies, institutes, companies) across 62 countries.[25] Nevertheless, the advent of the Second World War had a profound impact on the activities of the societies.

The State and the Military Enter the Stage

Whatever we may think about the true motivations of the principal space enthusiasts, in the absence of financial resources and an institutional base to support their research on rocketry, the activities of amateur societies were incrementally taken over by the military in Soviet Russia and Nazi Germany. Subsequently, the beginning of the Cold War had the effect of altering the relationship between the state and techno-science. But key engineers, designers, and space enthusiasts, who had participated in the space movement of that period, would play a crucial role in promoting the cause of spaceflight during the space race between the United States and the Soviet Union.

[25] See IAF's official website at http://www.iafastro.com/index.php/about.

Therefore, to understand the trajectory of Soviet Russia's development of rocketry during that period it is useful to briefly say something about how amateur efforts began to interact with the state and military. More specifically, during the early 1930s, rocket research continued to evolve and some significant contributions were made to rocket technology. Around that time, Sergei Korolev, who would become the most prominent figure in the Soviet space programme, joined an amateur society called the Group for Studying Reaction Propulsion (GIRD) in Moscow. In 1932, Korolev resumed the leadership of the society and one year later GIRD members successfully launched Soviet Russia's first liquid-fuel rocket (Winter, 1983: 53-61).

The amateur society soon attracted attention from the military, which eventually provided limited financial support to its activities. In the meantime, another key rocket enthusiast, Valentin Glushko, was working with the Gas Dynamics Laboratory (GDL) in Leningrad. Significantly, in 1933, the Moscow GIRD and GDL were merged under the military auspices to form the Reactive Scientific Research Institute (RNII) (Winter, 1983: 56, 61). Throughout the 1930s, therefore, interest in rocket research devoted to national defence began to take centre stage. However, rocket research and development suffered a serious setback in the late 1930s, when Stalin initiated a massive wave of purges. Korolev survived the purges, but he spent the next years of his life working as a military aircraft engineer in a prison camp (Bille and Lishock, 2004: 57-8).

In relation to Germany, one of the crucial factors that came to distinguish the development and research on rocketry in the country was, of course, the consolidation of the Nazi regime. Generally, it has become commonplace to argue that Germany's interest in rocketry was driven by restrictions on rearmament imposed by the Treaty of Versailles, which did not mention the development of rockets. Of these restrictions, it appears that the most important was the ban on heavy artillery, given that the development of powerful rockets could replace other restricted weapons. In this light, one of the prime movers behind building rockets was the idea that they would be appropriate for the delivery of poison gas against enemy troops (Neufeld, 1995: 6). Be that as it may, by the mid-1930s, most of the members of the Society for Space Travel (VfR) were absorbed by the military. In 1932, the young and pragmatic von Braun was the first who decided to leave the society and to sign a contract as a civilian employee with the Germany's army rocket programme. Few years later, von Braun would become the director of the newly founded rocket research facility near

Peenemunde. There he directed the development of sophisticated rockets. The work of the Peenemunde rocketeers culminated in the successful test of the infamous 'vengeance weapon' or V-2 in 1942.[26] This led to the mass production and deployment of the V-2 during the last years of the war. It is believed that roughly 6,000 V-2s were built between 1944 and 1945 in Germany (Neufeld, 1995: 117).

Plainly, the V-2 rocket was unique for a number of reasons. First, following its ballistic trajectory at a peak altitude of 96 kilometres above the Earth, the V-2 was the first rocket to reach at the fringes of outer space. Second, although it has been estimated that the investment in the development and production of V-2s was about equivalent to the costs of the Manhattan Project to build America's atomic bomb, the use of V-2 rockets during the Second World War was strategically insignificant, and thus, it was a remarkable waste of resources (Neufeld, 1995: 273-4).

More importantly, perhaps, the V-2 attacks against Britain (London and the Norwich area) and Belgium caused the loss of roughly 8,000 people (Chun, 2006: 54-5). However, more people died as slave labourers in its production. It has been estimated that 60,000 inmates passed through the concentration camps linked to *Mittelwerk,* the main V-2 assembly plant. Of these prisoners, at least 10,000 did not survive. Thus, what also makes the V-2 rocket unique is that the number of people who lost their lives producing the rockets surpassed the number of people who perished in the V-2 attacks (Neufeld 1995: 264).

Nevertheless, at the strategic level, one of the principal consequences of the V-2 rocket was that it demonstrated the military potential of the use of missiles. By that time, the strategic potential of ballistic missiles was becoming apparent for American and Soviet strategists. With the demarcation between the communist and capitalist camps on the horizon, the hunt for the Nazi scientists had begun. As the Red Army was approaching, von Braun and his team decided to evacuate Peenemunde and eventually they surrendered to the Americans. Few months later, von Braun and his best engineers were offered contracts with the US Army Ordnance Corps. The 'Peenemunde team' would prove to be a significant asset in the US efforts to develop missile and space capabilities (Bille and Lishock, 2004: 21-3).

Accordingly, although the Soviets were less successful in capturing leading German rocket engineers, they occupied all of the important V-2 sites and they managed to

[26] For a detailed account of German rocketry during that period, see Neufeld (1995).

recover German technology and to recruit available German experts who had remained in their country. While the extent to which German engineers and technology contributed to the research and development of rocketry in Soviet Russia remains debatable, specific designs and hardware must have been useful to the work of Soviet rocket designers. Ironically, perhaps, when the Soviet troops entered in Peenemunde, they came across a German edition of one of Tsiolkolvky's books on rocketry and space exploration, which was added with notes by von Braun (Bille and Lishock, 2004: 23-5).

The implications of the growing interest in the military uses of missile technology and the potential utilisation of space would be determined by a number of structural and agential factors and their impact on the complex strategic nature of the relationship between the Soviet Union and the United States. Thus, we need to look closer at the historical conditions that enabled the emergence of the Space Age.

The Soviet Space Programme

While a detailed discussion of the drivers that shaped the Soviet activities in space is beyond the scope of this chapter, a few salient points can be made. First, it is clear that national security considerations help to explain the motivations for the pursuit of the Soviet missile programme. Indeed, without acknowledging the military requirements of the USSR in the Cold War confrontation with the United States, it is not possible to understand the origins of the Soviet space programme. Soviet policy makers and strategists recognised immediately after the Second World War that is was necessary to develop long-range delivery systems. But it was the development of the hydrogen bomb in 1953 that led the Soviets to give emphasis on the production of powerful intercontinental ballistic missiles (ICBMs), which could deliver nuclear weapons against targets in the United States (Humble, 1988: 3; Sheehan, 2007: 25).

However, it is important to note that there was nothing preordained about the decision to build an ICBM. Despite the Soviet preoccupation with building delivery systems, there is evidence to suggest that the Soviet Party and leadership paid more attention to the acquisition of the atomic bomb or the development of air defence programmes in the late 1940s. It was only after 1953 that the development of an ICBM gained momentum, before becoming a national security priority two years later. What is noteworthy here is that the role of designers was crucial in shaping the Soviet missile programme throughout the early phases of long-range missile development. Other key actors, such as bureaucrats, Party leaders, and the military industry, entered the equation only when the idea of building ICBMs had proved to be an effective way of carrying nuclear weapons. Consequently, the process of designing and building the Soviet ICBM was dependent on a series of negotiations and compromises between the many actors involved. Nevertheless, the impressive outcome of such efforts was the development of a powerful rocket codenamed R-7, which was lobbied and built under the leadership of designers, including Korolev and Glushko (Siddiqi, 2010a: 241-89). With the first successful flight test of R-7 in 1957, the prospect of spaceflight had now become a realistic possibility.

Given the nature of the Soviet regime, we might reasonably expect that the decision to develop the Soviet space programme and to launch Sputnik in 1957 would have been informed by rational calculations as part of long-term strategy with the aim to demonstrate the technological prowess of the Soviet Union. Yet, and this is the second point to make, in reality, there was no Soviet space programme at that time in the sense that there was no overarching body responsible for Soviet activities in space, nor was there a coherent space policy framework. Remarkably enough, the Soviet leadership would respond to the initiatives and proposals of the design bureaux in a reactive manner and on an ad hoc basis (Sheehan, 2007: 29; Siddiqi, 2003: 171).

Significantly, despite the fact that the Soviet achievements in space between 1957 and 1964 would deliver considerable propaganda benefits in the context of the superpower rivalry, these were recognised and exploited by Soviet leaders only post facto. In the sort-term, this approach seemed to be effective, but the very fact that the Soviet leadership never advanced the Soviet space programme to its high priority meant that the Soviet Union could not lead the space race in the long-term (Sheehan, 2007: 29).

Nowhere was the role of designers more clear that in the case of Sputnik. Although the development of ICBM capabilities had provided the Soviet Union with the necessary technical means to access space, the decision to launch the first Soviet satellite into orbit was the product of a set of international and contingent circumstances. In particular, we now know that Soviet scientists began studies on the technical feasibility of satellites in the early 1950s. However, it was only after the personal initiatives of key figures of the Soviet missile programme that the Soviet government decided to develop a space programme (Siddiqi, 2010a: 290-331; Bille and Lishock, 2004: 63).

The most significant attempt to promote spaceflight was a formal proposal for a space programme prepared by Korolev, which was submitted to the government in 1954. Three months later, the Soviet leadership approved limited work on space research and the formation of the Commission for Interplanetary Communications, which would serve as the public face for the secret work on space technology. In early 1956, during a visit to the organisation that was tasked with the building of long-range missiles by the senior Soviet leadership, Korolev seized the opportunity to press Nikita S. Khrushchev, the first secretary of the Communist Party, for the approval of putting a satellite into orbit. When Korolev assured Khrushchev that the launch of a satellite would not interfere with the development of ICBMs, the Soviet leader assented, ‘if the main task doesn’t suffer, do it’ (Bille and Lishock, 2004: 63).

Subsequently, Korolev and his aides embarked upon a well-orchestrated effort to communicate the goal of spaceflight both in secret and in public in the Soviet Union with the aim of pushing the government to approve a dedicated satellite project. A key dimension of their effort was that they managed skilfully to manipulate media announcements to promote their cause. In 1955, for example, Korolev and other space activists publicised the existence of the Commission for Interplanetary Communications in a Moscow newspaper. The existence of the commission was interpreted by Western media as a clear manifestation of the Soviet interest in spaceflight. This had the effect of convincing leading officials within the United States that the Soviet Union was already committed to be the first to launch a satellite into orbit (Siddiqi, 2008: 533-5).

Consequently, these concerns accelerated the US decision to develop an American civilian satellite project, which was publicly announced by the Eisenhower administration in 1955. In turn, exploiting the new round of publicity triggered by the US satellite plans, again highly placed designers, including Korolev, approached the high echelons of the Soviet government to lobby for the creation of an artificial satellite. Defence, prestige, and science were usually provided as key justifications for undertaking such a project. This concerted effort eventually culminated in the government’s decision to launch Sputnik and signified the beginning of Soviet activities in space. Therefore, the Soviet plans in space were tied to those of the United States, even before the launch of Sputnik (Siddiqi, 2008: 535-7). Thus, to understand the wider historical and strategic context within which the Soviet space effort occurred, it is important to examine some key aspects of the US space programme.

The US Space Programme

In contrast to the Soviet space programme, the US space programme has been subjected to extensive analysis, but it worth briefly highlighting its principal features as they continue to shape space policy preferences in the United States and elsewhere.[27] A brief examination of this period can also offer a better understanding of the current debate over the militarisation and weaponisation of space, given that it appears to be a rehearsal of the debates that have defined the formation of US space policy since the 1950s (Kalic, 2012: 1-2).

Although much attention has been paid to the inadequate response of the Eisenhower administration to what has been described as the ‘Sputnik crisis’ and how the Kennedy administration restored the confidence and international prestige of the United States with its decision to go to the Moon, less attention has been paid to the ways in which this formative period of the US space policy shaped future policy outcomes and preferences that have had a profound impact on the normative structure of international space order. Thus, if we want to understand the key material and ideational factors that defined US activities in space, we need to place the constrains and possibilities that the United States confronted in their specific historical and strategic context.

Historically, the United States did not share with the Soviet Union a tradition of research on rocketry and space technology before the Second World War. Despite Goddard’s contribution to rocketry research and development, his work did not attract the support of the military. Nevertheless, with the V-2 missiles having demonstrated the potential strategic significance of ballistic missiles during the war, there was the recognition among US strategists of the need to develop missile capabilities. This was evident in the determination of the United States to find the German scientists and engineers who were involved in the V-2 rocket project. In July 1945, this official

[27] On key aspects of the history of the US space programme, see, inter alia, McDougall (1997); Divine (1993); Levine (1994); Launius (2004); DeGroot (2007); Logsdon (2010); McCurdy (2011); Kalic (2012); Mieczkowski (2013); and Logsdon (2015).

effort, which was initially codenamed ‘Operation Overcast’ and later changed to ‘Operation Paperclip’, resulted in the capture of top V-2 personnel that were brought to the United States and recruited by the US Army. In addition to the German rocket engineers, it has been estimated that roughly 14 tons of paperwork, along with V-2 rockets and other hardware were also moved to the United States (Bille and Lishock, 2004: 23).

One of the most important aspects of this period was the reconfiguration of the pattern of US science and technology research through the formation of research institutions and organisations usually funded by government resources in the service of national defence. The Manhattan Project served as the model of this process (Bille and Lishock, 2004: 27-8). Accordingly, the recognition of the military potential of missiles by the US armed forces led to modest steps towards the design and application of rockets based on V-2 launches between the mid-1940s and early 1950s. Meanwhile, the US armed forces began to investigate the possibility of a satellite vehicle (Bille and Lishock, 2004: 30-4).

As early as 1946, a now infamous RAND report suggested that the launch of a satellite might be possible. The RAND report identified a number of reasons for the development of a satellite, including the following: a satellite would be ‘one of the most potent scientific tools in the twentieth century’; the launch of a satellite ‘would inflame the imagination of mankind, and would probably produce repercussions in the world comparable to the explosion of the atomic bomb’; and a satellite would demonstrate that the United States is the world’s technological leader. The report also highlighted the military uses of satellites for reconnaissance, navigation, intelligence gathering, communications, and targeting, all of the main military functions of today’s satellites (Kalic, 2012: 8-10).

However, a number of factors had the effect of impeding these efforts. First, the goal of the Truman administration and Congress to keep the military budget comparatively low in the post-war period meant that the availability of financial resources to rocket and space technology research was limited (Moltz, 2008: 84). Second, the interservice rivalry between the three brunches of the US armed forces led to competing rocket and satellite efforts. Indeed, by the early 1950s, all of the three services had developed separate missile programmes, which further delayed the pace of progress. More importantly, perhaps, US strategists did not perceive the development of missile capabilities as an urgent task because the possession of long-range bombers provided the US military with the necessary means to conduct strikes deep into the Soviet Union effectively (Sheehan, 2007: 38). Nonetheless, the election of President Eisenhower in 1952 was an important event in catalysing the reorientation of the US strategy, leading to the acceleration of missile and satellite development. A key aspect of this process was Eisenhower's New Look Policy, which emphasised the role of nuclear weapons for national defence and the reduction of conventional forces as part of his broader attempt at constraining the growth of government expenditures (Callahan and Greenstein, 1997: 20). At the strategic policy level, the development of the hydrogen bomb by the Soviet Union in 1953, soon after the end of the Korean War, presented the Eisenhower administration with a new challenge. In response, the United States recognised the need for more credible deterrence based on a wide range of strategic scenarios from massive retaliation to the possibility of regional conflict. As a consequence, the development of long-range missile capabilities assumed more strategic importance (Moltz, 2008: 86).

At the same time as these major changes to the structure of the international system were occurring, the two superpowers were enacting different approaches to the negotiations on arms control and disarmament. While the United States were supporting an arms limitation on the basis of an inspection mechanism, the Soviets were vehemently opposed to any agreement that would allow on-site inspections. On the one hand, even if an agreement on arms control were possible, the conduct of on-site inspections would be crucial for monitoring nuclear activities. On the other hand, the possibility of nuclear competition, without reaching any arms control agreement, would plainly implicate the need for reliable information on Soviet capabilities. Either way, given the absence of information concerning the development of Soviet long-range ballistic missiles, the United States had to devise effective ways to spy on the Soviet Union in order to mitigate the threat of a surprise attack against US soil (McDougal, 1997: 115).

The most obvious manifestation of the need for information about Soviet nuclear activities was Eisenhower's 'Open Skies' initiative that was presented at the Geneva summit in July 1955. Under the initiative, the United States and the Soviet Union would allow aerial surveillance of their capabilities for verifying any arms control agreements that might be reached. Given that secrecy served to hide the military weaknesses of the Soviet Union, it is not surprising that the Soviets rejected the proposal (DeGroot, 2007: 50).

What was causing particular concern to President Eisenhower was the possibility of a ‘nuclear Pearl Harbor’. This led him to establish the Technological Capabilities Panel, a top-level study group of experts known as the Killian Panel, which was consisted of distinguished scientists and engineers headed by James Killian of the Massachusetts Institute of Technology. In February 1955, the group sent a classified report to President Eisenhower entitled ‘Meeting the Threat of Surprise’. The report advised the government to accelerate the development of the ICBM programme and the inter-mediate range ballistic missile (IRBM) programmes as the highest national priority. The Killian panel group also recommended the development for an advanced airplane for gathering intelligence, which led to the now-infamous U-2 spy plane. Finally, the report suggested the idea of launching a reconnaissance satellite in order to establish the precedent for the principle of ‘freedom of space’ for future reconnaissance satellite overflight. This is an important consideration if we remember that the free transit of space was not given at the time (Bille and Lishock, 2004: 74).

Consequently, one of the most important developments in this regard was the National Security Council policy statement ‘US Scientific Satellite Program’ (NSC 5520), which was approved by Eisenhower in May 1955. The classified document provided a number of important recommendations that defined the key features of the inchoate space programme. More specifically, the document suggested that the launch of ‘a small scientific satellite will provide a test of the principle of “Freedom of Space”’. Moreover, highlighting that the Soviet Union was working on its own satellite programme, as we saw previously, the document recognised that ‘considerable prestige and psychological benefits will accrue to the nation which first is successful in launching a satellite’. Accordingly, NSC 5520 suggested that the ‘demonstration of advanced technology’ through the launch of a satellite and its ‘unmistakable relationship’ to ICBM technology would have significant political implications for ‘the political determination of free world countries to resist Communist threats’ (National Security Council, 1955: 3).

Nelson Rockefeller, special assistant to the President, circulated the document through the government with an appended memo of his own, in which he noted that the launch of a satellite ‘will symbolise scientific and technological advancement to peoples everywhere. The stake of prestige that is involved makes this a race that we cannot afford to lose’ (McDougal, 1997: 120). His view echoed those of von Braun, who was working on the development of a new missile for the Army at the Redstone

Arsenal at the time. In his 1954 report ‘A Minimum Satellite Vehicle’, von Braun warned that ‘it would be a blow to US prestige if we did not do it first’ (McDougal, 1997: 119).

Although NSC 5520 highlighted the scientific and technical benefits that would derive from the use of satellites, it also underlined their potential military uses for surveillance and intelligence gathering. Furthermore, given the desire of the Eisenhower administration to stress the peaceful purposes of the US satellite, the International Geophysical Year (IGY) was suggested as ‘an excellent opportunity’ for the launch of a scientific satellite (National Security Council, 1955: 2-4). However, the report recommended the launch of a small scientific satellite with the understanding that this should not impede the progress of research directed towards the development of satellites for research and intelligence purposes, nor to delay ‘other major Defense programs’, an allusion to the ballistic missile programme (National Security Council, 1955: 6).

The approval of developing a scientific satellite raised the questions of how to launch a satellite and which satellite to use. The Ad Hoc Committee on Special Capabilities, known as the Stewart Committee, was tasked with selecting the best way of placing a US satellite in orbit, given that all of the three branches of the US armed forces were simultaneously conducting research associated with space and rocket technology. In August 1956, the members of the Stewart Committee voted for the Navy’s proposal, known as the Vanguard Project, although it is plain that the Army’s rocket programme (Redstone) was more technically matured than the Navy’s Viking research rocket (Bille and Lishock, 2004: 82). In retrospect, this has been an important issue because of the technical difficulties and launching failures of the Vanguard Project that followed the decision. Not surprisingly, perhaps, it is usually assumed that the United States had the rocket and space capabilities to launch a satellite before the Soviet Union, but political considerations delayed the US space effort.

The controversial decision remains debatable today, although it has become commonplace among observers to argue that the selection of the Navy’s proposal reflected the desire of the committee to use a research rocket (Vanguard), rather than a rocket that would be derived from a military ballistic missile, like the Army’s Redstone, which was developed by von Braun and his team (Schefter, 1999: 15-6). In this regard, given the less openly military aspects of the Navy’s rocket, it is also plausible to suggest that the choice of the Vanguard rocket indicated Eisenhower's priority to establish the 'Freedom of Space' principle, and, thus, to ensure that the Soviets would not protest against the future overflight of US military satellites over their national territory (McDougall, 1997: 121-3). In addition, the Navy's satellite proposal promised to offer solid scientific benefits (Bille and Lishock, 2004: 81).

While there is something in this argument, the potential importance of other factors behind the rationale of the Stewart Committee's decision has also been recognised. For example, given that the Navy's satellite proposal was more detailed and scientifically solid, the possibility of a compromise could be achieved based on a combination of the Navy's satellite with the Army's rocket. Yet, as Clifford Furnas, a member of the Stewart Committee, notes 'we finally decided that breaking the space barrier would be an easier task than breaking the interservice barrier' (Bille and Lishock, 2004: 82). There is also evidence to suggest that the decision was taken on the grounds that the Navy's proposal was less expensive and had the potential for further development. A less influential factor seems to be an anti-German feeling among the Committee's members, given that the Redstone rocket was designed by von Braun and his team and was a descendant of the V-2 rocket (Bille and Lishock, 2004: 82-4).

Be that as it may, on 29 July 1955, James Hagerty, Eisenhower's press secretary, publicly announced that the United States would launch a scientific satellite as part of the IGY. The United States would eventually launch their first satellite, Explorer 1, on 31 January 1958. However, by that time, the Soviets had already launched Sputnik. But before considering the implications of Sputnik, it is worth briefly saying something about the IGY.

The International Geophysical Year

The idea of organising the IGY was suggested as a Third Polar Year in April 1950 on the occasion of an informal gathering of American upper-atmosphere physicists, including prominent scientists like James Van Allen. The two previous International Polar Years had taken place in 1882-3 and 1932-3 to study the polar regions. But because 1957-8 would be a period of intense solar activity, it presented a good opportunity for scientists to organise another international scientific project encompassing Earth sciences, hence the International Geophysical Year (IGY).[28]

In discussing the role of the IGY in setting the stage for the Space Age, a few aspects are worth emphasising. First, despite the fact that the IGY has been usually described as a reflection of the activities of the international scientific community that happened to coincide with the US plans to launch a scientific satellite, in reality, it has been a telling manifestation of the intersection of politics and science during the Cold War. The formation of the IGY was largely the product of key American scientists most of whom had links with the US government. In this respect, it is noteworthy that the inclusion of artificial satellites in the IGY programme was successfully proposed by the American delegation (Bulkeley, 1991: 95-7). Second, the IGY programme was also an expression of scientific internationalism and one of the largest cooperative scientific endeavours ever pursued (Deudney, 1985: 285). As Bulkeley (2010: 235) notes, 'the founders of the IGY have cited only its scientific merits, perhaps out of an ideological commitment to the purity of basic science'. The third point to make is that after the inclusion of space research in the IGY activities, the US IGY committee approached Eisenhower for his approval, given that the use of military rockets would be needed. The announcement of the US plans for the launch of a satellite during the IGY soon followed (Bulkeley, 2008: 8).

On 3 August 1955, four days after the announcement, Leo Sedov, a senior Soviet rocket scientist who was attending the Sixth Congress of the International Astronautical Federation in Copenhagen, told reporters at a press conference that the Soviet Union had plans to put an artificial satellite into orbit 'in the comparatively near future' (Bulkeley, 2008: 8; Schefter, 1999: 3-4). Henceforth, American officials and participants in the IGY would try to gather any information related to the details of the Soviet plans (Bulkeley, 1991: 104-5).

Sputnik and the Beginning of the Space Age

The launch of Sputnik was in large part the consequence of human agency and historical contingencies. But if there is one individual that epitomises much that was unique about the ad hoc structure of the Soviet space programme during that period, it

[28] On the origins of the IGY, see, for example, Bulkeley (2010). The most detailed account of the IGY and the Sputniks is Bulkeley (1991).

is Korolev, as indicated earlier. His proposal of placing a satellite into orbit before the Americans was facing objections from key military officials, Party commissioners, scientists, and engineers. This was because, among other reasons, of the conservatism of the Armed Forces and the scientific community, and concerns that putting a satellite into space would interfere with ICBM development. Indeed, Korolev needed the approval of the sceptical members of a high-level state committee to use a modified ICBM from the available stock of the R-7 ICBMs, the number of which had been depleted because of successive test failures (Brzezinski, 2007: 142-50). Yet, in light of the public announcement of the US plans to launch a scientific satellite, Korolev was eventually effective in lobbying for his cause. His efforts were further helped by the subsequent successful trials of R-7s. Under such circumstances, instead of being accused of hindering the progress of a potential important achievement, the members of the committee approved the launch of a Soviet satellite (Bille and Lishock, 2004: 71).

On 4 October 1957, the Soviet Union launched Sputnik, the first artificial satellite to orbit the Earth. Despite the fact that Sputnik was undoubtedly an important technological accomplishment, it was not a scientifically sophisticated satellite. What is noteworthy in this regard is that Korolev carefully designed the first Soviet satellite in ways to maximise the propaganda and psychological benefits derived from its launch. He intentionally ordered the satellite to be made of a highly reflective aluminium alloy in a spherical shape so as to be more visible in the night sky. The same logic also informed his preference for the use of audio capability, rather than scientific instrumentation. What mattered to Korolev was to safeguard that nobody would deny the Soviet achievement in space, hence the steady transmission of its well-known 'beep' (Brzezinski, 2007: 146-7). As we shall see in chapter 4, similar political considerations influenced the design of China's first satellite, which effectively undermined its scientific value. Interestingly, even members of Korolev's team did not anticipate the sensation that Sputnik would make worldwide. Boris Chertok, who was closely involved in the launch of the world's first satellite, recalled, 'at that moment we couldn't fully understand what we had done. We felt ecstatic about it only later, when the entire world ran amok. Only four or five days later did we realise that it was a turning point in the history of civilisation' (Associated Press, 2007).

To suggest that the launch of Sputnik posed a significant political and scientific challenge to the United States is hardly controversial. Yet, although there has been agreement among observers about the decisive impact of the launch of Sputnik on US space policy, there has been less agreement about the nature of the US response to the crisis generated by the Soviet triumph in space. Clearly, there were different opinions among policy makers within the United States on the best way to react to the Soviet challenge, which were partly reflective of their different views about the extent to which state power should be used to support space exploration for the public good (Launius, 2010: 261-2). Equally, the response that Sputnik elicited from the Eisenhower administration in the wider context of his leadership style remains rather controversial in much of the space history literature. Therefore, it is important to briefly review some of the main policy decisions that have influenced the evolution of US space policy, leading to the moon race, and to briefly highlight some of the key aspects of the debate that deals with the US response to Sputnik.

The first point to make is that two different visions regarding space utilisation had already emerged even before the launch of Sputnik. On the one hand, Eisenhower's vision for space placed emphasis on the use of satellite technology for military and scientific purposes and, thus, he was opposed to the idea of entering into an international race with the Soviet Union determined by the pursuit of engineering feats, such as human spaceflight, without tangible practical benefits (McCurdy, 2011: 68-9). On the other hand, there were a number of influential promoters of space travel, including von Braun and Ley, who advocated very effectively that the expansion of human presence in space was inevitable. Based on influential ideas entrenched in American culture and society, such as the myth of the frontier, this vision of space eventually became so powerful and appealing to the public imagination that any alternative approach to space exploration seemed unthinkable (McCurdy, 2011: 12-3, 155, 308-9).

But the early efforts of space promoters alone could not justify the enormous amount of money for human spaceflight. For this reason, in addition to stressing the adventurous nature of space exploration, space advocates had to exploit public anxieties about the Cold War. Hence, the political ramifications of the Sputnik crisis presented them with an opportunity, not only to excite, but also to frighten, the US public. This becomes an important consideration if we remember that the so-called 'Sputnik crisis' transformed space exploration into a new arena for political competition and congressional partisanship. Consequently, given that the public's knowledge of complex technical issues related to space exploration was rather absent during the opening of the Space Age, it hardly needs to be added that certain politicians, journalists, and military-industrial hawks inflated the threat of Sputnik by alarming the public about the military importance of space. As a result, Soviet achievements in space were effectively connected to nuclear missiles and to the possibility of a nuclear attack from outer space (McDougall, 1997: 142-9; McCurdy, 2011: 71-7).

It was within this reconfigured domestic political context that Eisenhower's personal style of leadership became so important. A few aspects of the 'Sputnik crisis' are worth highlighting here. First, it has become commonplace to argue that Sputnik was 'the shock of the century' that took the Americans by surprise, and produced a popular crisis as a consequence (Dickson, 2001). Yet, there is the recognition by contemporary analysts that the wider US public did not identify the Soviet satellite as a threat in the days that followed. By contrast, if there was any sort of panic following the launch of the Soviet satellite, it took place in Washington and among the elite, not among the general public (McQuaid, 2007). In addition to the role of space advocates in exploiting the launch of Sputnik, it seems that the sense of panic that followed the Soviet satellite was also constructed for political purposes via selective reporting and news coverage (McQuaid, 2007; Launius, 2010: 258-9).

From the perspective of some of 'Eisenhower revisionists', who challenge the assumption that Eisenhower was a presidential figurehead, the formulation of the US space policy under his administration serves to illustrate that he was an astute politician and strategist (Callahan and Greenstein, 1997: 15-6). In this respect, there is evidence to suggest that the highly classified WS-117L military reconnaissance programme was a high priority for the Eisenhower administration (Divine, 1993: 110). However, although Eisenhower worked hard behind the scenes to devise a strategy that emphasised the use of satellite technology for military purposes, what is noteworthy is that he certainly underestimated the role of prestige associated with spaceflight (Launius, 2010: 259). Plainly, the image of the United States as a scientific and technological leader suffered abroad. For example, according to a survey, the majority of people from India, Canada, France, Norway, Finland, and Denmark shared the view that Sputnik had 'struck a hard blow at US prestige' (Von Benche, 1997: 20).

That Eisenhower failed to recognise the role of prestige is especially striking given that it was discussed by key military and civilian observers and it was identified as a key aspect of space exploration in reports regarding the use of space technology, as was mentioned earlier. Equally, in discussing how Eisenhower managed the response to the Sputnik crisis, it is important to note that he eventually lost the initiative in the issue of space exploration to space promoters and political rivals who vigorously supported spaceflight as a way to challenge the early Soviet triumphs in space (Launius, 2010: 255, 259-60). As Callahan and Greenstein (1997: 29) note, Eisenhower's space policy was characterised by the tension between his belief that space should not become an arena of competition and his growing recognition that it unavoidably was. Only one month after the launch of Sputnik, the Soviet Union sent a dog into space, Laika, the first living creature to orbit the Earth. This achievement clearly indicated that the Soviets were considering the possibility of human spaceflight. In light of the successive Soviet space feats following Sputnik, Eisenhower eventually succumbed to the pressure from spaceflight advocates and authorised the creation of the National Aeronautics and Space Administration (NASA) in 1958, although he tried to safeguard a modest space exploration agenda for the newly founded organisation. Notably, his experience with the management of the 'Sputnik challenge' was partly reflected is his famous farewell address on 17 January 1961, when he warned the American public about the dangers of a rising 'scientific-technological elite' closely linked to the military-industrial complex (Launius, 2010: 254-5).

Significantly, in an attempt to highlight the demarcation between the civilian and the military space programme, Eisenhower directed key military missile and space research programmes to be placed under NASA's control, including the Vanguard programme and von Braun's rocket team. Ironically enough, however, despite Eisenhower's preoccupation with the military-industrial complex, the institutionalisation of the US space policy, with the establishment of NASA under his administration, solidified the intersection of military and civilian uses of space. While NASA was regarded to be a civilian organisation in nature, the legislation that enacted NASA recognised the organisation's affiliation with the Department of Defence (Harding, 2013: 54-5). Therefore, on 31 January 1958, the United States launched its first satellite, Explorer 1, using an upgraded Redstone as a launching vehicle (Juno 1), which was developed by von Braun and his team (Bille and Lishock, 2004: 128).

A number of observations flow from this discussion. First, as far as the US space programme is concerned, it is important to recognise that this period established a closed relationship between NASA and the US military, which continues to define US activities in space. The use of space launch vehicles, such as the Delta, Atlas, Titan, and Saturn, which were originally developed as military rockets, is a telling expression of the enduring intersection of military and civilian uses of space. That the later space shuttle was designed to support military applications is also indicative of the unclear distinction between military and civilian activities in space (Harding, 2013: 55-6).

The second important historical aspect to emphasise at this stage is that this period established the foundations for international space order. It is plain that the launch of the world's first artificial satellite signified the emergence of a social structure in space that encompasses virtually every aspect of international relations. Despite Soviet objections, the 'Freedom of Space' was 'socially established' as a key principle and practice underpinning international space order, which would later be enunciated as a key legal principle embodied in the Outer Space Treaty. Accordingly, although it is clear that this period was characterised by antagonism between the Soviet Union and the United States, it also marked the first steps towards forming normative rules for the conduct of activities in space within the UN system, as I shall discuss later.

Of even greater long-term significance, perhaps, for the purposes of this study, was that the launch of Sputnik by the Soviet Union has had a profound influence on the ways in which space technology was 'socially constructed' as a key symbol of scientific and technological leadership and power in international society. Consequently, although there has been an absence of a global history of space exploration to date largely because nationalist narratives still prevail among many observers (Siddiqi, 2010b), it is useful to remember that the aftermath of Sputnik saw the emergence of national space programmes in many countries.

As we shall see, this dynamic was also evident in the history of the space programmes of China and India. In the case of China, in May 1958, at the Second Session of the Eighth National Congress of the Communist of China, Mao famously declared 'we want to make artificial satellites'. Subsequently, China began working on a programme to develop a satellite. Likewise, the Indian National Committee for

Space Research (INCOSPAR) was established in 1962, under Vikram Sarabhai, which inaugurated the formulation of the Indian space programme.

The circumstances in which these Asian countries established their efforts in space are considered in detail in subsequent chapters. At this stage, it is important to emphasise that the global implications of Sputnik might seem to highlight how ideas and meanings associated with space technology as the outcome of a complex mix of historical and contingent factors became embedded in the fabric of the nascent international space society. But despite the significance of this period in establishing outer space as a new realm of international relations, it was the dramatic events of the moon race and the emergence of what Moltz (2008) calls the 'cooperative restraint' between the two superpowers since 1962 that would define technological achievements in space as a powerful symbolic tool of foreign policy.

The Moon Race

The story of the moon race has been frequently told, but a few salient points are worth briefly re-capping as this period established human spaceflight programmes as a principal marker of power, status, and modernity. The key figure in developing a more aggressive US space policy stance was John F Kennedy, who took over as US president in January 1961. What is striking about Kennedy's policy is that space exploration did not occupy an important place in his personal or policy agenda when he took office (Krug, 1991: 30).

Although the implications of Kennedy's space policy remain rather controversial, it is possible to identify two especially important factors in making space exploration his priority. First, the unsuccessful attempt to overthrow Fidel Castro of Cuba had the effect of undercutting both the US and Kennedy administration's credibility abroad (Krug, 1991: 30). Second, Yuri Gagarin's first human orbital flight in April 1961 and the international reaction to it prompted a US response. Kennedy was quick to express his interest in a spectacular accomplishment that could improve the US image abroad (Logsdon, 2010: 117-8). In this regard, he directed his Vice President, Lyndon Johnson, to identify a space programme 'which promises dramatic results in which we could win' (Kennedy, 1961a).

While a detailed report regarding Kennedy's request was under completion, in a memorandum to the President concerning the progress of the space programme after Gagarin's flight, Johnson noted that 'the Soviets are ahead of the United States in world prestige attained through impressive technological accomplishments in space' (Johnson, 1961). Likewise, von Braun, who was consulted by Johnson during the preparation of the report, suggested that sending a man to the Moon and back would offer the United States a good chance of being first to accomplish a dramatic achievement in space. This would require the development of a new powerful rocket that both the Americans and the Soviets did not have at their disposal at that time (Logsdon, 2010: 86, 88).

A few weeks later, the classified report was submitted, recommending the expansion of the US space programme to include a lunar-landing human mission. The report noted that 'Dramatic achievements in space… symbolize the technological power and organising capability of a nation' and 'contribute to national prestige'. Therefore, the report continued, the United States 'needs to make a positive decision to pursue space projects aimed at enhancing national prestige', like 'lunar and planetary exploration' projects, because such achievements and the prestige they would confer are 'part of the battle along the fluid front of the cold war' (Logsdon, 2010: 105).

Consequently, Kennedy accepted the recommendations contained in the report and he gave a speech before a joint session of US Congress, announcing the plans for an ambitious space exploration programme. He famously told the Congress, 'I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to Earth' (Kennedy, 1961b). The announcement marked the beginning of the Apollo space programme, which would culminate in the Apollo 11 first lunar landings on 20 July 1969.

Meanwhile, in the early 1960s, the Soviets had forged ahead with a series of 'firsts' in spaceflight that provided huge propaganda benefits as a Soviet foreign policy tool. Following Gagarin's dramatic flight, and that of the second man to orbit Earth, German Titov, in 1961, the Soviet Union achieved the first 'rendezvous' in space between two Soviet spacecrafts in 1962. In 1963, Valentina Tereshkova became the first woman in space, which allegedly demonstrated that the social values of the Soviet Union were superior to that of the United States (Sheehan, 2007: 31).

What is noteworthy is that period also witnessed some efforts towards cooperation in space. Following the Cuban Missile Crisis that made for the first time nuclear annihilation a real possibility, the Kennedy administration considered signing an agreement on cooperation with the Soviet Union. However, Khrushchev declined Kennedy's proposal and later the US Congress approved an amendment that forbade the US government from reaching an agreement with the Soviet Union on space cooperation (Sheehan, 2007: 63). But despite these initiatives and a preoccupation with the unjustified high costs of the programme, Kennedy's unflinching determination to go forward with the Apollo programme persisted. As Jerome Wiesner, science advisor to Kennedy, noted, the Moon race would serve as an important 'surrogate for military power' (Logsdon, 2010: 83).

We now know that prestige considerations were at the heart of Kennedy's decision to go to the Moon. For example, a discussion during a meeting between President Kennedy, NASA administrator James Webb, and others that was held at the White House in November 1962 sheds a revealing light on the manner in which Kennedy sought to exploit space exploration. During the meeting, Kennedy tried to make clear to Webb that the Apollo project was the highest priority of NASA. Explaining the rationale behind his decision to support the Apollo programme, Kennedy said that 'this is important for political reasons, international political reasons, and this is, whether we like it or not, in a sense a race'…'otherwise, we shouldn't be spending this kind of money, because I'm not that interested in space' (Logsdon, 2010: 155-6). Equally, a discussion during a meeting with Webb regarding the future of the US space programme in September 1963 indicates that Kennedy was concerned about how to sell the Apollo programme to the American public since the support for space exploration seemed to be waning at the time. Consequently, he told Webb that 'putting a man on the moon really is a stunt and it isn't worth that many billions', thus, 'the heats going to go on unless we can say this has got some military justification and not just prestige' (Kennedy, 1963).

The most direct consequence of the dramatic accomplishment of the lunar landings was, of course, that the main objective of beating the Soviets in space and restoring the image of the United States as the scientific and technological leader in the eyes of the world was achieved. However, Kennedy's approach to the space programme 'as a means to a political end' meant that once the political goal was attained, the 'means' were obsolete (Krug, 1991: 35-6). As a result, after the dramatic expeditions to the

Moon, NASA entered a long period of identity crisis from which it seems it has yet to recover (Logsdon, 2010: 242).

As far as the Soviet space programme is concerned, although the 1957-1962 period was characterised by remarkable Soviet firsts in space, in reality these achievements served to hide the comparative weakness of the programme in computers, miniaturisation, and electronics (Moltz, 2008: 117). In contrast to Korolev, who wanted the development of sophisticated technology with scientific priorities, which would allow for the consolidation of a next generation of advanced space technology, Khrushchev was only interested in the pursuit of political propaganda and prestige through high-publicity civilian stunts. Not surprisingly, perhaps, this approach eventually proved to be ineffective and self-defeating with respect to the Moon landings (Sheehan, 2007: 29). In addition to technical deficiencies and the mismanagement of the limited available resources, the death of Korolev in 1966 had the effect of hindering the progress of the Soviet space programme (Moltz, 2008: 155).

Despite the existence of an ambitious Soviet lunar human spaceflight programme, in the aftermath of the successful Apollo Moon landings, the Soviets denied that they had entered into a moon race with the United States. Given that copying an American achievement would not confer prestige or propaganda benefits, in the end, Moscow decided to abandon its lunar programme. Consequently, in 1969 the Soviet Union tried to adjust to the technical realities of its space programme by focusing on the development of space stations operating in low-Earth orbit (Sheehan, 2007: 34-5, 58). Moreover, it continued to exploit a series of successes of its space programme for political purposes. For example, the first robotic probe, Luna 16, landed on the Moon in 1970, followed by the remarkable landing of another spacecraft on the Moon's surface. Several probes were also sent deep into the solar system. All of these technical feats served to demonstrate the technological prowess of the Soviet Union (Sheehan, 2007: 57-8).

The Military Uses of Space

There is a consensus among analysts that the militarisation of space began with the launching of the first communications satellites. As we saw earlier, military and national security considerations provided a strong rationale for the development of the US and Soviet space programmes. The point to emphasise here is that the space race between the two superpowers was also an arms race originating from the need to acquire highly accurate intercontinental ballistic missiles. It is also in this context that the use of space satellites was utilised to support critical elements of military operations such as surveillance, reconnaissance, early warning, and targeting that served as the foundation of the US and Soviet deterrence policies during the Cold War.[29]

In discussing the military uses of space, the second point to make is that both the US and the Soviet Union entertained the idea of space warfare from the early phases of the Space Age. Not only did the two superpowers develop and deploy anti-satellite (ASAT) weapons, but they also detonated nuclear weapons in high altitudes. However, a number of factors led to the re-evaluation of these projects. In addition to high financial costs and technology deficiencies, it is clear that the specific qualities of the space environment posed unexpected dangers and risks that constrained the deployment of certain technologies, such as nuclear weapons in space and the use of ASATs. Through tests and experiments, US scientists realised that the space environment could not contain the emitted nuclear radiation in the space environment, putting human spaceflight, communications satellites, and reconnaissance satellites in jeopardy. Space debris generated by the conduct of ASAT's also highlighted the existence of mutual interdependence in the space environment. Given that the United States was leading in the area of communications and reconnaissance satellite technology, there was no need to risk losing that position. But there were additional factors that ultimately brought about the re-evaluation of a number of proposed US space weapons. These included: concerns within the defence department that the Soviet Union might be compelled to respond to the US nuclear test programme, pressure from the international scientific community, and the emerging US commercial space interests. The Soviets also recognised that harmful activities in space could put in danger human spaceflight and other space activities, and, thus, they adjusted their plans to the physical realities of the space environment. This led to the emergence of 'cooperative restraint' that defined the interaction between the United States and the Soviet Union since the early 1960s (Moltz, 2008: 65, 42-66, 121-75).

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[29] For detailed accounts on the militarisation of space, see Wong and Fergusson (2010); Moltz (2008); Sheehan (2007: 91-123); and Kalic (2012).

It was in this context that the two superpowers decided to tread carefully to avoid destabilising their relations, as they were aware of any move in space that could possibly distort the crucial relationship between the use of satellites and nuclear weapons. Consequently, the United States and the Soviet Union came gradually to mutually recognise the use of space as a collective good (Moltz, 2008: 65). This logic was reflected in the bilateral arms control agreements, signed between the two superpowers during the Cold War, that acknowledged the use of and non-interference of satellites as 'National Technical Means of Verification' (NTM) (Sheehan, 2007: 129). It was also manifested in the formation of the legal regime that still guides the multiple activities in space, as we shall see in the next chapter. Beyond strategic restraint, it is useful to briefly highlight the ways in which the Soviet Union and the United States engineered international cooperation as an effective instrument of foreign policy.

International Cooperation

Although it is clear that the space race in tandem with the growing use of space for military purposes were an expression of the intense competition between the United States and the Soviet Union, it is also apparent that international cooperation was a key feature of space activities during the Cold War. This has been evident in a number of bilateral cooperative agreements between countries, multinational space programmes, and in the establishment of the international regime of outer space. Accordingly, both superpowers realised the importance of space cooperation as a symbolic tool in the pursuit of foreign policy objectives. Thus, while a detailed discussion of international cooperation in space during the Cold War is beyond the scope of this chapter, it is worth briefly highlighting some of its key features here.

After the Soviet Union lost the race to Moon, it continued to invest in its space programme as an instrument of political propaganda and foreign policy. In this regard, space cooperation was seen as a way to emphasise the integrity of the Communist world and to confirm the unity of the Soviet bloc. This was manifested in the *Intercosmos* programme, which began in December 1976, based on the development of space stations operating in low-Earth orbit. Improvement in the design and operation of the Soviet space stations allowed visiting astronauts outside the Soviet

Union to fly on Soyuz/Salyut missions for a short period of time. What is noteworthy is that all of the Warsaw Pact states sent their cosmonauts aboard the Soviet space station as part of their participation in the Intercosmos programme. The selection of cosmonauts from countries like Cuba, Vietnam, France, India, Afghanistan, and Mongolia to fly on Soyuz/Salyut missions was illustrative of the politicised nature of this programme. For example, the selection of the Indian Air Force pilot Rakesh Sharma, the first Indian to fly in space in 1984, indicates the Soviet interest in strengthening ties with India as the leader of the non-aligned movement. Accordingly, cooperation with Soviet Union in space research promised to enhance India's space capabilities and served to highlight the autonomy of its foreign policy (Sheehan, 2007: 58-62).[30]

While it is clear that the Soviet Union placed greater emphasis on turning the space programme into a tool of political propaganda and foreign policy than the United States did, international cooperation was also a key dimension of the US space programme. Indeed, one of NASA's key missions was 'cooperation by the United States with other nations and group of nations' that marked NASA's role as 'an arm of American diplomacy' (Krige, 2013a: 6). This usually involved the launch of foreign scientific satellites, sharing of space-derived data, and the provision of scientific instruments on foreign spacecrafts. A telling expression of space cooperation in this respect was the Ariel I satellite, which was launched by the United States in 1962, carrying scientific instruments designed and developed by the British National Committee for Space Research. The launch of Ariel I made the United Kingdom the third country, after the Soviet Union and the United States, to operate a satellite. Likewise, the United States launched Canada's Alouette I in the same year to ensure that a country from the Western alliance was the first, other than the two superpowers, to have its own satellite in space (Krige, 2007: 209-10). Similarly, the US-Japan cooperation in rocket and satellite technology helped to accelerate the development of the Japanese space programme in the 1970s (Watanabe, 2011: 1335-6). However, cooperation was also expanded to developing countries, including India, as I shall discuss in Chapter 5.[31]

[30] A more detailed analysis of the flight of the first Indian astronaut is taken in chapter 5.
[31] International cooperation has also been involved in the establishment of tracking and communication facilities funded in support of space missions. Yet, little attention has been paid to this area of cooperation in the literature. For example, NASA funded the formation of a satellite tracking facility near Johannesburg in 1958, and a second facility in Hertebeesthoek in 1961 (Alden, 2007: 39-40).

The most obvious manifestation of cooperation in space as an instrument of foreign policy during the Cold War was that between the United States and the Soviet Union. In May 1972, the ‘Agreement Concerning Cooperation in the Exploration and Use of Space for Peaceful Purposes’, was signed, which led to a number of joint scientific programmes. But the most important event was the design and plan of a joint mission, the Apollo-Soyuz Test Project (ASTP), which led to the first rendezvous and docking of the two spacecrafts on 17 July 1975. The ‘handshake’ in space between the Soviet and US commanders became a symbol of the policy of détente pursued by the United States and the Soviet Union at the time (Ross-Nazzal, 2010; Sheehan, 2007: 65).

However, it is plain that President Reagan’s ‘Strategic Defence Initiative’ (SDI), known as ‘Star Wars’, combined with renowned Soviet ASAT testing, marked a significant policy shift from civilian to military programmes that challenged international order in space. This policy change had the effect of deteriorating US-Soviet relations, including cooperation in space (Moltz, 2008: 187-94; Johnson-Freese, 2009: 39-48).[32] Given the profound impact of the Reagan administration’s policies, especially on China, some of the implications of the SDI programme are examined in more detail in the following chapters. What is important to note here, however, is that the Reagan administration also placed emphasis on cooperation with US allies through the SDI programme and the creation of the ‘Space Station Freedom’ (Sheehan, 2007: 177; Westwick, 2010). The most general point to make is that by that time several countries, including China and India, were already engaged with key institutions of the nascent international space society.

Concluding Remarks

Even a long chapter such as this can barely analyse the complex amalgam of factors that influenced the history of the international politics of space. Nevertheless, a few important points that emerge from this discussion are worth emphasising as they help to explain the course of a set of ideas, norms, and practices that have shaped the existing international space order within which other space actors, like China and

[32] These developments severely strained strategic constraint in the early 1980s (Moltz: 2008: 176-218; Deudney 1983-1984: 105, 98-109). However, a number of factors, including the continuing influence of collective approaches to space security, prevented the emergence of a new round of a space arms race (Moltz, 2008: 226).

India, continue to pursue their space policies and activities, as latecomers to the Space Age. First, it is important to recognise the combination of structural and agential factors that defined the emergence of the Space Age as a key feature of modernity and progress in the twentieth century. What this chapter has tried to demonstrate is that a number of key engineers, designers, and space enthusiasts, who had participated in the space movement of interwar Europe, played a crucial role in promoting the cause of spaceflight during the space race between the United States and the Soviet Union.

The second point to make is that, although most IR analyses focus on the emergence of space politics as the upshot of national security considerations in the context of the Cold War, it is necessary to emphasise the role of technological achievements in space as a marker of scientific and technological prowess. True, the specific historical and strategic circumstances of the Cold War have had a profound impact on the development of space technology as a crucial strategic asset that eventually, through the use of surveillance and reconnaissance satellites, helped to stabilise the US-Soviet relations. But space technology has also been 'socially constructed' as a normative symbol of prestige and modernity during the space race. While is it clear that this process was the product of the US-Soviet competition, it also reflects an established practice among nations to construct technological achievements as a marker of modernity and prestige.

Plainly, the ways in which the Soviet Union and the United States constructed space technology has important comparative significance for much of the space activities of China and India. As the following chapters explain, in the longer term, the beginning of the Space Age impelled the two Asian countries to participate in the Space Age in order to demonstrate their share in modernity as well as to influence international space order. Consequently, the second long-term impact of the beginning of the Space Age has been manifested in the emergence of a dynamic international society in space.

Chapter 2. Space as International Society in Theory and Practice

This chapter focuses on space as international society. Drawing on key English School concepts, it argues that it is possible to conceptualise outer space not merely as a system, but also as an international society at the sectoral level with a distinct social structure. I attempt to develop this argument by highlighting how the nature of space as a distinctive sectoral interstate society is manifested in the ways in which its primary institutions are differentiated from such institutions at the global level in a historical and comparative context. In doing so, the following discussion helps to highlight the constitutive impact of these institutions on space-faring states.

The argument of the chapter is developed in the following ways. The first section engages with the use of international society as a central analytical idea and how it can help to conceptualise order in space. It is here that my analysis introduces my most innovative and ambitious contribution: I argue that a possible way to relate technology to international society is to focus on sectoral international societies, while recognising most of the key insights developed by scholars working on subglobal/regional international societies, including the need to identify how distinct primary institutions are differentiated at the subglobal/regional or sectoral level. The second section of the chapter then sketches out the primary institutions of international space society. Although the intention is not to provide a comprehensive and definite account of what may be counted as a primary institution, this conceptual exercise has the merit of highlighting the nature of space as a distinctive sectoral interstate society. This is manifested in the ways in which its primary institutions are differentiated from such institutions at the global level. In doing so, this study offers an important test of our ability to understand how order is maintained in space and helps to illustrate the growth of tensions and contradictions among the pluralist and solidarist conceptions of order in the social structure of international space society.

Sectoral International Societies and International Space Order

Before considering the key institutions of international space society in detail, it is necessary to make a number of points about the ways in which we can relate the idea of international society to outer space.[33] First, although, arguably, the launch of Sputnik can be seen as marking the expansion of international society in outer space, how to understand outer space presents knotty analytical and conceptual challenges when trying to treat it as a subglobal international society. The contention that there is an international society in outer space might seem at first sight to be rather straightforward and unproblematic, if we intuitively accept that outer space constitutes a different geographical region in terms of spatiality existing beyond the surface of Earth. This, of course, is reinforced by the fact that the physical attributes of the space environment are quite dissimilar from Earth (Deudney, 1982: 52). Hence, a focus on outer space as international society in spatial and geographical terms might be important enough in itself to be worth further examination, but it would provide a very narrow understanding of what an international space society entails. Following the ‘logic of geography’, such an analysis would deal merely with topics such as the operation of the International Space Station as a microcosm of international society as well as on human-made objects placed in orbit as enclaves of each state’s sovereign territory.[34]

Second, as Deudney (1982: 52) notes, it makes more sense to see outer space, or at least near space, ‘as an extension of the human world’ rather than as a ‘remote frontier’. In this vein, I also share McDougal’s view that it is important to understand the expansion of space activities from Earth to space as an ‘earth-space community process’, which was initially confined to Earth, and then gradually expanded to outer space. This ‘earth-space social process’ means that ‘the people conducting activities in space are the same people who have been acting on earth’ (McDougal, 1963: 621). In this regard, it makes more sense to identify a large number of actors as ‘effective participants’ in this community process, including states, international governmental

[33] In this chapter I use the term ‘outer space’ in a conventional way to highlight what the concept of international space society entails in terms of geography and spatiality. However, after putting forward the case of international space society, the use of the term ‘space’, which is more in line with a *sectoral* approach, is preferred, unless indicated otherwise.

[34] To the best of my knowledge, only Stuart (2008) has adopted an explicit English School approach to analyse how outer space has played a role in influencing world politics. Her thesis focuses on areas of cooperation as instances and expressions of international society. However, her focus is on the wider context of international society and world politics rather on the existence of a space-faring society of states. What merits emphasis here is that, although the International Space Station can be seen as an illustration of international society in space, in my analysis it is an epiphenomenon of the complex array of social relations between states that constitute social order in space.

organisations, non-governmental organisations, pressure groups, private enterprises, individual human beings, and so on (McDougal, 1963: 621-2).[35]

Third, while McDougal's concept provides a more comprehensive framework of the expansion of international society in outer space, the question of how to examine outer space as a different international society by utilising the analytical tools of the English School remains. My intention here is to take a less trodden path. I argue that it is necessary to recognise that certain technologies lead not only to the formation of technological systems, but also to technological international societies, such as the international space society or 'space-faring society of states', and what might be called the nuclear society of states and the cyber-society of states. This requires us to give attention not only to regional, but also to sectoral international societies, while acknowledging most of the key insights developed by scholars working on subglobal/regional international societies. Significantly, this involves the need to identify how distinct primary institutions are differentiated at the subglobal/regional or sectoral level within a globalised international society. As we saw earlier, Buzan and Gonzalez-Pelaez (2009) have utilised regional differentiation as a conceptual framework for capturing the extent to which the Middle East can be seen to constitute a regional international society with distinctive primary institutions. In a similar fashion, Schouenborg (2013) has suggested that there is a Scandinavian international society with different regional institutional developments. More recently, Buzan and Zhang (2014) have examined whether a distinct international social structure exists in East Asia at the regional level.

Despite the fact that the conceptual move towards a sectoral approach might seem to be a less travelled road, it has not been wholly uncharted territory within the English School literature, albeit largely neglected. For example, employing a sectoral analysis, Holden (2008) shows how world cricket can be regarded as a *sui generis* postcolonial sectoral international society in the sector of sports. More recently, Palmujoki (2013) has explored the extent to which an international society has been formed around global climate change governance, hinting at the merits of a sectoral approach to international society in general and to issues of global governance in particular. As far as nuclear technology is concerned, in his seminal work on nuclear weapons and international order, Walker (2012: 10) acknowledges the formation of orders in

[35] I would like to thank Daniel Deudney for bringing McDougal's work to my attention. For a detailed analysis of the 'earth-space social process', also see McDougal, Lasswell, and Vlasic (1963).

particular domains, such as the regional, economic, security or other orders, and how the international nuclear order, as 'an example of an order to an issue area, refers to the international order developed to address the distinctive set of problems, issues and goals associated with nuclear technology'. In my view, however, Walker misses a trick by not linking nuclear order with the existence of an international nuclear society underpinned by distinct institutions. The same also applies to Horsburgh's insightful work on China's engagement with global nuclear order (Horsburgh 2015).[36]

It is also important to note that Buzan and Albert (2010: 318) have drawn attention to the ways in which functional differentiation defines 'distinct and specialized subsystems or sectors of activity', including science, as a consequence of the emergence of modernity. Although limited space precludes a discussion of how the approach put forward in this thesis could draw upon and contribute to debates about functionally specific sectors, it is clear that it can speak to this very promising body of scholarship, and so it is a task worth undertaking elsewhere.[37] Suffice it to say that the international space society as a sectoral international society has also some ontological quality as the very debates over the nature of the global space order and the notion of a space club indicate. In other words, while the principal focus of this thesis is on the analytical purchase of a sectoral approach to space, it is important to note that this study also offers a way of examining international space society in hermeneutical and ontological terms, if we remember that there is the idea of an imagined and constructed community and/or an exclusive club of space-faring countries, just like nation-states or regions (Anderson, 1991; Hurrell, 2007: 242). The notion of a space community or space club is usually articulated by actors, governments, diplomats, lawyers, analysts, and the global media.

In light of the above, it becomes less fanciful to suggest that specific technologies have the effect of creating new domains of social interaction that have a constitutive impact on their members. In this sense, technological international societies are characterised by their own social structure and their distinct institutions, which construct distinctions between outsiders and insiders by defining certain conceptions of rightful membership of what is perceived as legitimate patterns of conduct among the members of these technological societies. It is important, therefore, to understand

[36] Building on Walker and the English School, Horsburgh (2015) offers an innovative framework for analysing China's engagement with global nuclear order, which has influenced my analysis of China's engagement with international space society discussed in Chapter 6.
[37] On this debate, see also, for example, Donnelly (2011); and Albert and Buzan (2013).

outer space not merely as a structure of strategic interaction between states, but also as an expression of an international society of states underpinned by social order. In this vein, this study contends that there is an international space society 'with its own social structure which embodies complex social relations among participating and constituent states, and which has a particular set of institutions that help to define norms of acceptable and legitimate state behavior' (Zhang and Buzan, 2012: 8). Briefly stated, a sectoral approach helps to transcend the boundary between outer space and Earth by focusing on the social structure in the sector of space as a whole.

This complex amalgam of social practices, values, and norms reflects the conscious effort of the space-faring countries to build social order in space. However, it is also suggestive of the embedded institutions that define and reproduce the structure of international space society through a process of institutionalisation, emulation, and socialisation. Consequently, this opens up the possibility of exploring the ways in which its primary institutions are differentiated from such institutions at the global level (war, law, diplomacy, balance of power, great power management, nationalism, market, environmental stewardship and so on) and how space order is created, maintained, negotiated, and transformed. This may involve an attempt to identify what should be counted as an institution as well as the ways in which the institutions of the space social domain as a sectoral inter-state society differ from those at the global level.

A few additional points should be made at this stage. First, a sectoral approach helps to highlight the tension between three different normative orders underpinning the international space society, which is reminiscent of the three traditions espoused by Wight (1991): Hobbesianism or Machiavellianism (realism), Grotianism (rationalism), and Kantianism (revolutionism), respectively. In discussing distinct schools of thought concerning space utilisation and space governance, several authors have captured this tension. For example, as far as the space weaponisation debate is concerned, Mueller (2003) has identified six schools of thought: idealist, internationalist and nationalist sanctuary theories, and preemptive, utilitarian and hegemonist pro-weaponisation perspectives. In relation to space governance, Gallagher (2013) singles out three strategic logics for space cooperation associated with distinct ideas and policies: the 'strategic stability', the 'space governance for global security' and the 'global commons' logics. While an analysis of these schools of thought and strategic logics is beyond the scope of this study, it is clear that an explicit English School approach, which builds on the three traditions of what might be called 'Space Machiavellian', 'Space Grotian', and 'Space Kantian', can enrich these debates by highlighting the constant tension and conversation between the two extremes of 'Star Wars' and 'Spaceship Earth'.[38] In doing so, an English School approach also helps to underline the fragility of international space order.

The second point to make is that a sectoral approach should not preclude the study of regions, regionalism, or distinct regional patters of order within international space society. After all, regional space orders within the global space order are far from unimaginable. By way of illustration, one can speak of an East Asian space order or a European space order. Furthermore, there is good reason to explore the study of inter-sectoral and intra-sectoral relations and dynamics. What I have here specifically in mind is the relationship between the international space society and the international nuclear society or how space is related to the cyber society of states.[39] Third, from the above, it also follows that a sectoral approach opens up new avenues for exploring the ways in which the English School can provide insights about global governance. Equally, it can also be seen as a first step, albeit incomplete and underdeveloped, towards responding to Buzan's call for bridging the English School with International Security Studies (Buzan, 2014b).

Therefore, it is worth briefly sketching out how it is possible to apply structural concepts from English School to space. As we saw earlier, this may involve an attempt to identify the ways in which the institutions of space as a sectoral inter-state society differ from the global level. In what follows, my intention is not to provide a comprehensive or definitive list of the primary institutions of international space society. Rather my aim is to sketch out the ways in which the employment of international institutions as subjects of analysis can offer insights into the study of the international politics of space.

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[38] The tension between the two images of space as 'Star Wars' and 'Spaceship Earth' is succinctly captured in the title of Deudney's *The High Frontier of Outer Space in the 1990s: Star Wars or Spaceship Earth?* (Deudney, 1991).

[39] This is significant, given the growing intersection between the space and cyber domains. See, inter alia, Baylon (2014); Stuart (2015); and Livingstone and Lewis (2016).

Primary International Institutions in Space

Space War

Given that war appears somewhat unthinkable between liberal democratic states operating inside the existing liberal international order and great-power war involves high costs largely because of economic interdependence and the threat of the use of nuclear weapons, there is some scope for questioning whether war should be seen as a primary institution of the contemporary international society.[40] However, as Pejcinovic (2013: 164) notes, the policies associated with efforts to avoid the use of nuclear weapons, including nuclear deterrence, 'so deeply embed a *necessity* to be prepared for war that we are unable to think of war as anything other than a vital institution of international society'.[41]

Be that as it may, war as an institution of international space society presents at least three key differences with the global level. First, the very idea that space is seen as a different domain of warfare because of the particular qualities of the space environment helps to illustrate how space warfare differentiates from war at the global level. Second, despite the fact that the use of space assets has had an important impact on the conduct of terrestrial warfare, it is striking, perhaps, that a conflict in space has not occurred yet. This, of course, presents a key difference with the global level. At the same time, it is indicative of the existence of order in space. Third, as we shall see, the trend towards the militarisation and even weaponisation of space suggests that it makes more sense to treat space militarisation as a key institution of international space society, at least for now, which is also another main difference with the global level.

In the context of discussing militarisation as an additional derivative institution of international space society, it is worth remembering that both the United States and the Soviet Union developed means of conducting space warfare from the early phases of the Space Age, but a reassessment of the technical challenges and destabilising effects that this involved gave rise to 'cooperative restraint', as we saw in the previous chapter. But this period also saw the militarisation of space. While there was not a

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[40] On these points, see Buzan (2014a: 150-3). On liberal international order, for example, see Deudney and Ikenberry (1999); and Deudney and Ikenberry (2009).

[41] For an insightful analysis of the impact of nuclear weapons on international order, see Deudney (2007: 244-64).

clear and authoritative definition of the term 'peaceful uses' in the UN documents and treaties, the widely accepted interpretation of the term 'peaceful' in relation to outer space is 'non-aggressive' instead of 'non-military' (Kuskuvelis, 1988: 91-2). Notably, the legal regime of space contains important prohibitions concerning military activities, but at the same time it leaves open the option for the use of conventional weapons or the use of ASAT weapons, the transit of nuclear weapons through space or the launch of nuclear weapons from Earth into space to reach an incoming missile (Tannenwald, 2004: 370).

Although the term 'peaceful uses' in relation to space has been accepted to mean 'non-aggressive', problematic here has been the distinction between the militarisation and the weaponisation of space. While a definition of space weapons is highly contested, generally it refers to 'any specialized destructive device built to operate or take effect' from Earth-to-space, space-to-space and space-to-Earth (Bulkeley and Spinardi, 1986: 3; Jasani, 1987). Yet, other definitions refer only to those weapons in orbit that have the capability to attack targets in space or on Earth (Institute of Air and Space Law, 2005: 3).

But whatever one thinks about the merits of these definitions, the weaponisation of space should not be seen as a linear process that follows the militarisation of space. There is not a turning point that signifies the transition from the militarisation to the weaponisation of space (Mueller, 2003: 5). Indeed, as we saw in Chapter 1, the United States and the Soviet Union soon came to realise how destructive and destabilising the use of nuclear weapons in space would be in the exoatmospheric environment, as the destructive effects of the blast and radiation would not differentiate between friendly and enemy satellites. Likewise, the two superpowers decided to restrain the use of ASAT systems (Moltz, 2008: 42-66). While these systems were developed and tested, they didn't reach operational status or used against other countries. But despite the development and deployment of these weapons, space has not been weaponised (Deblois, 2003: 31). In other words, there was nothing inevitable about the course of these developments if we consider that 'space weaponisation is inherently political' (Mueller, 2003: 23).

That said, the issue of space militarisation and weaponisation came again on the forefront when the George W Bush administration announced plans for the deployment of space-based missile defence systems and the development of anti-satellite weapons (Mueller, 2003; Deblois, 2003; Johnson-Freese, 2009: 56-94). The

ASAT test carried out by China in 2007 served to further highlight how pertinent the issue of space militarisation and weaponisation is for the maintenance of international space order. The Chinese ASAT test is examined in detail in Chapter 6, but it is useful to say briefly something about the US plans to deploy space-based weapons under the Bush administration.

From the Militarisation to the Weaponisation of Space?

Certainly, the 1990s saw a shift from the use of space assets in support of strategic deterrence to space utilisation as a military force multiplier that enhances the effectiveness of combat forces on the ground.[42] This change began with the first Gulf War in 1991, known also as the 'first space war', which confirmed the strategic significance of space systems in warfare at both the operational and tactical levels. As a result, the national space policy under the Clinton administration that followed elaborated for the first time on the concepts of space support, force enhancement, space control, and force application and recognised 'access to and use of space' as 'a vital interest' of the United States (Sheehan, 2007: 94, 98). Yet, it was apparent that the Clinton administration did not make any tangible effort to develop the required technologies for the implementation of its space policy (Moltz, 2008: 239-40, 254).

This position changed with the George W Bush administration's plans to pursue and develop certain technologies that would signal the move towards the weaponisation of space.[43] This was accompanied by a series of US doctrines and documents that called for the development of space weapons and control in space. This was evident in the 2000 *Report of the Commission to Assess US National Security Space Management and Organization* that infamously warned of an imminent 'space Pearl Harbor'.[44] Then, in 2002, the Bush administration announced the withdrawal of the United States from the Anti-Ballistic Missile Treaty (ABMT). This meant that there was no

[42] On key developments related to the military uses of space, for example, see Handberg (2000); Sheehan (2007: 91-123); Coletta and Pilch (2009); and Wong and Fergusson (2010).

[43] For detailed accounts of the US space policy under the George W Bush administration, see, inter alia, Moltz (2008: 259-301); and Johnson-Freese (2009: 56-94).

[44] Known as the 'Space Commission' chaired by Donald Rumsfeld just prior to his nomination as US defence secretary, the commission in its final report submitted to Congress on January 2001 concluded that 'If the United States is to avoid a 'Space Pearl Harbor', it needs to take seriously the possibility of an attack on US space systems. The report also called the United States to take the necessary steps in order to 'develop the needed capabilities and to maintain and ensure continuing superiority' (Commission to Assess US National Security Space Management and Organization 2001: viii, x).

international treaty obligation for the United States to refrain from moving forward with missile defence and space-based missile defences (Sheehan, 2007: 95). One month later, the Joint Chiefs of Staff issued a doctrine document for space activities that enunciated the concept of 'space superiority'.[45] Subsequently, in 2004, the United States Air Force issued the first doctrinal document that declared space superiority as providing 'freedom to attack as well as freedom from attack' (U.S. Air Force, 2004: 1). More importantly, on 31 August 2006, President Bush authorised a new national space policy that called on the Secretary of Defence to 'maintain the capabilities to execute the space support, force enhancement, space control and force application missions' and to 'develop capabilities, plans, and options to ensure freedom of action in space, and if, directed, deny such freedom of actions to adversaries' (the White House, 2006: 4).[46]

But although there is general agreement that during the Bush presidency the quest for space dominance became a priority, there is less agreement about the precise operability of these programmes or their outcomes. What is more clear, however, is that the emphasis on space superiority in tandem with an ambiguous position on space weaponisation, reflected in the wording of certain US doctrines and statements during the Bush administration, had the effect of reinforcing the views of other countries about the inevitability of space weaponisation and conflict by exacerbating security dilemmas (Peoples, 2008).[47] Conversely, as we shall see, the fact that the Obama administration placed greater importance on international cooperation has contributed to the strengthening of international space order.[48]

Consequently, the issue of space militarisation and weaponisation highlights the pluralist/solidarist dilemma under conditions of uneven development and asymmetries of power in space. It also points to the significance of socialisation in international space society. But although the space weaponisation threshold has not been crossed yet, the trend towards space militarisation continues apace. Therefore, for the

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45 The concept of space superiority called for the use of space by the US military not only for support functions, but also for two offensive missions: 'space control' and 'space force application' (Hitchens, Katz-Hyman, and Lewis, 2006: 35).

46 In addition, the new policy stated that: 'the United States will oppose the development of new legal regimes or other restrictions that seek to prohibit or limit US access to or use of space. Proposed arms control agreements or restrictions must not impair the rights of the United States to conduct research, development, testing, and operations or other activities in space for US national interests' (the White House, 2006: 4).

47 On space security and the growing security dilemma between the United States and China, for example, see B. Zhang (2011).

48 For a trenchant analysis of the US space policy under Obama, see Gallagher (2013).

purposes of this study, it is more helpful to treat space militarisation as a key sectoral derivative institution of international space society.

Space Law

According to Wight (1986: 107), 'the most essential evidence of the existence of an international society is the existence of international law.[49] As far as space law is concerned, the realm of space is governed by five international treaties. These are: the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space*,* including the Moon and Other Celestial Bodies, known as the 'Outer Space Treaty' (OST)[50]; The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the 'Rescue Agreement')[51]; the Convention on International Liability for Damage Caused by Space Objects (the 'Liability Convention')[52]; The Convention on Registration of Objects Launched into Outer Space (the 'Registration Convention')[53]; The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the 'Moon Agreement')[54] (United Nations Office for Outer Space Affairs, 2008).

In addition to the five treaties, the space regime comprises a set of five declarations and principles,[55] and a number of bilateral disarmament and arms control agreements

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[49] For a good overview of the English School's approach to international law, see Wilson (2009).

[50] The Outer Space Treaty was adopted by the General Assembly in its resolution 2222 (XXI) and entered into force on 10 October 1967.

[51] The 'Rescue Agreement' was adopted by the General Assembly in its resolution 2345 (XXII) and entered into force on 3 December 1968.

[52] The 'Liability Convention' was adopted by the UN General Assembly in its resolution 2777 (XXVI) and entered into force on 1 September 1972.

[53] The 'Registration Convention' was adopted by the UN General Assembly in its resolution 3235 (XXIX) and entered into force on 15 September 1976.

[54] The 'Moon Treaty' was adopted by the UN General Assembly in its resolution 34/68 and entered into force on 11 July 1984.

[55] The five declarations and legal principles are: the Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space (UN General Assembly resolution 1962 (XVIII) of 13 December 1963); The Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting (UN General Assembly resolution 37/92 of 10 December 1982); The Principles Relating to Remote Sensing of the Earth from Outer Space (UN General Assembly resolution 41/65 of 3 December 1986); The Principles Relevant to the Use of Nuclear Power Sources in Outer Space (UN General Assembly resolution 47/68 of 14 December 1992); The Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries (UN General Assembly resolution 51/122 of 13 December 1996). See United Nations Office for Outer Space Affairs (2008). Also, see http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.html.

between the United States and the former Soviet Union[56], in line with international law and practices. It also consists of various multilateral and bilateral legal instruments, including a series of agreements related to the commercial use of space and a number of pronouncements concerning the establishment of intergovernmental bodies and organisations and their functions (Tannenwald, 2004: 370).[57]

The 'Outer Space Treaty' (OST) remains arguably the cornerstone of international space order largely because it introduces a series of principles and concepts that have since been regarded as the basic framework of international space law. Specifically, the Outer Space Treaty recognises 'the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes' and that 'the exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind'. It also acknowledges that 'outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means' and prohibits the placement of nuclear weapons or other weapons of mass destruction in orbit or on other celestial bodies. Briefly stated, the fundamental principles governing space activities include the concept that space should be reserved for 'the benefit and in the interests of all mankind' and for 'peaceful purposes' and that it is 'nonappropriable' (Tannenwald, 2004: 370-1).

[56] There is a series of bilateral disarmament and arms control agreements that explicitly apply to space operations or include a space component meriting discussion (Tannenwald, 2004: 370, note 28). The 'Partial Test Ban Treaty' (PTBT), also abbreviated as the 'Limited Test Ban Treaty' (LTBT), formally the 'Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water', prohibits the use of nuclear weapons in space. It was signed between the United States, the Soviet Union, and the United Kingdom and entered into force on 10 October 1963. The Interim Agreement between the United States of America and the Union of Soviet Socialist Republics on Certain Measures With Respect to the Limitation of Strategic Offensive Arms (SALT I), signed on 26 May 1972, and the Treaty on the Limitation of Strategic Offensive Arms and Protocol Thereto (SALT II) prohibit interference with National Technical Means (NTM) of verification (reconnaissance and communications satellites). Further, the SALT II agreement contains provisions relating to outer space by forbidding the development, testing, or deployment of weapons of mass destruction in space. The Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems (ABM Treaty), which was signed on 26 May 1972, recognised the non-interference principle by one party with the national technical means of verification of the other and it also banned the deployment of space-based missile defence systems between the two parties. However, on 13 December 2001, the Bush administration announced the withdrawal of the United States from the ABM Treaty, and thus, it is not in force anymore. For a good summary of these developments and the treaties related to arms control, see Graham and LaVera (2003).

[57] For a non-exhaustive list of a number of bilateral and multilateral agreements, see http://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/bi-multi-lateral-agreements.html.

Notwithstanding the rather progressive language of the normative framework envisioned by the legal regime of outer space, given the historically small number of states with space capabilities these general principles have not been tested and remain largely aspirational (Tannenwald, 2004: 370). To complicate matters, while there have been a series of recent diplomatic initiatives, one of the striking aspects of the international politics of space is how little has been achieved in terms of new agreements or treaties pertaining to the legal regime of space in the post-Cold War era. Moreover, although interpretations of the principles asserted in the Outer Space Treaty are still hotly debated among scholars, they also serve to highlight the familiar order/justice dilemma expressed in pluralist/solidarist debates within the English School literature. Nowhere is this more evident than in the endless normative debate about how to understand sovereignty in space as I explain below.

Sovereignty

The institution of sovereignty constitutes the heart of international society as it usually defines who legitimately controls what territory and who is a member of the society of states. It is here perhaps that we can see how realist calculations and universalist aspirations are pulling in different directions in international space society. At one level, it is clear that the institution of sovereignty in space introduces important elements of difference with the global international society. This has been reflected in the principles of 'Mankind', and 'non-appropriation' that mark a departure from traditional conceptions of Westphalian sovereignty and, thus, set up a solidarist promotion of the exploration and exploitation of space 'for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development'. Likewise, the 'common interest' provision leans towards a solidarist conception 'of the interests of the international community as a whole' (Wolter, 2006: 97). The Outer State Treaty, therefore, establishes a shift towards cosmopolitan sovereignty (Stuart, 2009: 16).

At another level, however, this solidarist conception is staged as complementary to a pluralist logic. This is because the Outer Space Treaty confers the responsibility of conducting space activities upon states, irrespective of 'whether such activities are carried on by governmental agencies or by non-governmental entities' (Fawcett, 1984: 10). Besides, for all its aspirational, and rather inspirational overtones, the Moon Agreement has yet to be ratified by any key space power. Indeed, the Agreement provides that the Moon and its natural resources are the common heritage of mankind and that an international regime should be established to govern the exploitation of such resources when such exploitation is about to become feasible. But the fact that the Moon Agreement is essentially a failed treaty becomes more important, given that ideas about colonising the Moon are still favoured by key space powers as well as by non-state entities that promote the privatisation of space and the exploitation of the Moon's resources. Thus, the ongoing normative tension between order and justice in space will remain as the idea of territorialising space gains more support among those who favour the commercialisation of space resources. Yet, the general point to make is that the institution of sovereignty in space does present significant sectoral specificities that differentiate it from the global level.

Space Diplomacy

The institution of diplomacy, together with its derivatives of bilateralism and multilateralism, does not present any recognisable sectoral differences with the global level. Nevertheless, it played a crucial role in contributing to the creation and management of order in space.[58] Historically, the UN system has been used as the main forum for space cooperation from the early days of the Space Age. In 1958, after the launch of Sputnik by the Soviet Union, the United Nations General Assembly established the Committee on the Peaceful Use of Outer Space (COPUOS) in Vienna as an ad hoc committee by adopting resolution 1348 (XIII).[59] In 1958, the General Assembly decided to establish COPUOS as a permanent body and reaffirmed its original mandate in its resolution 1472 (XIV). In 1961, the General Assembly adopted resolution 1721 (XVI) that requested the Committee: to maintain close communications with governmental and non-governmental organisations involved in outer space matters; to provide for the exchange of information among governments

[58] The most detailed account of space diplomacy is Peterson (2005).

[59] The mandate of the Committee was to consider: the activities and resources of the United Nations concerning the peaceful uses of outer space; the proper ways in which international cooperation could be undertaken under UN auspices; organisational arrangements to facilitate international cooperation within the UN framework; and legal problems arising from the exploration of outer space. See, United Nations Office for Outer Space Activities, COPUOS History, http://www.unoosa.org/oosa/en/ourwork/copuos/history.html.

relating to activities in space on a voluntary basis; and to contribute to the study of measures for the promotion of international cooperation in space. The same resolution also called states to provide the United Nations with information on their launching objects in space through COPUOS and requested the UN Secretary General to maintain a public registry of objects launched into space (United Nations Office for Outer Space Affairs, 1961). These mandates have guided the activities of COPUOS in its efforts to promote international cooperation in the peaceful uses of outer space since then.

The Committee consists of two standing subcommittees: the Scientific and Technical Subcommittee and the Legal Subcommittee. The Committee and its two Subcommittees meet annually in Vienna to consider questions raised by the UN General Assembly and issues that concern the Member States. In this regard, the Committee and its two Subcommittees make recommendations to the General Assembly on the basis of consensus. Significantly, COPUOS has played a fundamental role in the evolution of the legal framework that governs space activities and has promoted the use of space applications by developing countries. Indeed, COPUOS has been the primary forum for the elaboration and development of the five international treaties and agreements that thereafter govern the realm of outer space (Graham and Huskisson, 2009: 108). At the same time, it was also a forum for US-Soviet competition to achieve the image as the country most committed to the use of space for peaceful purposes, both at the international and the domestic level (Von Bencke, 1997: 40; Peterson, 2005: 23).

Beyond COPUOS, it should be added that the UN Conference on Disarmament (CD) in Geneva has been the single forum for negotiating space arms control. In 1981 the UN General Assembly adapted the resolution on Prevention of an Arms Race in Outer Space (PAROS), which was put on the agenda of the CD in 1982. An *ad hoc* committee was established in 1985 on negotiating PAROS on the basis of consensus. From 1985 to 1994, the *ad hoc* committee held several meetings, but the process reached an impasse largely because of the US refusal to enter into such negotiations. In fact, as a result largely of the US position that there is no arms race in space and that there is no need for new treaties or agreements concerning space arms control, negotiations held at the CD have been stalemated since the late 1990s.[60]

[60] For a detailed discussion on negotiating PAROS, see Wolter (2006: 60-80).

Nevertheless, given the emergence of new space security challenges from the growing military use of space and the orbital debris problem to the issue of frequency interference, as space becomes increasingly crowded, there have been a number of new multilateral efforts to enhance space governance. It is worth briefly spelling out the most important of these recent initiatives, as they help to highlight the growing recognition that space diplomacy is a fundamental pillar of managing international space order.

Current Multilateral Initiatives

There are currently three important multilateral initiatives concerning space activities focusing on voluntary measures, which are related to each other: the EU Code of Conduct, the COPUOS Working Group on the Long-term Sustainability of Outer Space Activities, and the Group of Government Experts (GGE) on Transparency and Confidence-building Measures (TCBMs) in Outer Space. Moreover, proposals for a legally binding treaty banning space weapons have been submitted at the CD. More specifically, in June 2008, the European Union proposed a 'Code of Conduct in Outer Space Activities' as a way to place the issue of space security back in the agenda of space diplomacy amid the continuing deadlock in the CD and the Bush administration's opposition to any new treaty regarding space.[61] China's ASAT test in January 2007 caused EU policy makers to further realise the need for cultivating a safe space environment for European space activities (Dickow, 2009: 153). The initiative partly originates in the efforts of the US based non-governmental organisation, the Henry L. Stimson Center, whose founding director, Michael Krepon, has been advocating the concept of a code of conduct or 'rules of the road' for what constitutes responsible behaviour in space (Krepon and Clary, 2003; Krepon, 2012).

The proposed EU code is non-legally binding, voluntary, open to all states, and complimentary to existing international law as it applies to space. In addition to contributing to TCBMs, the draft code is aimed at enhancing the safety, security and sustainability of space-related activities by setting consensual norms of behaviour that define responsible and irresponsible practices in space based on general principles

[61] On the background of the EU draft Code of Conduct, see, inter alia, Dickow (2009); and Rathgeber, Remuss, and Schrogl (2009).

associated with the peaceful and sustainable use of space.[62] It also provides a set of measures on space operations and space debris mitigation and proposes several cooperation mechanisms among the subscribing signatories (Council of the European Union, 2008).

The EU proposal generated a variety of responses and reactions. In January 2012, Ellen Tauscher, US undersecretary of state for arms control and international security, announced that the United States would not sign the EU draft at the time on the grounds that it was 'too restrictive'. There were also concerns that signing the draft code would limit the freedom of action of the US military in space. Instead, it was stated that the EU draft could serve as the foundation for future deliberations on what was now referred to as 'an international code of conduct' (Weisgerber, 2012).[63]

Aside from the United States, Australia, Canada and Japan endorsed the code of conduct. However, the reaction of Russia, China, and India was rather negative for at least two reasons. First, there was a general unease that the procedure followed by the EU was not inclusive because key space-faring states and developing countries were not consulted prior to the code's drafting. Second, there was discomfort with the idea that negotiations over the EU code would take place outside of the UN multilateral structure based on informal consultations. China and Russia were especially concerned that the proposed code would shift the focus of attention from their draft text concerning a legally binding treaty to prevent an arms race in space, which was proposed to the CD in 2008 (more on which below) (Moltz, 2014: 161; Su and Lixin, 2014: 35; Hitchens, 2015: 7). To overcome the concerns and criticisms that the drafting of the code was not inclusive, the EU convened a series of multilateral consultations open to all interested states. The consultation process led to the publication of revised drafts versions of the code in September 2010, June 2012, and September 2013. The latest draft of the code was released in March 2014.[64]

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[62] The proposal's emphasis on codifying norms of responsible and good behaviour in space is a tacit recognition that space is a social environment where a behavioural framework can 'foster mutual constraint, mutual accommodation', and 'the pursuit of separate purposes' in space (Wilson, 2009: 178). This points to the importance of normative rules in providing a behavioural framework that is keeping in line with an English School understanding of law (Wilson, 2009: 171). Krepon (2012) provides an insightful analysis of the importance of norms setting in space.

[63] Shortly after, the US Department of State issued a press statement that reaffirmed the US stance on the EU draft (US Secretary of State, 2012).

[64] European Union External Action, 'Code of Conduct of Outer Space Activities', http://eeas.europa.eu/non-proliferation-and-disarmament/outer-space-activities/index_en.htm.

Given the stalemate at the CD, another important step towards continuing dialogue on space security issues has been the formation of the GGE on TCBMs in Outer Space.[65] In December 2010, Resolution 65/68 by the UNGA's First Committee, which deals with disarmament and security issues, requested the Secretary-General to establish a GGE to carry out a study on TCBMs in space (United Nations General Assembly, 2010). Consequently, the GGE on TCBMs was established in 2011, consisting of fifteen international experts.[66] The key upshot of the GGE work was its final report, which was received and adopted by the UNGA in 2013 at its 68th session. The report puts forward basic TCBMs for space that can contribute to fostering mutual trust and understanding among nations and minimising the risk of misconceptions, misperceptions, and conflict (United Nations General Assembly, 2013: 16-8). It remains to be seen how successful the implementation of these recommendations will be, but as Hitchens (2015: 5) points out, the report is also significant because it is the first UN agreement that has emerged after many years focusing on measures related to improving space security. Meanwhile, in 2010, COPUOS formed the Working Group on the Long-term Sustainability of Outer Space Activities, which is tasked with drafting a consensus report regarding best-practice guidelines with the aim to safeguard the long-term sustainable use of outer space (C. Johnson, 2014b).[67]

Beyond multilateral initiatives based on voluntary measures, in 2008, China and Russia offered at the CD a draft for a legally binding 'Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force Against Outer Space Objects' (PPWT) (Loshchinin and Wang, 2008). It is clear that this initiative by China and Russia reflected their shared concern about the US Ballistic Missile Defence (BMD) programme, which could possibly negate their nuclear deterrent (Arbatov, 2010: 85). But the draft treaty received mixed reactions. On the one hand, it was seen as an important step in trying to break the deadlock at the CD. On the other hand, there were still concerns regarding the intentions of China's 2007 ASAT test that remained unaddressed (Moltz, 2014: 158-9).

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[65] For the role of TCBMs in space, see Robinson (2010).

[66] Five of the fifteen spots were secured by the permanent members of the UN Security Council (China, France, Russia, UK, and the United States). The following countries filled the remaining spots: Brazil, Chile, Italy, Kazakhstan, Nigeria, Romania, South Africa, South Korea, Sri Lanka, and Ukraine (C. Johnson, 2014a: 1).

[67] For the background of the long-term sustainability of outer space activities, see Brachet (2012).

As far as the content of the treaty was concerned, in August 2008, Ambassador Christina Rocca (2008: 3-8), the US representative to the CD, issued a number of comments and criticisms that pointed to the vague language and provisions in the draft treaty, especially with regards to the following issues: a) the definition of the 'use of force' in space, b) whether the draft treaty prohibits the testing and deployment of terrestrial-based ASATs, c) and the absence of a provision for a verification regime. In a formal reply, China and Russia indicated that the draft PPWT addresses weapons in space (Loshchinin and Wang, 2009). This means that the proposed treaty prohibits the use of space-based ASAT and BMD systems as well as space-to-Earth weapons, but not the research, testing or deployment of ground-based space weapons like China's 2007 ASAT test (Arbatov, 2010: 85; Su, 2010: 86; Mutschler, 2013: 140-1).

In June 2014, China and Russia issued the updated draft PPWT (Borodavkin and Wu, 2014). Yet, as Tronchetti and Hao (2015: 44-5) argue, while the amended proposed treaty was characterised by a considerable rewording of its provisions, it retains the most controversial features of the 2008 version, including an exclusive focus on prohibiting weapons placed in space and the lack of verification mechanisms. Therefore, the prospect for a positive reception to the proposed treaty was seriously undermined.

The Balance of Power

In many ways, the advent of the Space Age was the result of the Cold War rivalry between the United States and the Soviet Union. However, it is important to note that the balance of power did not only reflect the sort of a mechanistic understanding espoused by realists. It was also an expression of a conscious effort to maintain international order in space. In other words, Little's distinction between *adversarial* and *associational* balancing is relevant to this discussion (Little, 2007: 66-7, Buzan, 2014a: 143). Although the first phase of the space race followed the logic of adversarial balancing, the emergence of cooperative restraint that defined the interaction between the United States and the Soviet Union since the early 1960s was in line with associational balancing. As we saw earlier, the United States and the Soviet Union decided to tread carefully to avoid destabilising their relations in space

(Moltz, 2008: 124-75). This led to the mutual recognition of treating the use of space as a collective good (Moltz, 2008: 65). In turn, this paved the way towards the bilateral arms control agreements signed during the Cold War that acknowledged the use of and non-interference of satellites as 'National Technical Means of Verification' (NTM) (Sheehan, 2007: 129). It was in this context that a set of norms regulating the conduct of behaviour in space was emerged as embedded practices shared by latecomers in the Space Age.

With the end of the Cold War and the emergence of the United States as the sole superpower, the fundamental question is the extent to which the balance of power has weakened as a primary institution of international society (Buzan, 2014a: 144). The same question is also relevant to the status of the balance of power as an institution of international space society. After 1989, not only did the action-reaction dynamic that underpinned much of the US-Soviet space relations end abruptly, but also the very issue of space security was given relatively low priority by the United States (Moltz, 2008: 228-9).

However, as we shall see in more detail in subsequent chapters, there is evidence to suggest that some form of balancing behaviour is emerging, especially in the context of the US-China rivalry, which involves a mix of both types of balancing. But whether the balance of power will be strengthened as a key institution of international space society, not the least because of the rise of Chinese space power, remains an open question. What can be said is that much will depend on how Washington and Beijing will decide to manage their broader strategic relations and work together to shape international space order. How India will decide to use its growing clout in space will also be an important factor. These questions are closely tied to the functions of great power management as an institution of international space society.

Great Power Management

The idea of great power management (GPM) is about the 'existence of a club with a rule of membership', which is largely underpinned by great powers seeking to be recognised by others to assume, and have been recognised by others, to assume managerial responsibilities and rights in international society (Bull, 2002: 194, 196). In this regard, as an institution it is closely linked to an associational balance of power

(Little, 2006). Given that at the outset of the Space Age space capabilities were confined to the two superpowers, great power management initially fell to the hands of the United States and the Soviet Union. As we saw earlier, gradually, the two superpowers reasserted space as a common good, which was manifested in the emergence of strategic restraint (Moltz, 2008). Therefore, one of the fundamental goals of the Outer Space Treaty was to ensure that outer space would not be an arena of colonial competition and military conflict (Park, 2006: 877).

According to Wolter (2006: 19), there were three main principles that defined the responsibilities of the two superpowers in space. These were: the 'responsibility towards the international community not to extend the arms race into outer space; the principle of the peaceful use of outer space; and the principle of putting the interest of mankind above individual interests'. Another principle, embodied in the Outer Space Treaty, is that of state equality, which suggests that great powers have the duty of assisting developing countries to participate in space activities (Wolter, 2006: 96). Some initiatives were taken by the United States and the Soviet Union towards this direction as part of their Cold War competition over the 'hearts and minds' of the 'Third Word', but these were often overshadowed by the primary goal of preserving strategic stability between the two superpowers.[68]

With the passing of the Cold War, a key discussion within the English School has centred on how to make sense of the operation of great power management given the uncontested hegemonic position of the United States and, since 2001, its unilateralist tendencies under the Bush administration.[69] One useful way of conceptualising the management of order under conditions of primacy has been put forward by Clark (2009b), who postulates that it is possible to treat hegemony as an institution of international society. Be that as it may, as far as great power management in space is concerned, the end of the Cold War broke down the cooperative restraint that the United States and the Soviet Union had established in the management of international space order, which had facilitated the signing of bilateral arms control agreements and international treaties pertaining to space activities. But after 2000, international space order appeared particularly weakened due to a number of challenges, including the US plans for the weaponisation of space, its refusal to

[68] As we shall see in Chapter 5, cooperation between NASA and ISRO in the 1960s and early 1970s was an a key example of providing assistance to a developing country.
[69] Recent works on great power management include: Morris (2005); Little (2006); Bukovansky et al. (2012); Aslam (2013); C. Jones (2014); Lasmar (2015); Cui and Buzan (2016); and Loke (2016).

negotiate arms control, and China's ASAT test. As a result, great power management was subject to increasing pressure. But, as we shall see, since the late 2000s, some progress has been made towards stabilising international space order as a consequence of collective efforts by great space powers, including the United States, China, and India.

In terms of great power responsibilities, as Bukovansky et al. (2012: 47-8) observe, since the end of the Cold War, the move from state-based definitions of security towards a broadened security agenda with a deepened content, including environmental and human security, has had an important impact on what is accepted as the special responsibilities of great powers.[70] Likewise, one of the most important changes in the normative structure of international space society in the post-Cold War era has been the shift from a traditional focus on the military security of states to the widening and deepening of the concept of space security, which now encompasses other dimensions, especially environmental and human security (Sheehan, 2015).

Two points are worth making about this. First, as Sheehan (2015: 10) argues, the evolution of the meaning of space security can now be seen to embrace three crucial dimensions: a) *outer space for security*, which describes the use of space assets for security and defence purposes; b) *security in outer space*, which refers to the protection of space-based assets from natural and/or human threats or hazards in the context of sustainable space utilisation[71]; and c) *security from outer space,* which concerns the contribution of space-based assets to terrestrial human and environmental security, including the use of space for disaster and rescue management, weather and climate monitoring, improvement of agricultural production, and tele-education. In light of the above, Sheehan (2015: 21) suggests that a working definition of space security would be 'secure and sustainable access to, and use of, outer space in accordance with international laws and treaties, free from the threat of disruption, as well as security of terrestrial human and state security from threats emanating from space'.

Second, and consequently, the evolution of the meaning of space security has had a significant impact on what great power responsibilities involve by generating new

[70] On this point, also see Cui and Buzan (2016: 195). On the widening of the security agenda, see, inter alia, Buzan, Wæver and de Wilde (1998); Sheehan (2005); Buzan and Hansen (2009); and Dannreuther (2013). For an early influential critique of environmental security, see Deudney (1990).

[71] Natural and human threats or hazards include: space debris, interference with satellite communication frequencies, and space weather effects (Sheehan, 2015: 15-7).

functions for great power management in international space society. This is evident in the growing acceptance of the norm of the long-term sustainability of space. Several governments now emphasise the concept of ‘space sustainability’, with a particular focus on tackling space debris as an important transnational threat that requires collective action. Indeed, as mentioned previously, there have been a series of multilateral initiatives with the aim of mitigating space debris and ensuring the sustainable use of space. As we shall see, these threats to space security have highlighted the vital role of great powers in dealing with global challenges in space. Equally, another key function of great power responsibilities is the provision of space-related goods that address the needs of developing countries with limited or no space capabilities. These usually include: sharing satellite data for disaster management, weather monitoring, and rescue support, the provision of training and technical assistance focused on space utilisation for socio-economic development and so on. While this function is related to the duty of great powers to facilitate the participation of developing countries in space activities, it has become increasingly conflated with the contribution of space-based systems to human security and the use of space by developing countries for socio-economic development.

The implications of these developments for China and India as aspiring great space powers will be taken up in subsequent chapters, but the point to make here is that great power management has grown in strength over the last years. What should be added is that the possession of space capabilities has been historically associated with acquiring the status of a great power. It is in this context that great power management is interwoven with another master institution of international space society, that is, techno-nationalism. Certainly, becoming a member of the so-called space club is almost synonymous with entering the club of great powers at the global level, and this remains a significant driver behind the space programmes of aspiring space powers, such as China and India.

Techno-nationalism

Mayall (1990) explores the dynamics of the rise of nationalism as a key institution of international society. What follows from this is that there is good reason to treat techno-nationalism as a master institution of international space society. Yet, as noted in the introduction, my understanding of the term highlights how articulations of a techno-nationalist ideology explicitly associate technological achievements with the relative position of the state in international society. As far as China and India are concerned, my formulation of the concept of postcolonial techno-nationalism is also attentive to the ways in which a variant of techno-nationalism that signifies technological advancement as an indicator of the state's status, power, and modernity is still influential in a postcolonial context. This largely reflects the origins of techno-nationalism, which can be traced back to the expansion of the European society of states in the nineteenth century, when scientific and technological advancement operated as a formal standard of civilisation, as we shall see in the next chapter. Suffice to say at this stage that the formative experience of China and India's encounter with the expanding European international society and the civilisation dimension that was ascribed to this process has had, and continues to have, a profound impact on Chinese and Indian views about the importance of highly visible technological projects, such as nuclear and space programmes.

As far as space technology is concerned, it is also important to acknowledge the close relationship between being space-faring and being modern. Significantly, we cannot understand the importance of becoming space-faring without considering that the Space Age coincided with the process of decolonisation.[72] In this regard, the advent of the Space Age, like the Nuclear Age, marked a global condition that defined space capabilities as a new form of reproducing insiders and outsiders on the basis of space-faring hierarchies. This raises the issue of hierarchy in international space society. Indeed, as the space-faring society has expanded to include a large number of states, social hierarchies of space participation have been established according to the different levels of space capabilities (Hanberg and Li, 2006: 53). Thus, human spaceflight remains a 'marker of modernity and first-class status' (Mindell et al., 2009: 15). While robotic space exploration appears to be less prestigious, of course, than human spaceflight, it can also be understood in this way. Equally, one key insight developed from scholars such as Sagan (1996/1997) is that we need to go beyond realist assumptions that focus on national security considerations if we want to understand why states seek to develop nuclear weapons. Sagan (1996/1997) argues that nuclear weapons are not merely military tools, but also serve as political devices

[72] On this point with regards to the Nuclear Age and the meaning of being nuclear, see Hecht (2006).

in the context of domestic politics and can also be regarded as symbols of status and modernity. Likewise, both civilian and military space-based assets can be understood as 'the touchstones upon which any capable state's modernity is measured' (Harding, 2013: 194).

Moreover, it is necessary to briefly say something about how techno-nationalism as a primary institution interacts with some of the other institutions of international space society. First, in many ways, techno-nationalism is complimentary to sovereign statehood because sovereignty in space is largely embedded in cosmopolitan and solidarist conceptions. This is partly why highly visible space projects define space-faring hierarchies. Second, and consequently, techno-nationalism is also closely linked to great power status and great power management in the sense that different space capabilities also confer different levels of status and responsibilities in the management of international order in space. Likewise, in relation to diplomacy, highly visible techno-nationalist space feats can also offer a seat at the table of diplomatic initiatives and negotiations. Seen in this light, 'high-visibility' projects, such as space programmes are part of 'recognition games', which states play in order to acquire the status of a great power (Suzuki, 2008). As Cunningham (2009: 74) notes, 'to be a superpower, one must be a "spacefaring" nation'.

The Space Market

Arguably, the economic factor has been one of the most neglected issues in the English School literature. Discussing some of the shortcomings of Bull's work, Miller (1990: 74) pointed out in 1990, 'a basic criticism of Bull's account of international society' is 'that it does not include a strong economic component' dealing with rules regarding trade, navigation, and investment and the common interests that permeate the sphere of economic activities. Since then, some important work has been done to bring together the economic sector and the English School, especially in the context of globalisation (Buzan, 2004; Buzan, 2005; Hurrell, 2007: 194-215). However, the question of how to consider the economic sector within the English School remains rather underdeveloped. According to Buzan, one response is to treat capitalism as a master institution, but he prefers the use of the market as a more neutral term, which has the additional merit of encompassing other practices, such as trade (Buzan, 2004: 193-4, Buzan, 2014a: 136).

Consequently, given the growing globalisation and commercialisation of space activities (OECD, 2014: 9-10), there are good reasons for considering the space market as an emerging primary institution of international space society. Significantly, in some ways, since the advent of the Space Age, the space market has followed a parallel trajectory to the market as a distinctive institution at the global level. In particular, although the market was a key primary institution of the Western-global international society during much of the Cold War, it has emerged as a sort of a global institution in the post-Cold War era (Buzan, 2014a: 138). Likewise, the space market was initially confined to American-led space activities, beginning as a US government initiative with the Communications Satellite Act in 1962, which led to the creation of the International Telecommunications Satellite Consortium (Intelsat) in 1964 (Moltz, 2014: 94). However, during the early Cold War, commercial activities were largely limited to the field of satellite communications and even commercial transatlantic cooperation in space was determined to a large extent by political and strategic factors and technology transfer considerations (Krige, 2013b). Equally, the idea of the commercialisation of space remained contested not the least because of the opposition of the Soviet Union and communist China to the market in general. This began to change only in the 1980s, when a number of space players emerged, including Europe and Japan, that challenged the US leadership in the fields of satellite manufacturing, launching capability, and other commercial space services. It was also during this period that the Soviet Union and China became less reluctant to get involved with commercial space activities (Krige, 2013a: 16-7).

But it was after the end of the Cold War that the globalisation and commercialisation of space activities gradually led to the emergence of a global space market, which points to its inclusion as a primary institution of the international space society. According to a recent report by the Space Foundation (2015: 2), the global space economy grew up by 9 percent in 2014, totalling $330 billion, with commercial space activities accounting for the 76 percent of the global space economy and direct-to-home television services accounting for more than three-quarters of the commercial space sector. Even in the launch field, which has been traditionally reserved to the state largely due to national security and cost considerations, US small private companies have emerged like Space Exploration Technologies Corporation, known as

SpaceX, and XCOR Aerospace. As Newlove-Eriksson and Eriksson (2013) argue, the globalisation of space activities has been underpinned by the growing importance of private authority and transnational Public-Private Partnerships (PPPs) and the blurred distinction between the military and civilian uses of space.

Therefore, it makes sense to think of the space market as an institution of international space society. Yet, a number of points are worth noting here as they help to highlight the possibilities and limits of this move. First, despite all the attention paid to the privatisation of space travel promoted by space entrepreneurs of the likes of Elon Musk (SpaceX), Jeff Bezos (Blue Origin), and Richard Branson (Virgin Galactic), the privatisation of space should not be overstated. Not only does the degree of privatisation vary across space services and products (Moltz, 2014: 102-12), but governments also remain central actors in the space industry as key sources of initial investment and as customers for several space products and services (Brennan and Vecchi, 2011: 18, OECD, 2014: 17).

Second, while it is clear that the argument over whether to have the market or not ended with the collapse of the Soviet Union, the tension between economic nationalism and economic liberalism is far from over, as there are not many states fully open to the forces of the global economy and many states support a form of capitalism that is embedded in economic nationalism. This points to the contested nature of the market as a primary institution in the sense that for many states the challenge of how to relate to the global market and make it more effective remains (Buzan, 2014a: 138). As far as international space society is concerned, it is necessary to note that the contested nature of the space market as an institution is reflected in the continuing dialectics between techno-nationalism and techno-globalism. It is commonplace among scholars to argue that Japan and China are two key examples of states that privilege a techno-nationalist approach to technology and innovation, including space technology. But even the United States has not been immune to techno-nationalist impulses. As Weiss (2014) shows, the enduring lead in high technology that the United States still enjoys is largely explained by the creation of not a liberal, but a hybrid political economy, whereby the national security state is interwoven with the commercial sector. NASA, of course, has been a key institution of the national security state since the beginning of the Space Age. But this has also been manifested in its recent efforts to catalyse the development of a commercial space industry through inviting competitive innovation (Weiss, 2014: 119-20, 27-8).

This leads to the third point to make about how to understand the relationship between techno-nationalism and the space market. Because of the enduring influence of the former, it is tempting to see techno-nationalism as containing the space market (at least for the time being). Clearly, at one level, the space market can be understood as complementary to techno-nationalism in the ever-globalising international space society. Yet, at another level, the space market as a solidarist institution is staged as opposed to techno-nationalism. This tension is compounded by the fact that, in many ways, techno-nationalism occupies the crucial place of national sovereignty and territoriality in the sector of space considering that sovereignty in international space society is largely understood in cosmopolitan terms.

Fourth, in discussing the market as a primary institution, Beeson and Breslin (2014) suggest that it makes more sense to treat the 'developmental state' and 'regional production structures' as primary institutions in East Asia rather than focusing on the market. This is an important consideration that serves to highlight how the global political economy is underpinned by significant regional derivations. Following from this, although it is apparent that the space market is a key feature of the social structure of international space society, it is possible to say that there are significant regional derivations. Perhaps the best expression of this is the Chinese and Indian variants of postcolonial techno-nationalism that still shape how the two rising Asian space powers relate to the space market.

In light of the above, for now, it seems that there is some sort of hierarchy between techno-nationalism and the space market with the former subsuming the latter, especially with regards to space programmes in a postcolonial context. Certainly, the integration of China and India into the global space economy has accelerated over the last decades, but, as we shall see, techno-nationalism is still prominent in the ways in which the two Asian space powers approach space technology. Moreover, the space market remains contested as an emerging institution due to the ambiguity embedded in space law regarding space activities carried on by private actors. This process is further complicated by the inherent dual-use nature of space technology and the blurring of the distinction between the private and public realms (Newlove-Eriksson and Eriksson 2013).

Environmental Stewardship

There is now a burgeoning literature that deals with the relationship between international society and global environmentalism and assesses the extent to which environmental stewardship can be seen as a nascent institution of international society.[73] Recent efforts to find ways to mitigate space debris as well as to create a normative framework for the sustainability of space are illustrative of how environmental stewardship is gradually becoming an institution in space. For example, in 2007, COPUOS adopted the 'Space Debris Mitigation Guidelines', which were wrought by the international Inter-Agency Debris Coordination Committee (IADC), consisting of experts from thirteen space agencies (United Nations Office for Outer Space Affairs, 2010). Moreover, as discussed earlier, in 2010, COPUOS formed the Working Group on the Long-term Sustainability of Outer Space Activities. Notably, the European Union proposal for a Code of Conduct for Outer Space also includes provisions on space debris control and mitigation (Council of the European Union, 2008: 9; Dickow, 2009: 159).

Thus, there are grounds for considering environmental stewardship as an emerging institution of international space society. Indeed, the growing number of governments, private firms, and non-state actors that emphasise the importance of the sustainable utilisation of space suggests that space sustainability has emerged as a key norm. However, what should be noted is that these developments reflect a more pragmatic approach to maintain the space environment sustainable for the effective use of space rather than an expression of cosmopolitan values. Consequently, in the subsequent chapters, rather than examining in detail the engagement of China and India with environmental stewardship as a nascent institution in space, the focus will be on the emerging norm of space sustainability as a key great power responsibility in managing international space order and the implications of this development for China and India as aspiring great powers.

[73] See, inter alia, Jackson (2000: 170-9); Buzan (2004: 186, 233); Hurrell (2007: 216-36); Falkner (2012); Palmujoki (2013); and Buzan (2014a: 161-3).

Concluding Remarks

Although it is clear that there are a number of ways of understanding the international politics of space, it may be worth going beyond standard theoretical approaches to understand how order is maintained in space. Drawing on key English School concepts, this chapter suggests that it is possible to conceptualise space not merely as a system, but also as an international society with a distinct social structure. This exercise of concept development is important both analytically and hermeneutically, given the notion of an exclusive club of space-faring countries. The chapter developed this argument further by highlighting how the nature of outer space as a distinctive sectoral interstate society is manifested in the ways in which its primary institutions are differentiated from such institutions at the global level (space war, space law, cosmopolitan sovereignty, space diplomacy, balance of power, great power management, techno-nationalism, space market, and environmental stewardship) in a historical and comparative context. In doing so, the chapter helps to highlight the constitutive impact of these institutions on the norms that shape the behaviour of the space-faring states.

This argument also points to the importance of recognising the socialisation process in international space society and the social hierarchies that underpin international space order. As a consequence, if the development of space technology is what the members of international space society make out of it, then, it becomes clearer that there is nothing inevitable about the weaponisation of space and the emergence of a new 'race mentality'. Equally important is that a sectoral approach that relates technology to the idea of international society offers an innovative and straightforward way of trying to bring technology into the English School theory. Moreover, it is a significant step towards relating the English School to International Security Studies. While an analysis of what form this investigation might take is beyond the scope of this thesis, as far as space security is concerned, it offers a more holistic understanding of space security that transcends the three dimensional framework (outer space for security, security in outer space, security from outer space). For instance, by bringing together both terrestrial and non-terrestrial dimensions of space security from ground stations and communications to space weapons and space debris, a sectoral approach to space offers a different way of conceptualising a normative framing for securitisation and helps to highlight the outside/inside distinction in the security dynamics of space.

All in all, while the conceptual framework provided here remains incomplete in many ways, the suggestion that it is possible to conceptualise an international space society based on the English School also provides a useful framework for understanding the ongoing complex dynamics of the growing exploration and utilisation of space. It also offers important insights about China and India as members and aspiring great powers in international space society. Before considering this, however, it is necessary to take a look at the origins of techno-nationalism and technological hierarchies in international society, to which the next chapter turns.

Chapter 3. Civilisation, Modernity, and the Origins of Techno-nationalism in International Society

The central contention of this chapter is that it is important to consider how a civilisation dimension was ascribed to the role of technology during the expansion of the European society of states in the nineteenth century, if we want to understand the origins of techno-nationalism in international society and its enduring influence in the postcolonial context of China and India. It does this by illustrating the ways in which the emergence of scientific and technological advancement as a normative measure of the level of civilisation in international society since the mid-nineteenth century have had a powerful and enduring impact on Chinese and Indian conceptions about science and technology.

I develop this argument in the following ways. The first part of the chapter briefly revisits the concept of the 'standard of civilisation' and then moves on to review the ways in which technological achievements have been represented as markers of the superiority of Western civilisation since the late nineteenth century and how China and India were seen as 'uncivilised', based on European perceptions of their technological backwardness. The second part of the chapter then suggests that the social pressure created by the need to conform to the operation of technological advancement as an informal European standard of 'civilisation' was one of the key drivers behind late Qing China's technological modernisation. In this regard, the origins and the enduring influence of Chinese techno-nationalism have been largely a consequence of the international social pressure from European international society to introduce technology as a normative marker of the state's modernity, power, and status. The final part briefly highlights some of the principal aspects of the nexus between science, technology, and modernity in British India and the Indian responses that this process elicited.

Given that it is difficult to do justice to what has arguably been a very complex reality, the discussion that follows is necessarily a schematic simplification. However, it is crucial to have a sense of the formative legacy of China and India's encounter with the expanding European international society and how science and technology were key features of this process, as it helps to illustrate one of the overarching arguments of this thesis: history does not just matters, but it continues to influence contemporary conceptions about the role of science and technology as a principal marker of the state's power, status, and modernity in international society. This also calls attention to how the 'global transformation' of the nineteenth century still influences key understandings of the relationship between state, modernity, and technology in the context of international relations (Buzan and Lawson 2015).

The Standard of Civilisation

One of the most important aspects of the modern structure of international society has been the expansion of the European international society into the non-European world and the subsequent great transformation of regulating international relations it brought about in the nineteenth century as a consequence.[74] Although it is clear that a complex amalgam of factors played a decisive role in shaping the ways in which non-European states came to accept key European institutions, norms, and practices in the conduct of their international relations, for the purposes of this discussion, the important feature of this process has been the 'standard of civilisation', based on civilisational and racial hierarchies.[75] A detailed discussion of the evolution of the standard of civilisation in international society is beyond the scope of this chapter, but a few points are worth making. First, as the Europeans were accumulating more economic and military power, in large part as a consequence of the industrial revolution, they came to regard modern civilisation as synonymous with European standards of behaviour and they saw it was their duty and interest to spread European civilisation to the rest of the world.[76] By the nineteenth century, the shared conviction among the key colonising European powers that their institutions and moral values were superior to those of the non-European world led them to impose their civilisation and their administrative standards in most parts of Asia and Africa (Watson, 1984: 27). Permeated with this strong belief in the superiority of European culture, the expansion of European international society was also a violent process that involved the subjugation and suppression of indigenous peoples (Bowden, 2009: 105; Keal, 2003).

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[74] The classic account of the expansion of the European international society is Bull and Watson (1984). Also, see Watson (1992). For a recent discussion of the 'expansion thesis' literature, see Buzan and Little (2014).
[75] The most comprehensive account of the 'standard of civilisation' is Gong (1984). Also, see Keene (2002); Hobson (2004); Bowden (2009); the contributions in Stroikos (2014a); and Linklater (2016). For an overview of the literature on the standard of civilisation, see Stroikos (2014b).
[76] Scientific racism also contributed to perceptions of European superiority (Hobson, 2012).

Second, the underlying logic of the standard of civilisation was evident in how the classification of ‘civilised’, ‘barbarian’, and ‘savages’ was used by international lawyers as three categories consistent with different stages of legal recognition (Simpson, 2004: 227-53; Anghie, 2005). A key dimension of the operation of the ‘standard of civilisation’, therefore, was that those political entities aspiring to be brought within the confines of the perceived international society of ‘civilised’ states had to fulfil a number of requirements set by the European society of states in order to be recognised as full members states (Gong, 1984: 3).[77] Effectively then, as Keene (2002: 98-99) notes, two patterns of order emerged: toleration and civilisation. Interaction between those states that were recognised as full members of the ‘civilised’ society of states was based on reciprocal diplomatic engagement and international law and it was characterised by ‘the toleration of other political systems, cultures and ways of life’. Accordingly, it was reasonable for those polities that were deemed as ‘uncivilised’ to be patronised and to be subject to violent and coercive behaviour in the name of promoting civilisation (Keene, 2002: 98-9). In this regard, the standard of civilisation was also important in constructing the European Self in relation to the non-European ‘barbarian’ or ‘savage’ Other (Neumann and Welsh, 1991). As Ringmar (2014: 447) points out, the social construction of a demarcation between insiders and outsiders meant that the formation of international society was constituted by practices of mutual recognition among the Europeans themselves and practices of non-recognition regarding their interaction with non-Europeans.

Third, as a result, the implementation of legal, administrative, and economic reforms was presented, with varying degrees, by non-European elites as a path towards modernity and progress based on the assumption of a universal and inclusive modern civilisation, which promised to lead non-European states to their recognition as equal members of international society (Aydin, 2007: 15, 23). But the need for adjusting to Western style standards usually involved the introduction of alien values and norms to their culture, and, hence, the dilemma of how to balance traditional culture with modernity and reforms. It is in this context that the cases of Japan, China, Russia, and the Ottoman Empire have generated debates about their encounter with

[77] According to Gong, these standards were expressed in a number of treaties signed with non-European political entities in the nineteenth century and came to include an extensive set of political and economic criteria such as basic rights of life and property; the existence of an organised political bureaucracy; the adherence to international law; the operation of diplomatic interchange and communication; and the abstract notion that a ‘civilised’ state follows the norms and practices the ‘civilised’ international society (Gong 1984: 14-5).

European international society and their struggle with the standard of civilisation.[78] Notably, however, accounts of other cases have also been provided.[79] On the other hand, the cases of colonies, such as India, have been largely neglected in the 'expansion thesis' literature.[80]

Nevertheless, it is worth noting that the fulfilment of this set of criteria remained largely a moving target for non-European polities. In particular, Japan is usually invoked as the first non-European state that met the standard of civilisation and was successfully accepted as a member into international society. Although it is difficult to identify the exact landmark of Japan's entrance into international society, there is an agreement among scholars that with the abrogation of extraterritoriality in 1989, the Anglo-Japanese military alliance in 1902 based on equal relations between the two countries, the Hague conferences in 1899 and 1907, and the victory of the Russo-Japanese War in 1905, Japan was recognised as 'civilised'. Yet, despite these achievements, the reality was a good deal more complex. The 1895 Triple Intervention by Russia, France, and Germany after the first Sino-Japanese War and the denial of racial equality clause by key Western powers at the Paris Peace conference in 1919 are testimony to the tensions and contradictions that were central to the process of the standard of civilisation as a universal process (Okagaki, 2013: 117; Gong, 1984: 63).

Great Powers, Civilisation, and Modernity

The case of Japan also serves as a touchtone for wider debates about the relationship between great powers, civilisation, and modernity. The intention here is simply to highlight that, although the recognition of equal membership into European international society was premised on the fulfilment of the European standards, it is useful to remember that the European society of states was characterised by multiple layers of hierarchies and tiers even among its members. A few points are worth noting

[78] For the case of Japan, see Gong (1984: 164-200); Suzuki (2005); Suzuki (2009: 114-39); Zarakol (2011: 160-200); and Okagaki (2013). Neumann has recently explored Russia's entry into international society (2011). On the Ottoman Empire and Turkey, for example, see Neumman and Welsh (1991); and Zarakol (2011: 111-59). It is not surprising that the case of China has generated a great deal of debate about its membership in international society. See, inter alia, Gong (1984: 130-63); Zhang (1998); and Suzuki (2009: 89-113).
[79] These include: Stivachtis (1998); Roberson (2009); Fabry (2010); and Englehart (2010).
[80] However, one exception is Abraham (2014: 46-72).

here. First, the logic of the standard also provided the normative basis for regulating the conduct of intra-European relations at a time when competition among European imperial powers was beginning to be projected in the scramble for colonial territory outside Europe, while the number of new independent states in Europe was increasing (Clark, 2005: 47-9). Moreover, the seemingly inclusive and expanding European society was clearly marked by a stratified hierarchy and what Simpson (2004) calls the 'legalised hegemony' of Great Powers throughout this process in the sense that it was a handful of European great powers, especially Britain and France, that served as the 'legitimisers' of membership in international society. In other words, notwithstanding the inclusive principles of the expansion, European powers continued to retain their role as distinctive members that constituted a special group of states carrying the managerial burden as the gatekeepers of international order. The middle and small powers recognised that role for the Great Powers (Simpson, 2004). In other words, as Keene (2014) shows, there have been different layers of differentiation within the family of 'civilised' nations.

Second, despite the fact that the material power of Russia and the Ottoman Empire have led to their recognition as participants in the European balance of power system, this was not enough to offset the perceived cultural superiority of the European elite of Great Powers and to allow the entry of non-European powers into this club as social equals, that is 'civilised'. Indeed, as Neumann (2014) suggests, it takes a combination of possessing material capabilities and fulfilling civilisational standards to achieve full acceptance into the club of great powers. Not surprisingly, perhaps, the legacy of this period is that self-narratives of being an outsider still influence the social self-identity of those non-European states that were seeking to acquire modernity and equal status in international society, only to realise that their entry was suspended as outsiders.[81]

Contemporary Practices and the Standard of Civilisation

Given that much attention has been paid to the consolidation of the contemporary structure of international society on the basis of equality among nations, especially after the decolonisation process, it may be supposed that the notion of the 'standard of

[81] On this point, see Neumann (2011); and Zarakol (2011).

civilisation' has been redundant. Ironically enough, therefore, it was the 'barbarian' behaviour of the self-perceived 'civilised' European powers during the First and Second World Wars that delivered a blow on hierarchical ideas about civilisations (Bowden, 2009: 126). Yet, there is by now a burgeoning literature on examining the relevance of the 'standard of civilisation' to key practices engrained in the normative structure of contemporary international society, which are closely related to liberal norms, ideas and principles (Fidler, 2001). These usually include: human rights (Donnelly, 1998), economic and financial standards (Gong, 2002: 85-92; Mozaffari, 2001: 77-96; Bowden and Seabrooke, 2006), democratic government (Hobson, 2008; Clark, 2009a; Navari, 2013), the status of women (Towns, 2009; Towns, 2014), the European Union's membership conditionality (Behr, 2007; Stivachtis, 2008), development and environmental stewardship (Buzan, 2014c: 590-2), peacebuilding and statebuilding (Paris, 2002), and trusteeship (Bain, 2003).[82] This has been evident, of course, in the generation of new categories of outsiders to the liberal structure of international society, such as 'rogue', 'failed', 'pariah', and 'outlaw' states (Simpson, 2004: 278-316; Clark, 2005: 176; Bowden, 2009: 17, 186, 190-1).

In this context, non-European countries continue to face the same dilemmas of how to respond to the challenges of modernisation, development, and globalisation (Gong, 1984: 10). As Gong (2002: 80) notes, 'one cannot speak of "modernization", or the "process of becoming modern", in a historical perspective without referring to what an earlier age called "civilization" and the process of becoming "civilized"'.[83] This is an important consideration, for the purposes of this chapter, especially given how Chinese and Indian elites continue to struggle with the stigma of 'not being of the 'West', not being 'modern' enough, not being developed or industrialized or secular or civilized or Christian or democratic enough' (Zarakol, 2011: 4).

Indeed, China has attracted much attention in the scholarly literature that deals with international society and the particular dynamics highlighted above. Although there are varied differences of opinion about when China gained entry into international society as well as on quite what this process might have involved, it is possible to identify a classical and a modern round to it (Buzan, 2014c: 583). The first describes

[82] The discussion of the enduring relevance of the standard of civilisation is part of wider debates about the importance of civilisation and culture in international relations. See, inter alia, O'Hagan (2002); Salter (2002); Mazlish (2004); Hall and Jackson (2007); Bowden (2009); Katzenstein (2010); and Buzan (2010a).

[83] On this point, also see Gong (1984: 10).

China's struggle with the classical standard of civilisation, whereas the latter one describes Communist China's 'alienation' (but not isolation) with international society under Mao, when China was a 'revolutionary state in international society' (Armstrong, 1993: 176-84; Zhang, 1998). But there is a noteworthy twist in China's struggle to cope with modernity, especially in the post-Cold War era, given how the normative structure of international society has moved towards more liberal norms and standards of conduct at a time when China's international behaviour still emphasises Westphalian practices and principles. As a consequence, there has been a great deal of debate about the whole question of the standard of 'civilisation', be it the classical/historical or the modern one, and its relevance to our understanding of China's place in international society.[84]

Unlike China, however, India's encounter story has been largely neglected presumably because it appears as a somewhat straightforward case.[85] India initially succumbs to colonial rule so its struggle with modernity is understood as part of the broader issue concerning the relationship of ruler and ruled. It becomes a sovereign member of international society after its partition from Britain in 1947. But reality has been less linear and more complex than is usually assumed in the literature. In this light, some scholars have provided a necessary corrective to this narrative (Anand, 2010; Abraham, 2014: 46-72). For example, from 1919 to 1947, India's international recognition as an international person was something of an anomaly under international law. Notwithstanding that it remained under British rule throughout this period, it participated as a sovereign state at the 1919 Paris Peace Conference, it was admitted to the League of the Nations and was a founding member of the United Nations (Anand, 2010). Equally, some work has been done recently on India as a rising power in international society (Ogden, 2015; Hall, 2015).

Nevertheless, the point to emphasise here, for the purposes of this discussion, is that it is simply impossible to consider the emergence of the 'standard of civilisation' in the nineteenth century without recognising how a civilisation dimension has been central to technological achievements in international relations in the context of the expansion of the European international society and how this process reinforced not only the sense of European superiority, but also the link between the state,

[84] Recent examples are: Zhang (1998); Foot (2001); Suzuki (2009); Buzan (2010b); X. Zhang (2011a); X. Zhang (2011b); Suzuki (2014); and Clark (2014).
[85] On this point, see Buzan (2014c: 581).

technology, and modernity. As soon as we begin to unpack the relationship between civilisation, modernity, and technology, it becomes clear that the decolonisation process led to the creation of new sites of inclusion and exclusion in the form of the spread of exclusive clubs based on technological capabilities as sources of social recognition and status in international society. It is here that contributions from the history and sociology of technology are potentially helpful in illuminating the wider historical context that defined the impact of scientific and technological accomplishments as a key feature of the expansion of the European international society.

Before considering some key aspects of this literature, however, a caveat should be noted. One of the most enduring and influential assumptions has been the centrality of science and technology in Western civilisation and the ignorance of the sciences of other cultures based on the idea of a Great Divide between the scientific West and its intuitive East. This has culminated with an analytical property of a Eurocentric and hierarchical understanding of the relationship between science and civilisation, which often entails 'the comparison of civilisations along normative teleologies of moral, political, scientific, or economic progress' (Hart, 1999: 90).

My intention, therefore, is not to advocate a Eurocentric conception of science and technology that seeks to deny Eastern agency from the global story of science and technology, but to try to understand and explain how notions of Western superiority and hierarchy based on the state of scientific and technological development have had profound implications in the context of the whole standard of 'civilisation' question, notwithstanding how discomforting their telling may be. Hence, it seems clear to me that trying to shed a light on a rather neglected aspect of the modern history of international society is not thereby endorsing it.

Technological Advancement and Civilisational Hierarchies

One of the most important contributions that historically-informed analyses have made is in interrogating how science and technology were used by Western countries after the Industrial Revolution to establish a Western ideology that justified concepts of Western superiority, dominance, and colonialism as part of their 'civilising mission'. In his seminal work on science and technology, Adas (1989) persuasively demonstrates how scientific and technological achievements became an indication of what it meant to be civilised. Simply put, underpinning Western ideologies of dominance was the notion that scientific and technological accomplishments were markers of the level of civilisation a given society had achieved. In addition, Pyenson (1993) offers an account of how the spread of pure science abroad was a key element of the French civilising mission, while Headrick (1981) shows how technological advancements were becoming a crucial factor in colonial expansion.

More broadly, the origins of science and technology as representations of cultural authority can be traced back to the first phase of overseas expansion during the fifteenth century. Indeed, the advancement of weaponry, shipbuilding, and manufacturing provided the means for the voyages of Columbus and Vasco da Gama. There is also evidence to suggest that travellers and missionaries also paid attention to the material achievements of the cultures they encountered and drew comparisons with their own during the sixteenth and seventeenth centuries. However, in addition to the fact that travellers during this period placed more emphasis on Christian faith as a key indicator of their distinctiveness, merchants and missionaries shared also a limited understanding of key developments in scientific learning and technological improvements. This meant that their interest in assessing the material attainments of non-European cultures remained rather marginal in this era. As a result, the role of scientific and technological accomplishments in influencing broader categorisations of non-European peoples as civilised or barbarian was relatively limited before the Industrial Revolution (Adas, 1989: 21-68).

Nevertheless, although the consequences of the emergence of industrial civilisation were rather gradual, from the 1780s and onwards, machines became emblems of the level of civilisation a given society had attained. It is important to emphasise here that technological innovation and gauges never assumed the formal status of legal, political, and diplomatic standards of the sort described in the relevant literature on the standard of civilisation. Rather, technological feats served as an informal, but significant, marker of ordering polities along the stages of civilisation and progress.[86]

What is of importance is that technological advancement as an informal standard provided a framework for expectations about the proper place of science and technology within the context of state and modernity that indicated the differing levels

[86] Towns (2009: 694) makes a similar point with regards to the status of women as an informal standard of civilisation.

of material and social development. One reason for thinking that technological achievements emerged as meaningful measures of human development, progress, and civilisation by the nineteenth century is because they could be empirically demonstrated (Adas, 1989: 7). Equally importantly, in addition to their function as physical and symbolic indicators of the superiority of European colonial powers, scientific and technological attainments were also seen to embody a set of more subtle superior attributes, such as rationality, the mastery of time and space, precision and discipline (Adas, 1989: 224). Ironically, perhaps, the construction of the 'Other' as 'barbarous' in terms of technology occurred even though 'barbarous' countries such as China and India had developed sophisticated technologies in the past (Adas, 1989; Hobson, 2004).

Given this background, of particular significance here is the need to understand the representation of material achievements as a key element of the political ideology that imbued the political thought and public life in key colonising powers, such as Britain and France. In this sense, the representation of scientific and technological achievements was embodied in 'clusters of ideas, beliefs, opinions, values and attitudes usually held by identifiable groups, that provide directives, even plans, of action for public policy-making in an endeavour to uphold, justify, change or criticize the social and political arrangements of a state or other political community' (Freeden, 2004: 6). Put differently, the representation of material achievements as a standard of civilisation was not articulated in the form of a comprehensive strategy towards non-European polities, but it was a key feature of the political ideology of the civilising mission that emerged in key European imperial powers in the nineteenth century. While a detailed discussion of the quite different understandings of the relationship between technology and civilisation of that period is beyond the scope of this chapter, it is worth briefly considering some of the most influential works, especially those with a focus on China and India.

A wide range of European observers, authors, politicians, and travellers offered explicit accounts of the close synergy between technological accomplishments and civilisation, and their more subtle attributes. For example, in his comparative account of civilised and barbarian societies, William Cooke Taylor (1840: 1-2) distinguishes the 'civilised race' as the one that emphasises material improvements and progress based on new discoveries, such as the railroads, while the 'uncivilised race', exemplified by China, seems to 'have set bounds to itself' and there are 'no traces of a tendency to further and future improvement can be discovered'. For Taylor (1840: 5) 'the idea of progress, development, amelioration, or extension, appears to be the predominant notion…in the definition of civilization'. This compels him to identify civilisation with knowledge and barbarism with ignorance, and, thus, to examine the 'progress of science' and its impact on the 'advance of civilization and the moral improvement of individuals' (Taylor, 1840: 188).

Other observers came to draw conclusions about the level of Chinese and Indian civilisation by providing an extensive account of their technological achievements in the nineteenth century. Clearly, not everyone supported the idea that China and India should be evaluated and ranked as 'uncivilised' on scientific and technological criteria, while some authors acknowledged the contributions of the Chinese and Indian civilisations to scientific knowledge and technological progress, at least in ancient times. Nevertheless, the views of authors, such as those of James Mill and John Barrow, are illustrative of the ways in which technological achievements were articulated as a measure to evaluate China and India as 'uncivilised'. In his influential *History of British India*, Mill suggests that India has no mark of high civilisation because of the low state of scientific knowledge. After a rather detailed analysis of the use of key tools and machines by Indians, Mill (1840: 99) notes that:

> Whoever, in the present improved state of our knowledge, shall take the trouble to contemplate the proofs which we possess of the state of knowledge and civilization among the Hindus, can form no other conclusion, but that every thing (unless astronomy be an exception) bears clear, concurring, and deniable testimony to the ignorance of the Hindus, and the low state of civilization in which they remain.

Referring to 'Surya Sidhanta' as a proof of the contribution of Hindu civilisation to astronomical knowledge, Mill (1840: 100-1, 106) contends that 'it is on the authority of our own countryman I am enabled to declare, that this book [Surya Sidharta] is itself the most satisfactory of all proofs of the low state of the science among the Hindus, and the rudeness of the people from whom it proceeds' and he concludes that 'the ignorance [of Hindus] of the present age is the same with the ignorance of all former ages. Elsewhere in his *History of British India*, Mill (1840: 220) offers a brief analysis of the use of machines and tools by Indians and Chinese to find that 'in the contrivance and use of machinery both are equally simple and rude'.

The publication of *History* helped Mill to take a position with the East India Company, where he eventually took over the post of Examiner of India

Correspondence. Although other works appeared soon after its publication that provided a more balanced account of Indian society and history, it is important to note that his views appear to have profoundly influenced the policies of reformist British administrators in India, as his *History* came to be regarded as the definite source on India for future British rulers, traders, and missionaries. That candidates for the Indian Civil Service had to read *History* as part of their training is also illustrative of its authoritative status at that time (Adas, 1989: 171).

In a rather similar fashion, Barrow's *Travels in China* has been an authoritative source on Chinese society and history since its publication in 1804. The book was the culmination of Barrow's participation in a British Embassy mission that travelled from Beijing to Guangzou in 1792 with the aim of improving trade with China. While Barrow (1804) acknowledged that China had once achieved a high level of civilisation in terms of social development and material culture, it steadily stagnated and, thus, its position in relation to European industrial powers eventually diminished after the fifteenth century. Barrow compares in detail the level of scientific knowledge and technological innovation in China with the magnificent achievements of the European powers and criticises China for its general backwardness in terms of technology and science.[87]

In discussing the use of Chinese tools and machines, Barrow (1804: 311) notes that 'the great advantages attainable from the use of mechanical powers are either not understood or, purposely, not employed'. Left unimpressed, Barrow (1804: 355) concludes that, although 'the Chinese have been among the first nations…to arrive at a certain pitch of perfection'…'more than thousand years ago, at a period when all Europe might be considered, comparatively, as barbarous', 'they have since made little progress in any thing, and been retrograde in many things'. While *Travels in China* did not receive the attention that Mill's *History of British India* did, Barrow's views and opinions about the level of Chinese scientific knowledge and technological innovation had an enduring impact on nineteenth century accounts of the Qing Empire and helped him to build a reputation as an authority on Chinese affairs (Adas, 1989: 182-3).

Not surprisingly, perhaps, non-European countries responded to their encounter with European international society during the nineteenth century in intrinsically

[87] On Barrow's background and the influence of his *Travels in China*, see Adas (1989: 178-84).

different ways. Japan provides again the model of a country that successfully placed emphasis on technological and industrial development during the Meiji period in order to be seen as equal with and independent from the West. However, one of the consequences of Japan's rapid technological and industrial transformation in its bid to be recognised as a 'civilised' great power was that it gradually posed a challenge to notions of Western superiority and hierarchy based on the state of scientific and technological development. Arguably, Japan's entry into international society was a thorny and ongoing process, but it seemed to confirm the earlier interest among Asian reformists in the universal nature of modernity. This possibility was nowhere clearer than in Japan's stunning victory over Russia in 1904-5, which marked the first time that a non-European country had proved to be more mighty and modern than a European empire, albeit a weak one. The Russo-Japanese War became a global moment of revaluating wide-held views about Western civilisation, colonial rule, and technological prowess, and reinforced the support among nationalists and intellectuals of China and India for equality with the West (Aydin, 2007: 71-82). Consequently, not only did the remarkable industrialisation of Japan over just a few decades demonstrate that it was a valuable model of modernisation for other Asian societies to follow, but it also put in question that the scientific and technological accomplishments of the Europeans were indicators of their racial superiority (Adas, 1989: 357-65).

Although Japan may be something of an extreme example with its emphasis on technological and industrial development, by the early twentieth century the tendency among states to cast technological achievements as markers of modernity was already consolidated. Indeed, as Harrison and Johnson (2009: 3) observe, 'the first states to take advantage of the power the nexus [between science and the nation-state] produced became globally dominant and were widely imitated'. For example, despite the significant differences between British and German understandings of the national importance of technology, the Anglo-German political and economic competition of that period helped to cultivate a culture of modernity that was conductive to technological innovation engrained in a sense of national purpose. This led observers in Britain and Germany to see passenger ships, civilian vessels, and airships as indicators of their countries' international status and national prestige that exhibited a country's creative potential, international leadership, and national aspirations (Rieger, 2005: 224-7). Given that the operation of these technologies consistently involved financial losses, it is clear that the symbolic meaning of technology as a marker of modernity and status helps to explain public support and enthusiasm in Britain and Germany for civilian and military technological achievements during that period (Rieger, 2005; Fritzsche, 1994).

Clearly, the first and the second World Wars have had a profound impact on the discourse of civilisation and notions of European superiority over non-European societies. Yet, the same cannot be said about the role of technology as an informal standard of modernity and hierarchy in international society. At a time when the erstwhile European powers were trying to recover from the devastating consequences of the two wars, technological development was increasingly becoming a key aspect of the growing influence of the United States and the Soviet Union as an indicator of national purpose, international status, and global aspirations amid the Cold War. Concomitant with this process was the reworking of the relationship between technology and the state in the context of modernisation. In many ways, modernisation, as a term associated with different levels of human worth, came to supplant previous ideas about civilisation and technological accomplishments (Adas, 1989: 402-3; Adas, 2006; Bowden, 2009: 69-72). In this respect, as Bowden (2009: 186) notes, the 'efficacy of science and technology' can be understood as one of a number of criteria that states need to meet in order to be recognised as full members of international society in the twenty-first century. What is more, as Buzan and Lawson (2015: 185) point out, contemporary attempts at restricting the spread of advanced weapons, including nuclear weapons and missile technology, to the periphery of international society is reflective of the nineteenth century colonial pattern of demarcating the 'civilised' at home and the 'barbaric' abroad.[88]

In light of the above, the postcolonial as outsider should not be understood in chronological terms, that is, the natural state of being automatically postcolonial after becoming independent. Rather, as Abraham (1998: 18-9) argues, it should be seen as a 'specific moment of a global condition of modernity' that represents 'modernity-as-a-Western-thing' as the "true' definition of the historical moment' rendering the condition of modernity as something 'desirable and impossible to escape'. At the same time, however, the quest for modernity is the reaffirmation of its absence that compels the reinvention of time as incomplete defined by an endless effort to catch up

[88] On the relevance of the standard of civilisation to the restriction and control of certain weapons, see, for example, Price (1997: 26, 35-8, 43); and Krause and Latham (1998: 41-4).

with the 'modern' in the future. This helps to explain the obsession of the postcolonial with world rankings and international status (Abraham, 1998: 18-9). As we shall see in the following chapters, it was in this context that an influential postcolonial techno-nationalism emerged that signified the space programmes of China and India as a possible response to the challenge of coping with the identity, sovereignty, and status of the postcolonial state and its struggle with modernity.

China's Response: A Technological Nation in the Making

Although the case of China has attracted much scholarly attention in the context of discussing the whole question of modernity and the standard of 'civilisation', less attention has been paid to the role of science and technology in China's encounter with international society. And yet, as Elman (2007: 523), a leading historian of science and technology in China, observes:

> If there has been one constant in China since the middle of the nineteenth century, it is that imperial reformers, early Republicans, and Chinese Communists have all prioritized modern science and technology. We can no longer afford to undervalue the place of science in modern contemporary China. China plans to send space expeditions to the moon and Mars in the twenty-first century are in part a response to the shock of heavy-handed Western and Japanese imperialism since 1850.

Therefore, it is worth briefly considering how China's encounter with international society has shaped its subsequent approach to scientific and technological development. It is not my purpose to go into a full discussion of the course of science and technology in China since 1850. My modest aim is primarily to briefly sketch the outlines in order to highlight the point that the origins of Chinese techno-nationalism can be found in the emergence of scientific and technological advancement as a key normative measuring rod in international society during the nineteenth century and how this compelled Chinese elites to respond to the 'social pressure' of introducing 'Western' technology and industry.

The Pursuit of Technology and the Standard of Civilisation

Certainly, one of the most dramatic consequences of China's violent encounter with the expanding European International Society since the mid-nineteenth century was to bring about the realisation among Chinese statesmen that institutional reforms were needed in order to adapt to the new international environment. The most important attempt to modernise was what is usually known as the Self-Strengthening Movement with the aim to enhance China's 'wealth and strength' (Kuo and Liu, 1978: 492). 'Self-strengthening' was part of a new Qing foreign policy and diplomatic outlook, designed to manage relations with major Western powers based on 'conciliation' and 'the acceptance of the treaty system' (Kuo and Liu, 1978: 492). In addition to the establishment of the Zongli Yamen in 1861, an important institutional innovation aimed at carrying out this new foreign policy, there was also a growing appreciation of international law and diplomatic practices (Zhang, 1991).

It was this backdrop of internal tension and external pressure that provided the impetus for a shift towards the introduction of these reforms, including the adoption of Western technology, as part of the Qing restoration. Despite the fact that there were a great many skilful officials, who tried to contribute to the restoration of the empire by imbuing the empire with a sense of purpose, bolstering the faltering economy, and establishing innovative institutions, Zeng Guofan, Li Hongzhang, and Zuo Zongtang are usually considered as the most influential of these (Spence, 1999: 192).[89] What these influential reformers also shared in common was the view of the urgent need to pursue Western technology in the search for 'wealth and strength' (Kuo and Liu, 1978).

This is not to say that there were not different views among late Qing reformists about the role of science and technology. But there was also an articulation of shared ideas and approaches that transcended political and philosophical divisions, which were indicative of the emergence of a nascent ideology of techno-nationalism. More specifically, Zeng, Li, and their advisors saw the construction of machines not only in narrow military terms, but also as the fundamental basis for industry. They were sharing the common conviction that there were three basic elements for building new industries: a) the manufacture of machines; b) the promotion of a new institutional

[89] Clearly, it is impossible to do justice to the multifaceted activities of these reformists, their personal backgrounds, and their complex motivations and political thought. A classic account of imperial reformists in late Qing Dynasty is Teng and Fairbank (1979).

category of 'engineers', and c) translating scientific and technical textbooks (Elman 2005: 360). Significantly, key reformists, like Feng Guifen and Li, saw the construction of *Chinese* machines as an indicator of China's leading role in international society, as a way to right the wrongs of past humiliations, and as a source of prestige (Teng and Fairbank, 1979: 54, 73).

In this regard, a recurring theme among influential 'self-strengtheners' was the need for the construction of 'machines that make machines'. Nowhere was this more evident than in the establishment of arsenals and shipyards, the most important of which were the Jiangnan Arsenal and the Fuzhou Navy Yard.[90] Besides the Jiangnan Arsenal and the Fuzhou Navy Yard, it has been estimated that 22 other key arsenals, shipyards, and factories were operating during the Self-Strengthening Movement (1861-1892) (Elman, 2006: 193). Many officially sponsored projects continued throughout the late nineteenth century as part of the Self-Strengthening Movement. But, among other factors, the prevailing conservatism and prejudice among Confucian literati and court officials hampered China's path towards modernisation and industrialisation (Teng and Fairbank, 1979: 87).

Modernisation vs. Westernisation: A false dichotomy?

But the question remains about how to make sense of the impact of the pursuit of science and technology in late Qing Dynasty in the context of the operation of the standard of 'civilisation'. In his important study on China and Japan's encounter with the expanding European International Society, Suzuki (2009) explores how military, technology, and industrial development were key aspects of what the process of learning the competence and skill to be a 'civilised' state involved. Crucially, however, as Suzuki (2009: 101) observes, in contrast to Japanese elites who saw the introduction of Western technology as a key feature of demonstrating their 'civilised' identity, for Chinese elites industry and technology 'served no value as a marker of 'civilized' identity, as it did for the members of the Society'.

One of Suzuki's major contributions in this regard has been to recognise that Chinese elites did not go beyond the introduction of Western technology and weapons to adopt European-style institutions on a wide scale, which would indicate their

[90] On the Jiangnan Arsenal and the Fuzhou Navy Yard see, for example, Elman (2005: 355-77).

intention to conform to the 'standard of civilisation' (Suzuki, 2009: 90, 106). Instead, they only linked industrialisation and Western technology to strengthening China militarily as a result of their socialisation into a competitive international environment (Suzuki 2009: 89-113).

While Suzuki's argument is interesting and important, it downplays the fact that a firm analytical separation between becoming militarily powerful and confirming to the social standards as part of what accorded 'civilised' status within international society has two substantial consequences. First, a focus on technology as a sole attribute of military power provides a rather superficial separation between the material and ideational or social dimensions of technology. Yet, the author himself shows that Chinese reformers conceived technological modernisation in both military and non-military terms, as part of the competence and skill to be 'civilised'. Second, this tension seems to arise partly because the author accepts, albeit reluctantly, the ti/yong dichotomy, according to which late Qing reformers opted for military modernisation, but not Westernisation (Suzuki, 2009: 93-4). Yet, an uncritical acceptance of the ti/yong schema does not help to account for some of the attitudes towards science and technology that emerged in China as a consequence of its encounter with international society.

To be sure, many Chinese reformists who advocated the introduction of Western weapons and technology operated within what is known as the ti/yong dichotomy, which is an abbreviated form of the longer prescription to understand 'Chinese studies as the essence, Western studies as function' (zhong xue wei ti, xi xue wei yong). In this regard, they called for the use of Western technology as functional means for Chinese ends, that is, the protection and preservation of Chinese civilisation.[91] Hence, underlying the thought of Self-Strengthening supporters was the belief that 'the "substance" (ti) of Confucian culture was essentially invulnerable to the "utility" (yong) of Western technology' (Kuhn, 2002: 52).

How then can we make sense of the fact that the views of Chinese reformist elites were seemingly more open-minded and multidimensional than the ti/yong dichotomy suggests? It is worth remembering that the Chinese intellectual Liang Qichao would introduce the term of nationalism to the public discourse via Japan somewhere between 1899 and 1901. In the absence of the vocabulary of nationalism, the

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[91] On the enduring importance of the ti/yong dichotomy and its relevance to Chinese nationalism, see Hughes (2011a).

advocates of the Self-Strengthening movement had to engage intellectually with the impact of transnational processes, unleashed by China's encounter with global modernity, drawing on neo-Confucian concepts (Hughes, 2011a: 125). Thus, as Hughes (2011a: 119) argues, instead of focusing on the logical inconsistency of the ti/yong dichotomy as a philosophical proposition that separates ontologically scientific knowledge from culture, it makes more sense to treat it as a political act that can be traced back to the efforts by late Qing Dynasty officials 'to mobilize the population by making tradition capable of harnessing the forces of nationalism' during late nineteenth century China.

Consequently, the use of the ti/yong formula by the Chinese reformists can also be seen as a political move to reconcile new conceptions of 'Western science' with traditional forms of knowledge and learning (Elshakry, 2010: 100). In particular, since the mid-nineteenth century, the consolidation of the idea of a universal and teleological 'Western science' led Chinese reformists to resort to a further process of legitimisation and conceptual appropriation. This involved an attempt to encourage and reinterpret traditions and disciplines of knowledge that regarded China as the source of 'Western learning' (Elshakry, 2010: 102). This, in turn, had the effect of rendering the pursuit of 'Western' learning and technology more compatible with Confucian tradition and identity, and, thus, more acceptable to conservatives. The very fact that this position was held among imperial examiners until the early twentieth century is illustrative of how it was used by many conservatives as what Elman (2005: 397) calls 'a strategic myth'.

Therefore, even if it is conceded that the ti/yong formula has some merit in the context of discussing the ways in which influential advocates of the Self-Strengthening movement tried to appropriate the pursuit of Western technology as a necessary and pragmatic step towards military modernisation, but not westernisation, it is important to recognise the complex nature of this process generally and the multidimensional nature of the views of Chinese reformists on the role of science and technology in particular. True, conservatism and ideology, among other factors, led to the limited and cautious introduction of Western technology during the second half of the nineteenth century. But the social pressure created by the need to conform to the operation of technological advancement as an informal standard of 'civilisation' was one of the key drivers behind China's technological modernisation nonetheless.[92]

From the Sino-Japanese War to Republican China and the Rise of Mr Science: 'Saving the Nation Through Science'

The Sino-Japanese War and its aftermath proved to be a turning point for China's engagement with international society generally and science and technology in China in particular.[93] One of the most important consequences of the War was that it gave rise to references to Japan as a great power and as a member of the family of 'civilised nations', whereas perceptions of China as weak and decadent became prevalent (Paine, 2003: 18-9). But what is also noteworthy is that the Sino-Japanese War had the effect of fostering a greater interest in Western learning and science (Elman, 2005: 399).

More generally, in the years following the War, a series of events conspired to further destabilise what was already a volatile domestic political environment, which created in turn the preconditions for the birth of the 'modern' Chinese state in 1911, ushering in the Republican era. Crucially, however, the broader question of the relationship between science and technology and China's struggle with global modernity remained at the heart of subsequent events. Perhaps, nowhere was this more apparent than in the May Fourth Movement. As Chow (1960: 358-9) points out, the May Fourth Movement was essentially an intellectual, political, and social movement aimed at achieving 'national independence, the emancipation of the individual, and a just society by the modernization of China'. What was unique about it was the degree to which many intellectuals espoused a complete break with Confucianism and Chinese tradition in favour for an embrace of modernisation or Westernisation in all key facets of Chinese culture, from literature and ethics to philosophy and politics (Chow, 1960: 359).

Importantly, as Mitter (2004: 101) points out, 'a faith in science and technology, linked with ideas of national salvation and reform', appeared for many to be the

[92] After all, as far as Japan is concerned, it is worth remembering that the notion of combining foreign technology with Japanese values, which was encapsulated in the slogan 'Japanese spirit and Western technology' (wakon yōsai), helped Meiji intellectuals to legitimise policies designed to attain national wealth and power through industrial and technological development during the Meiji Restoration (Samuels, 1994: 36-7).
[93] On the importance and implications of the Sino-Japanese War, see Paine (2003).

solution to China's manifold problems. Equally, according to Chow (1960: 359), the key underlying assumption behind advocating the creation of a new, modern civilisation to 'save China' was the idea that science and democracy constituted the essence of modern Western civilisation. This was evident in the famous slogans of 'Mr Science' and 'Mr Democracy' associated with the May Fourth Movement (Mitter, 2004: 65).

Clearly, the emergence of 'scientificism' as a principal feature of the ideology of the May Fourth Movement was significant in itself, but there are a number of additional points that can be made about the state of science and technology in Republican China as they help to illustrate the relationship between the state, modernity, and technological development. First, in his important study on the Science Society of China (SSC), Wang (2002) shows how a new generation of scientists and engineers, many of whom were educated abroad, aspired to save China through science and technology. Notably, whereas the members of the Society were driven by both professionalism and nationalism, in reality scientific nationalism had the effect of moderating the interaction of scientists and engineers with the state.

Second, although the failure of the governments to bolster central bureaucratic authority in early Republican China did not provide a permissive material context for the formation of a strong national industrial base of the sort that is indicative of a techno-nationalist ideology, this changed with the government of Chiang Kai-shek. His government stressed the importance of industrial development over other sectors of the economy in order to turn China into a modern, industrial, and technologically advanced country. However, it was only after the Japanese seizure of Manchuria in 1931 that an effort to create a national-defence economy culminated in the formulation of an industrial policy with the organisation of the National Defense Planning Commission in 1932, which became known after 1935 as the National Resources Commission (NRC). One of the most important features of the NRC was its emergence as a self-consciously technocratic organisation through which China's scientific and technological elite could harness technology and expertise for the service of the nation, relatively unencumbered by undue political interference (Kirby, 1989: 29). Remarkably, a tangible manifestation of the NRC's techno-nationalist ideology was its 1942 'Preliminary Enforcement Plan for Postwar Industrial Reconstruction' that set out policies aimed at ensuring China's status as an 'equal' and 'modernized' country (Kirby 1989: 32). Despite the fact that these policies proved to be ambitious in light of the impact of the Sino-Japanese War and the ensuing civil war, it is striking, perhaps, that most of the NRC industrial facilities were transferred to Communist control in 1948-49 and most of its leaders decided to be in the service of a new Chinese government (Kirby, 1989: 37).

Consequently, the most general point to make is that the overall approach to industrialisation and development policy during the Nanjing decade (1927-1937) would provide the institutional and ideological foundations for the support of a postcolonial techno-nationalist vision of science and technology in Communist China. In short, the fundamental interaction between the state, power, and technological hierarchies in international society that has been at the heart of late Qing reformists and Republican China would continue to shape conceptions about the role of science and technology in the PRC. As we shall see in the next Chapter, the Cold War and the concomitant space race would only serve to intensify this process.

India, Modernity, and the Making of the Postcolonial Technological State

The importance of the close links between science, technology, and colonial rule in British India has attracted much attention in the scholarly literature that deals with the social history of science and technology in India. As many have noted, British saw science and technology as important features of their 'civilising mission' as well as a manifestation of their superior civilisation (Prakash, 1999: 3, Arnold, 2000: 15, 22, Kumar, 2006: 15). A detailed account of science, technology, colonialism and modernity in the context of British Empire and its impact on India is beyond the scope of this chapter, but some of the key aspects of this process are worth highlighting here. First, the period of British rule in India witnessed the effort by the colonisers to enlighten the natives through science as a source of reason, which had the effect of configuring the function of science both as culture and power. In this regard, the very idea of Western modernity was embedded in the scientific outlook of the colonial and imperial project in the sense that the authority and legitimacy of universal reason signified science and technology as tools of the British rule in India (Prakash, 1999: 4).

Second, an important aspect of the projection of India as a modern colony was the development of infrastructures, practices, and institutions associated with the representation of science and technology as configurations of Western authority and universal reason. This was manifested in the ways in which the colonial state used modern techniques of governmentality from irrigation and mining to the railways and the telegraph system (Prakash, 1999: 11, 159-70). Indeed, for Marquis of Dalhousie, who was Governor-General of India in the early 1850s, the telegraph and the postal system represented the two of the three 'great engines of social improvement' of colonial India. In his view, the third engine was the establishment of a network of railways, which epitomised the moral and material superiority of the coloniser over the colonised (Adas, 1989: 225). However, it should be noted that this process was further consolidated after the 1857 Mutiny that placed India under direct Crown rule. Against the backdrop of further centralisation and tightening colonial control, the development of science and technology became one of the largest state-sponsored undertakings under the Public Works Department (Baber, 1996: 185-6, 212; Prakash, 1999: 4).

Third, the hierarchy of civilisations according to material accomplishments was also reflected in the reproduction of social hierarchies between the coloniser and the colonised. Not only was the Indian civilisation defined as stagnant and backward, but also the Indian worker had to be subordinated to the British engineer 'as civiliser' (Adas, 1989: 235-6). Equally, as Headrick (1988: 268) observes, the British were willing to educate the Indians only to a certain point. 'Beyond that point, they withheld the culture of technology'. Yet, although the consolidation of colonial rule in India led to the development of colonial structures that facilitated the institutionalisation of Western scientific research and technological projects, which had a decisive impact on the indigenous system of science, Indian scientists were key agents in promoting the introduction of Western science and technology. In other words, it is important to acknowledge that the introduction of Western science and technology in India cannot be understood as a simple process of imposing Western traditions of knowledge on indigenous ones (Arnold, 2000: 12-4; Baber, 1996: 251).

Indeed, during the second half of the nineteenth century an Indian scientific elite gradually emerged that could identify with the project of Western modernity. A key part of this effort was the creation of institutions like the Indian Association for the Cultivation of Science, which was formally established in 1876 with the aim of educating Indian scientists on basic research under native control and management.

Notably, one of its students, C V Raman, would become the first Indian to be awarded the Nobel Prize for theoretical physics in 1930 (Baber, 229-30).

But what merit emphasis, however, is that the embracement of modernity by the Indian scientific community became gradually interwoven with the rise of nationalism that marked the growing intersection of science and politics. As Prakash (1999: 7) argues, it became increasingly accepted among anti-colonial nationalists that 'to be a nation was to be endowed with science'. This involved the 'rediscovery' of a body of indigenous scientific traditions that was appropriated as congruous with Western science. Concomitant with this was a process of conceptual appropriation based on the idea that these traditions of science, technology, and knowledge were the past of the Indian nation imbued with universal thought and rationality. It was in this context that Hindu science soon emerged as 'symbol of the modern nation' and as a way to indigenise modernity. In turn, the claim by nationalists that Hindu science was an expression of universality and rationality reconfigured the colonial state defined by modern techniques, practices, and infrastructures as a national site that had to become independent (Prakash, 1999: 7-11).

Consequently, not only was science at the heart of the imagination and institution of India as a colonial project, but also became essential in the reconstruction of India as an independent nation. This was evident in the widely held assumption among nationalists that India succumbed to colonial rule because it did not manage to become modern. In this view of the past, as Chacko (2011: 186) notes, it was India's failure to develop a scientific outlook, and thus, to meet the standard of civilisation set by the European international society that brought India under British control. Indeed, in the postcolonial world the development of a scientific outlook emerged as an indicator of national character predicated on the idea that the nexus between modern science and the nation-state was a key factor in the making of the dominant European powers. In response, postcolonial states had to adapt and imitate these practices (Harrison and Johnson, 2009: 3).

The colonial experience, therefore, led to the conviction that India was backward, which in turn gave rise to the desire of mimicking Western practices, including science and technology. But whereas the increasing acceptance of modernity among Indian elites was seen as an inescapable process of the emerging international order, given the country's colonial past, India's response to modernity could not be underpinned by simple mimicry. India had to foster a different modernity 'on its own terms' (Prakash, 1999: 200). Put differently, the mimicry of Western modernity had to be counterbalanced with ambivalence towards Western modernity in order to highlight India's difference as a postcolonial civilisational entity (Chacko, 2011: 186). As we shall see in Chapter 5, these themes underlined the emergence of a powerful postcolonial techno-nationalist ideology under the leadership of Nehru that signified the pursuit of space projects as normative indicators of the postcolonial state's power, status, and modernity.

Concluding Remarks

Drawing on the concept of the 'standard of civilisation' and building on ideas from the history of science and technology, this chapter has argued that the origins of techno-nationalism and its enduring relevance to conceptions of technology as a normative indicator of power, status, and modernity can be found in the expansion of the European international society during the nineteenth century. I developed this argument by examining the ways in which scientific and technological attainments were seen to function as material and symbolic indicators of the cultural superiority of European colonial powers since the nineteenth century and how China and India were constructed as 'uncivilised', premised on European assumptions and perceptions about civilisational hierarchies and technological advancement. Crucially, although the first and the second World Wars have had a profound impact on the discourse of civilisation and notions of European superiority over non-European societies, sites of inclusion and exclusion on the basis of technological capabilities continued, and still continue, to define distinctions between outsiders and insiders and, thus, political forms of hierarchy, power, and status in international society.

This conceptual rethinking helps to highlight how China and India's formative experience with the European international society still informs a powerful variant of techno-nationalism in a postcolonial context. As we shall see in the following chapters, this becomes an important consideration, especially given how China and India remain enmeshed in a process of negotiating their role as non-European emerging technological powers in the context of modernisation, development, and globalisation. But before we consider how these dynamics of identity and history play out in international space society, we need to take a closer look at the ways in which the consolidation of a postcolonial techno-nationalism has had an enduring influence on the pursuit of the Chinese and Indian space programmes from their inception.

Chapter 4. The Long March Into Space: China's Space Programme (1956-1989)

This chapter provides an overview and analysis of the origins and development of China's space programme from the mid-1950s to the late 1980s. It does this by placing the relationship between science and technology and China's quest for high-visible technological projects in its specific historical context. In some ways, China's early interest in pursuing a space programme was influenced by the same military, political, and prestige considerations that shaped the space programmes of the United States and the Soviet Union. Like the first two participants in the Space Age, China's initial space endeavour can be seen as a reflection of the realisation that building space capabilities would enhance military effectiveness and improve China's international political prestige during the Cold War. Like the United States and the Soviet Union, China's space programme also benefited largely from ballistic missile development, which was driven by its nuclear programme.

Yet, despite the fact that the case of China may not appear to be quite distinctive in this respect, this chapter suggests that the context and evolution of the Chinese space programme was rather unique not the least because China, when compared with the United States and the Soviet Union, was not only a relatively backward state in terms of its economy and technology, but also went through periods of sustained political and social turmoil during the Maoist era. Under such circumstances, as Hymans (2012: 125) points out in his analysis of China's nuclear weapons programme, the key question is 'how did China's nuclear weapons project succeed?'. Clearly, this is a question that is also pertinent to the space programme, albeit one that is yet to be elaborated in the relevant literature.

In addressing the question of how China's space programme succeeded, this chapter argues that its space effort, from its inception, has been especially marked by the influence of postcolonial techno-nationalism. Indeed, the history and evolution of space development in China might have been different were it not for postcolonial techno-nationalism as a composite and complex, but influential, ideology that rendered the pursuit of space projects appealing to China's political and scientific elite as a normative indicator of the state's scientific prowess, great power status, and modernity. This is not the same as simply arguing that the space programme received considerable support and protection from the high echelons of the Chinese leadership. After all, this was not always the case, as we shall see. Equally importantly, and echoing again Hyman's question, postcolonial techno-nationalism does not only help to account for the reasons why China decided to build specific space technologies in the first place and how it used them once they were acquired, but also helps to highlight how building these technologies was justified and implemented efficiently (Hymans, 2012: 127).

Certainly, any attempt to provide an historical account of China's early quest for becoming a space-faring nation is inevitably confronted with the brevity of available and/or reliable information as a consequence of the general opaqueness that underpins much of China's space-related activities. Unfortunately, to a great extent, Johnson-Freese's description of the space programme as 'a mystery within a maze' back in 1998 is still valid (Johnson-Freese, 1998). Moreover, a definite political history of the Chinese space programme is yet to be written. However, recent works have offered helpful insights into how key decisions and space projects have come about, the most important of which is *A Place for One's Mat* by Kulacki and Lewis.[94] Building on these works helps to illustrate some of the main issues and themes discussed in this chapter. Another invaluable source on which this chapter draws upon is the lengthy official history of the space programme *China Today: Space Industry* by the Ministry of Space Industry, as it enriches our understanding of what can be called the 'consensus narrative' of principal decisions and events from a Chinese perspective.[95] In putting forward the above argument, the chapter also relies on the scholarly literature that deals with techno-nationalism and the history of China's nuclear and missile programmes, especially on the evidence and insights provided by Lewis and Xue, and Feigenbaum.[96]

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[94] Other useful works include: Chen (1991); Chen (1999); Johnson-Freese (1998); Harvey (2004); Handberg and Li (2006); Zheng (2007); Besha (2010); Zhang (2010); Moltz (2012: 70-89); Harvey (2013); Li (2013); Solomone (2013); and Erickson (2014).

[95] The Chinese version was published in 1986 entitled 'Dangdai Zhongguo de Hangtian Shiye' edited by Jun Zhang and was translated in English in 1992. A copy of the English edition is somewhat rare to find, but this is compounded by some confusion regarding who is attributed as the main editor of the volume. In the English edition, Jun Zhang is indicated as the chief editor of the volume in general, whereas Liu Jiyuan is credited with editing the English edition. Some works in the western literature refer to Liu as the editor, but here I have chosen to cite Zhang as the chief editor not the least because this is how the source is mainly known among experts of China's strategic weapons programme. Zhang Yun was director of the Ministry of Space Industry.

[96] See Lewis and Xue (1988); Lewis and Xue (1994); Feigenbaum (2003), Feigenbaum (1999a), and Feigenbaum (1999b). See also Lewis and Hua (1992); and Hymans (2012: 124-56).

The discussion of this chapter is organised in the following way. The first section spells out briefly the principal factors that led to the Chinese decision to build the bomb, which had far-reaching implications for the country's overall scientific and technical direction, before offering a brief sketch of the main individuals that shaped the strategic weapons programme. While there is no doubt that the role of Mao Zedong and Zhou Enlai was instrumental, most attention is given to Marshal Nie Rongzhen largely because it was the articulation of his postcolonial techno-nationalist vision that had a profound impact on the trajectory of the strategic weapons programme, and, consequently, on the space programme.[97] However, I do this by briefly assessing the impact of one other key figure, Qian Xuesen, who is usually known as 'the father of China's missile and space programmes'. The second section then delves into the first phase of the space programme (1956-1966), during which work on China's first satellite was put forth, only to be suspended due to the excesses of the Great Leap Forward. Nonetheless, the satellite project was soon revitalised along postcolonial techno-nationalist lines. The second phase of the space programme coincides with the decade of the Cultural Revolution (1966-1976), which is the focus of the third section. Despite the fact that the Cultural Revolution engulfed the entire Chinese society, this period also saw China joining the space club with the successful launch of its first satellite in 1970, which was followed by other space feats. The fourth section moves on to consider the third phase of China's space activities in the post-Mao era (1976-1989). Although this period was marked by Deng's emphasis on few space projects that could contribute to economic modernisation, such as communication and meteorological satellites, the reconsolidation of a postcolonial techno-nationalist vision in the mid-1980s enshrined in the '863 High-Tech Plan' provided a new impetus for the space programme, including human spaceflight. Of equal significance, this period also heralded China's engagement with the evolving international space society.

[97] The terms 'strategic weapons', 'high technology', and 'strategic technology' are used here interchangeably, unless explicitly stated otherwise, to describe what the Chinese call the 'Two Bombs, One Satellite' or *Liangdan Yixing* project. This is usually a reference to the atomic and the hydrogen bombs and the first satellite, but it has become synonymous with the successful building of nuclear and space capabilities in the 1960s and 1970s. Other related highly complex technological projects of that period, such as the missile programme and the nuclear submarine projects, have been part of the strategic weapons programme. See Cheung (2009: 238).

The Decision to Build the Bomb and Techno-nationalism

The Impact of the Korean War and the Sino-Soviet Cooperation

Almost from the establishment of the People's Republic of China in 1949, the political and military elites were well aware of China's technological gap with the advanced countries of the West and the need to respond to the new competitive international environment of the Cold War. While the Second World War served to illuminate the growing importance of technology in modern warfare, it was China's experience of the Korean War of 1950-53 that revealed the extent of its technological backwardness and galvanised industrial military modernisation (Feigenbaum, 2003: 16-21; Chen, 1994: 223).

Therefore, despite the People Liberation Army's early emphasis on 'fighting a people's war with a people's army', the trauma of the Korean War highlighted the urgency for depending more on advanced technology and professionalism (Lewis and Xue, 1988: 9).[98] This compelled Chinese leaders to rely on the Soviet Union for technical assistance as part of China's declared 'leaning to one side' policy.[99] Consequently, China and the Soviet Union signed the Sino-Soviet Treaty of Friendship, Alliance and Mutual Assistance on 14 February 1950. Soviet aid took the form of what has been described as 'the most comprehensive technology transfer in modern history' (Dittmer, 1992: 18-20). But while, in principle, the Sino-Soviet alliance meant that the Soviets would provide China with a nuclear umbrella, Mao was suspicious of the Soviet eagerness to resort to the use of nuclear force in support of China. This led to a shift from China's 'leaning to one side' policy to an emphasis on 'self-reliance' (Chen, 1994: 222). Furthermore, the Eisenhower administration alluded to the use of atomic weapons during the Korean armistice talks. Atomic threats were also issued during other crises that involved the United States and China, including the Indochina crisis in 1953 and the first Taiwan Straits crisis in 1954-55. The subsequent forward deployment of US nuclear-capable forces in areas surrounding China had the effect of intensifying concerns among Chinese leaders about the prospect of the use of nuclear weapons against their country and underlined the need for achieving nuclear deterrence (Foot, 1995: 169-70). The structural

[98] On the doctrine of People's War, see, inter alia, Burles and Shulsky (2000: 22-5); and Scobell (2003: 46-9).
[99] For an account of the diplomatic and political background of the 'lean-to-one-side' decision, see, for example, Chen (2001: 44-6, 50-3).

pressure on Chinese leaders to acquire nuclear weapons only increased with the unfolding of the Sino-Soviet split since the late 1950s

The Decision to Build the Bomb

Clearly, these events acted as a catalyst for the decision to build a national strategic force and urged the Chinese leadership to consider the establishment of an indigenous strategic weapons programme (Lewis and Xue, 1988: 35). However, even though the overarching geostrategic circumstances of the Cold War help to explain why the Chinese leaders decided to develop the strategic weapons programme, as many scholars note, ideational influences were also important. Indeed, as Lewis and Xue (1988: 35) point out, given 'the nationalistic ideology and concepts of force and diplomacy' of Mao and other Chinese leaders, the decision to manufacture a bomb might have been taken even without these external pressures. According to Foot (1995: 170), the possession of nuclear weapons as a marker of great power status, the desire to overcome its putative century of humiliation, and the use of nuclear power for economic purposes were also key drivers behind China's quest for building the bomb.

In this regard, while Mao's thinking has been complex and often contradictory, there is a plethora of evidence to suggest that his desire for the bomb was also driven by national identity impulses entrenched in China's colonial experience (Hymans, 2012: 134-5).[100] As Mao famously stated in 1958, 'as for the atomic bomb, this big thing, without it people say you don't count for much. Fine, then we should build some' (cited in Johnston, 1995/96: 8). On a different occasion, Mao encouraged the scientists involved with the nuclear programme to accelerate their work by instructing them, 'We are stronger than before and will be stronger in the future. We will have not only more planes and artillery but atomic bombs as well. If we are not to be bullied in this present-day world, we cannot do without the bomb' (cited in Lewis and Xue, 1988: 142).[101] Thus, for all his public references to the atomic bomb as a 'paper tiger' and his proclamation of 'fighting a people's war', in reality Mao conveyed a

[100] There is a conspicuous absence of a work that focuses explicitly on Mao's nationalism in the existing literature. However, in his important analysis of Mao's political thought, Schram (1989: 8, 15) identifies nationalism as a key theme of his thinking. For an overview of Mao's views about nuclear weapons, see Zhang (1999).

[101] This nationalist impulsion was also evident in Mao's discussion with Soviet Ambassador Yudin. See Christensen (1996: 209).

quite different message to his inner circle and to those involved with the development of the nation's nuclear weapons programme: 'whatever they have, we must have' (Lewis and Xue, 1994: 209).

What should be added is that other Chinese leaders also shared this deep-rooted symbolic and psychological importance attached to the bomb. For example, as one representative of a Chinese scientific association put it in 1951: 'only when we ourselves have the atomic weapon, and are fully prepared, is it possible for the frenzied warmongers to listen to our just and reasonable proposals…' (cited in Harris, 1965: 94). More tellingly, perhaps, expressing the operation of technological attainments as an informal standard of modernity, Premier Zhou Enlai remarked after the detonation of China first nuclear device, 'Have we not exploded an atom bomb? Has not the label, 'sick man of the east', fastened on us by Westerners, been flung off?' (quoted in Foot, 1995: 172).[102] Equally tellingly, addressing a group of Japanese reporters, Foreign Minister Chen Yi stated in the early 1960s, 'atomic bombs, missiles and supersonic aircraft are reflections of the technical level of a nation's industry. China will have to solve this issue within the next several years; otherwise, it will degenerate into a second-class nation' (cited in Lewis and Xue, 1988: 194).

It was against this backdrop that the decision to build the bomb was taken in January 1955 (Lewis and Xue, 1988: 37-9). But although we might reasonably expect that there was a consensus about building the bomb, reality was more complex. It was only after Marshall Nie Rongzhen and his aides articulated successfully a postcolonial techno-nationalist argument that China's nuclear programme made progress.

The Rise of Techno-nationalism and Marshall Nie Rongzhen

In the context of discussing how China succeeded in carrying out its first nuclear test by 1964, a central explanation usually offered is that China received crucial technical assistance from the Soviet Union. Certainly, Soviet help was fairly generous in many fields, but it also 'imposed demands and restrictions' on the Chinese side (Lewis and

[102] Racial and civilisational qualities ascribed to the bomb have been quite prominent in the Western discourse of nuclear non-proliferation. As Powell (1965: 616) noted, after the successful testing of China's first bomb, 'It is as portent of the future that the mushroom cloud over West China has crucial importance for the peace and security of the world. All previous atomic testing has been carried out by industrial powers of the Occident; Communist China is non-Western, non-white and only semi-industrialized'. On this racial dimension with regards to the Chinese bomb, see, inter alia, Jones (2010: 401-49).

Xue, 1988: 221, 228). As Hymans (2012: 130) points out, Soviet technology transfer 'was far from determinative' when it came to the nuclear weapons project. In fact, it was to a great extent the abrupt Soviet withdrawal that accelerated the progress of the strategic weapons programme (Lewis and Xue, 1988: 224). As we shall see, the Soviet withdrawal had a similar effect on the space programme. Another standard explanation provided is that China benefited enormously from Western-educated Chinese scientists who returned to China. True, by the early 1950s, a number of remarkable Western-educated scientists began returning to China from abroad to devote their energy to the conduct of cutting-edge scientific research usually related to the strategic weapons programme, including the US educated Qian Xuesen (more on whom below). But while it can be quite tempting to attribute the development of nuclear weapons or missiles to a few outstanding individuals, large-scale scientific research (big science), encompasses a large number of scientists working in numerous specialised research institutions defined by a clear division of labour between them. These were definitely qualities of the strategic weapons projects, save for the periods during which political and social turbulence hindered the progress of these projects (Hymans, 2012: 132).

How then can we make sense of the success of the strategic weapons programme? To be sure, Mao initially accorded to specific projects the necessary strong political support. But as he became more preoccupied with his revolutionary cause, he was less interested in getting directly involved even with the nuclear weapons project (Lewis and Xue, 1988: 221). What is more, his political campaigns created many obstacles to the advancement of these projects. It was the 'organizational genius' Marshall Nie Rongzhen (1899-1992) who gets much credit for the successful course of the strategic weapons programmes (Lewis and Xue, 1988: 235, 223; Lewis and Xue, 1994: 239; Feigenbaum, 2003: 15; Hymans, 2012: 133). Two of Marshal Nie's important breakthroughs merit emphasis. First, Nie and his aides articulated a techno-nationalist vision since the mid-1950s that justified the flow of enormous resources into strategic weapons projects. In response to those who opposed the prospect of building such technologies on both economic and military grounds, Nie put forward the argument that strategic weapons could play a decisive role both in national security and economic development terms, and thus, they could enhance the international political standing of China in international society (Feigenbaum, 2003: 15, 27-31).

Second, Nie's role was crucial in forging a nationwide organisational structure based on the coalition between high-politics and big science backed by Zhou Enlai (Lewis and Xue, 1988: 224, 229; Lewis and Xue, 1994: 239). What made this managerial system quite effective and innovative was the establishment of strongly professional and flexible organisations of horizontal controls and flattened hierarchy, premised on the autonomy of scientists and limited political and bureaucratic interference (Feigenbaum, 2003: 39-60). As a consequence, the personal and professional motivation of those working for the strategic technology projects was blended together with a sense of national mission and pride (Lewis and Xue, 1988: 232-6; Hymans, 2012: 139).

Two additional points are worth making here. First, it is difficult to make sense of how Nie's techno-nationalism became so influential without recognising the postcolonial context of his vision. For even a cursory glance at his memoirs and statements serves to highlight that his understanding about the place of science and technology in China was much informed by China's colonial legacy and the need to right the wrongs of its humiliating past by 'saving China through science'.

In his memoirs, Nie (1988: 663-4) explains what motivated him to get involved with leading the strategic technology programme: 'The Chinese people who created a new China through decades of struggle will certainly be able to turn their motherland into a modern, powerful country in the next decades…I saw in my youth how the old China, being poor and backward was humiliated by the imperialists. This left an indelible mark on my mind…I was guided by the ideal of "saving the country through the development of industry"'. The marshal also notes, 'The imperialists dared to bully us precisely because we were backward. To extricate ourselves from this passive position, we had to advance as rapidly as possible and, therefore, must develop science and technology energetically' (Nie, 1988: 661). Equally remarkably, in addressing the opponents of the strategic weapons programme, Nie (1988: 702) postulates a postcolonial techno-nationalist rationale that it is worth quoting at length:

> For more than a century, imperialists had frequently bullied, humiliated and oppressed China. To put an end to this situation, we had to develop sophisticated weapons such as the guided missile and atomic bombs, so that we would have the minimum means of reprisal if attacked by imperialists with nuclear weapons…[W]e had become keenly aware that the pursuit of guided missiles and atomic bombs would advance us in many other branches of modern science and technology.

Hence, acknowledging the postcolonial dimension of the vision expounded by Nie and his associates helps to illustrate why China's techno-nationalism has been somewhat different from that of Western countries. It also helps to explain how the plasticity of this postcolonial techno-nationalist ideology and the necessary political myths that animated it facilitated the creation of a broader synergy among the political leadership, scientists, and the military establishment.

Second, although Nie's influence on the strategic weapons programme is widely recognised in the literature that deals with the nuclear and missile programmes, scholarly works on China's space programme have usually overlooked his vital role.[103] Yet, this is not often the case with Qian Xuesen, who is usually seen as the key individual behind China's space effort and to whom we now turn.

Qian Xuesen

Qian Xuesen (1911-2009) is regarded as one of the most important aeronautical engineers and scientists of the past century.[104] After graduating from the Shanghai Jiatong University in mechanical engineering, he received a Boxer Rebellion Scholarship and left China in 1935 to study aeronautical engineering in the United States. Although he began his studies at the Massachusetts Institute of Technology (MIT), one year later he moved to the California Institute of Technology, known as Caltech, where he completed his PhD in 1939 under the mentorship of Theodore von Karman, the world-renowned aeronautical scientist. He would work for four years as a research assistant at Caltech. In 1945, he became a co-founder of the Jet Propulsion Laboratory (JPL), which was initially funded by the US military and later came under NASA. Notably, as the Second World War was nearing the end in 1945, Qian joined a team of top scientists led by Karman that visited defeated Germany to assess the progress of Nazi German missiles, where he interrogated Wernher von Braun. Subsequently, in 1949, he was appointed the Robert Goddard Professor of jet propulsion at Caltech (Chang, 1995: 40-113, 140-49). However, his life took a dramatic turn when barely one year after his appointment as the Robert Goddard Professor of jet propulsion at Caltech, he was labelled a communist at the height of

[103] For example, it appears that in *Chinese Space Policy* by Handberg and Li (2006) there is no single mention to Marshal Nie.
[104] The best biography of Qian remains Chang (1995), on which this section draws.

the witch-hunts of the McCarthy period. Qian tried to return to China, but he was arrested on accusation of attempting to 'send technical material overseas'. After his release he spent five years under virtual house arrest. Eventually, Qian and his family were deported to China in exchange for the return of American Korean War prisoners of war (Chang, 1995: 149-98).

Qian's immediate involvement with the strategic weapons programme upon his arrival to China was pivotal, but it is necessary to make a number of points about his role in the missile and space programmes at this juncture. First, while there is a widely held belief that he 'single-handedly led China's space and military rocketry efforts', this is somewhat overstated.[105] Indeed, there is a standard narrative in the United States according to which China's space and missile programmes might not have been progressed, were it for his forced return to China. Yet, Qian was not the main contributor to the design of any Chinese missile or satellite (Kulacki and Lewis, 2009: 30). According to Kulacki and Lewis (2009: 30), these views about Qian in the United States are enmeshed in 'American myths' about the role of 'great men' in history and McCarthyism. While there is clearly something into this, I would argue that these American views about Qian are also reflective of a subtle Eurocentrism in the sense that only somebody who was educated in the United States could help China to develop its missile and space programmes. This sort of subtle Eurocentrism is also linked to another 'myth' indicated above regarding the impact of Soviet technology transfer to China's missile and space projects. Following this logic, China's strategic weapons programme would not have advanced, were it not for Soviet technical aid.

Second, Chinese narratives about Qian also overstate his contribution to China's missile and space projects largely for political reasons. Remarkably, Qian began to heap praise and honours only after he expressed his support to the Chinese leadership for the Tiananmen Square crackdown in 1989. Since then, a glorification campaign has occurred that has elevated Qian to one of the most eulogised and honoured Chinese scientists not only for his contribution to the 'Two Bombs, One Satellite' project, but also for his allegiance to the Party. Consequently, a 'Qian literature' has emerged that reproduces this official Party narrative of 'hero construction', which has been facilitated by Qian's self-representation as a patriot and a loyal to the Party (Wang, 2011).

[105] This description is taken from the New York Times Qian's obituary (Wines, 2009).

What was then Qian's main role in the missile and space programmes? For Kulacki and Lewis (2009: 30), 'Qian, is first and foremost, a cheerleader, pressing China's leaders to consider the possibilities of interplanetary spaceflight…In other cases, he was essential to move the bureaucracy'. These observations are not quite dissimilar to what Chang identifies as Qian's principal contributions. According to Chang (1995: 209), one of the most important aspects of Qian's participation in the missile and space projects was that he instilled a sense of confidence in the Chinese leadership. As a standout scientist with an international reputation, Qian had the attention of the Chinese leaders. As Lin Jin, a missile expert confirms, Qian 'did not make any specific contribution or specific missiles, but it was his overall vision and organization that mattered. He was the one who made the proposals and gave advice to Mao and Zhou Enlai. They listened to him. He got us the funding' (quoted in Chang, 1995: 209). In this regard, Qian's 'role was symbolic' (Chang, 1995: 209). Qian also contributed significantly to the organisational direction of the missile effort and he initiated and guided several key missile and space projects (Chang, 1995: 210-1). Crucially, all of the above contributions dovetailed nicely with Nie's techno-nationalist vision.

The Twelve-Year Science and Technology Plan

In January 1955, the Soviet chief advisor to the president of the Chinese Academy of Sciences (CAS), V. A. Kovda, submitted a report to the academy on 'Some Measures for the Planning and Organisation of Chinese National Scientific Research Work'. Then a series of events unfolded that culminated in the 'Outline of a Long-Term Plan for the Development of Science and Technology, 1956-1967', known as the Twelve-Year Science and Technology Plan. The big-scale and ambitious 1956 plan set the stage for further Sino-Soviet cooperation, but it was also an important step towards making science and technology an essential part of 'nation-building and state formation' (Wang, 2015: 180). Wang (2015) details how the plan was the product of political tensions and compromises between a radical approach to science and technology based on revolutionary mobilisation favoured by Mao and a more technocratic vision supported by Zhou Enlai and Marshal Nie.

Nevertheless, a consensus reached at the 1956 conference that Western-influenced scientists and engineers should be trusted to contribute to the formation of communist China and, so, the technocratic vision won the day, something that helped to put forward the science plan. Significantly, this compromise partly reflected Chinese leadership considerations concerning building nuclear and missile technology (Wang, 2015: 184; Zhang, 1992: 5). Focusing on the quest for modernising China's national economic and scientific capability, the programme intended to follow the global trends in key world science and technology areas of research. Fifty-seven projects were identified for their significance in this regard, with five of them – atomic energy, electronics, jet propulsion, automation, and rare mineral exploration – designated as the most urgent ones (Cao, 2004: 29). Despite the fact that the 1956 plan did not explicitly identify the building of atomic bombs and missiles, the top five aforementioned areas of research were directly applicable to the nuclear and missile development. The connection between civilian scientific research and the nuclear and missile programmes, which was reflected in the 1956 plan, was further strengthened by the appointment of Marshal Nie as head of the high-level Science Planning Commission of the State Council in late 1956, given that Nie was already in charge of the strategic weapons programme (Wang, 2015: 192).

What is noteworthy is that Qian Quesen, as head of the General Group tasked with the overall drafting of the plan, was instrumental in shaping its direction and its focus on missile development. Qian's recommendations were also critical in convincing the Chinese government that missile development should be prioritised over building aircraft technology (Wang, 2015: 193; Chang, 1995: 211-12; Erickson, 2014: 145). Consequently, in April 1956, the Aeronautical Industry Commission (AIC) was formed, with marshal Nie as chairman and Qian as one of its members. One month later, it was decided that AIC would be responsible for setting up the administration for missile research (the Fifth Bureau) and the Missile Research Academy (the Fifth Research Academy) (Zhang, 1992: 5). This decision marked the beginning of the first phase of the space programme.

The First Phase (1956-1966): Maoist China and the Advent of the Space Age

The beginning of China's space effort has its origins in the establishment of the Fifth Academy of the Department of Defence on 8 October 1956 (Chen, 1991: 117; Zhang, 1992: 6; Harvey, 2004: 22). With Qian Xuesen as its first director, the academy was a missile research and development organisation aimed at building long-range missiles to counter the US threat to China (Lewis and Hua, 1992: 7). However, given their limited knowledge about missile technology, the Chinese had little choice other than looking for Soviet technical and material help. In August 1956, Nie asked Vice Minister Li Fuchun, who was in Moscow negotiating Soviet economic aid, to request technical assistance in building guided missiles (Nie, 1988: 694). From the outset, the Soviets were reluctant to assist the Chinese with developing missile technology and other sophisticated weapons, but they eventually agreed to supply to China two R-1 missiles in September 1956. These were essentially Soviet replicas of the Nazi German V-2 rockets. The primitive nature of these rockets meant that they were not of much help to the Chinese (Lewis and Hua, 1992: 7).

Nevertheless, Soviet leader Nikita Khrushchev soon expressed his willingness to provide more advanced missiles to China because he urgently needed Mao's political support in his effort to consolidate his political position, which had weakened both at home and abroad after his denunciation of Stalin (de-Stalinization) and the protests in Poland and Hungary (Lewis and Xue, 1988: 62; Kulacki and Lewis, 2009: 5). In September 1957, Nie, together with PLA generals, led the Chinese delegation in the Soviet Union for talks. After marathon negotiations that lasted 35 days, the Sino-Soviet New Defence Technical Accord was signed on 15 October 1957 (Nie, 1988: 696). Under the 1957 October agreement, the Soviet Union delivered two R-2 missiles, followed by the supply of blueprints and technical documents (comprising of 10,151 volumes) related to manufacturing, testing, and launching the two missiles. Subsequently, Soviet missile engineers visited Beijing and the Fifth Academy obtained twelve additional R-2 missiles. With the delivery of the R-2 missiles, the Fifth Academy soon embarked upon an effort to copy them, named project '1059'. The 1059 project essentially marked the birth of the Chinese ballistic missile programme (Lewis and Hua, 1992: 8). But it was an international event, the launch of Sputnik, which paved the way for plans to launch China's first satellite.

Mao and Sputnik

Chairman Mao Zedong gets much of the credit for China's decision to develop its first satellite soon after the launch of Sputnik in October 1957. Indeed, the Chinese leader was genuinely impressed by the Soviet feat in space (Lewis and Xue, 1988: 68; Kulacki and Lewis, 2009: 4-5; Zhang, 2010: 4-6). In November 1957, shortly after the 1957 October agreement and the launch of Sputnik, the Chinese leader visited Moscow to take part in the conference of World Communist and Workers' Parties, which was scheduled to coincide with the celebration of the fortieth anniversary of the Bolshevik revolution. There is agreement among scholars that the 1957 Moscow conference signalled the beginning of the Sino-Soviet split.[106] But despite serious points of conflict in the Sino-Soviet partnership, during his stay in the Soviet Union Mao adopted a somewhat conciliatory tone. Both sides had agreed that it was necessary to strengthen the unity of the socialist camp. Besides, participating at the conference presented for Mao a good opportunity to offer his political support to Khrushchev in exchange for the future provision of Soviet assistance to China's nuclear and missile programmes as part of the 1957 October agreement (Luthi, 2008: 74-9).

What is especially noteworthy for our purposes is that Mao made several remarkable references to Sputnik during his stay in the Soviet Union. When he arrived at the Moscow airport on 2 November 1957, the Chinese leader stated that since the Bolshevik revolution the Soviet Union had attained many successes that indicated its standing 'in the foremost rank among the countries of the world' and that sending the first satellite in orbit 'was no simple matter' as it heralded the beginning of a new era 'in mankind's [efforts] to conquer nature further' (Mao, 1957a: 758). In his speech at the conference on 14 November 1957, Mao acknowledged that the Soviet Union was the leader of the socialist camp by making an explicit link to China's lack of satellite technology. In his words: 'We, China, cannot be the head. We are not qualified; we have [too] little experience...In terms of population we are a big country; in economic terms we are a small country. We have not sent up even half a satellite' (Mao, 1957b: 768). In another speech addressed to Chinese students and trainees in Moscow, which became known for his assertion that the East wind was destined to prevail over the

[106] For an early insightful account of the Moscow conference, see Zagoria (1961). For a recent analysis of the importance of the conference in the Sino-Soviet partnership, see Shen and Xia (2009).

West wind, Mao described the launch of the two Soviet satellites, along with the Bolshevik Revolution and the 1957 Moscow conference, as major turning points in the history of humankind (Mao, 1957c: 775).[107]

What Mao's reaction to Sputnik suggests, therefore, is that the prestige value and the tangible military implications of the first Soviet satellite had quite impressed him. For Mao, the balance of power between the East and West had changed because of the supposed superior capacity of the Soviet Union to deliver nuclear weapons (Lewis and Xue, 1988: 217). But while the Soviet accomplishment in space was a mark of the power of the Soviet Union, it had also persuaded Mao of the superiority of the socialist camp in general (Pantsov and Levine, 2012: 442-3). Yet, notwithstanding his expressed optimism and confidence, Mao was concerned that the growing technological capabilities of the Soviet Union would also decrease China's strategic role within the alliance. Mao also feared that China could suffer the same fate as the Soviet Union's Eastern European allies (Christensen, 1997: 206). It was in this political and strategic context that the Chinese leader called for building China's first satellite.

Plans for China's First Satellite: Project 581

One of the immediate consequences of Sputnik was Mao's declaration that 'We too should produce satellites' during the Second Plenary Meeting of the Eighth Party Congress on 17 May 1958. The Chinese leader added that 'if we're going to throw one up there then throw a big one, one that weights two tons. Of course we start throwing small, but with one that is at least two tons. Something like that chicken egg of the Americans, I won't do it!' (Kulacki and Lewis, 2009: 5; Chang, 1995: 226). This phrasing was so characteristic of Mao's benchmarking approach to technological achievements by which he gauged China's international standing against that of its adversaries (Feigenbaum, 2003: 29).

Yet, although it is clear that Mao was a prime mover of China's space effort, it is unlikely that such a scientific and technological endeavour would have come to conceptualisation were it not for the support of China's scientific community. Indeed, by January 1958, even before Mao's proclamation, Qian Xuesen and his colleagues

[107] On 3 November 1957, the Soviet Union launched its second satellite, Sputnik 2, which was the first to carry a living animal.

had initiated the draft of a satellite development programme and appointed a working group under the code name ‘Project 581’ (Chang, 1995: 225). Apart from Qian, there were other key Chinese scientists, who had promulgated their ideas about the potential benefits stemming from the use of satellites (Kulacki and Lewis, 2009: 5).

That said, it is plain that Mao’s call for a Chinese satellite in May 1958 acted as a catalyst for plans to develop satellite technology. Thus, in August 1958, the State Council Scientific Planning Commission submitted the ‘Report on Implementation of the 12-Year Plan’, which listed the merits of a satellite. According to the report:

> The launch of an artificial satellite will accelerate the progress of top science and technology, open new research areas, and build up the missile technological reserve. In addition, the launching of a large satellite will be an open signal of success in the intercontinental ballistic missile, an expression of the nation’s scientific and technological level, and an indispensable means for scientific research to reach the outer space (cited in Zhang, 1992: 20).

Considering the crucial importance of building a satellite, Nie then assigned leading CAS scientists and the Fifth Academy with the responsibility to draft a satellite programme plan. Accordingly, CAS designated project 581 its first priority for 1958 under Qian and prominent scientist Zhao Jiuzhang (Zhang, 1992: 20).

Despite this promising beginning, two distinct but rather inter-connected aspects of this period were crucial in hindering the progress of China’s satellite programme. First, the anti-intellectualism of the Anti-Rightist Campaign and the political and ideological climate of the Great Leap Forward had the effect of generating obstacles and delays that led to a reconsideration of the plans to place a satellite into orbit. Second, tensions between China and the Soviet Union resulted in Moscow’s decision to withdraw Soviet technical assistance for China’s rocket programme.

The Anti-Rightist Campaign and the Great Leap Forward

The convention of the special conference on the issue of intellectuals by the CCP Central Committee in January 1956 marked a period of tolerance to the idea of intellectual freedom. Hence, in February 1957 Mao introduced the infamous slogan of ‘let the hundred flowers bloom, let the hundred schools of thought contend’. Many intellectuals and professionally trained elites responded by articulating publicly their discontent with the Party’s approach to science. But their ideas and views soon backfired, when the Party launched the Anti-Rightist Campaign (Wang, 1993: 50).

Then, in the summer of 1958, Mao introduced a set of ambitious and ill-conceived policies aimed at turning China into a socialist country based on the collectivisation of agricultural production and rapid industrialisation, known as the Great Leap Forward. The ostensible idea was that China could leap over the stages of economic development through the mobilisation of the productive power of the entire society in order to transform labour to capital (Lieberthal 2004: 103-9). But as Lieberthal (2004: 103) points out, the Great Leap Forward 'is most accurately viewed not as an integrated strategy but as a broad spirit and basic set of priorities'. The campaign was encapsulated in the organisation of the People's Communes and the construction of 'backyard steel furnaces' in every commune with the stated target of overtaking Great Britain in steel production within a period of fifteen years. In this regard, one of the main goals was also the belief of China's need to speed up its modernisation and to transform the country, over a period of several years, into a great power with a strong industrial base and nuclear capabilities (Christensen, 1997: 204-5). Interestingly enough, on a few occasions, Mao made the case that the Great Leap Forward was a continuation of the process of modernisation and industrialisation that began in the late nineteenth century by Qin reformist Zhang Zhidong (Schram, 1989: 131). But whatever one thinks about the motivations behind the Great Leap Forward, however, ultimately it proved to be a political, social, and economic failure that resulted in the Great China famine of 1958 and spun the Chinese economy into deep recession (Lieberthal, 2004: 108-9). It also contributed to the deterioration of the Sino-Soviet partnership and the ensuing Sino-Soviet split.[108]

What should be noted here is that an unscientific approach prevailed in every field during this period. Many scientists and engineers felt compelled to demonstrate their loyal support for what appeared to become the party line by proposing unrealistic projects.[109] It was during this period that Qian Xuesen turned into a hard-line politician by touting the party line (Chang, 1995: 237-45). At the same time, the slogan 'launch a satellite' (fang weixing) became a popular metaphor for pushing forward the implementation of ambitious projects from grain production to factory

[108] For an analysis of the connection between the Great Leap Forward and the Sino-Soviet Split, see Shen and Xia (2011).

[109] This seeming enthusiastic response to Mao's controversial campaign was somewhat typical of what Goldstein (1991) has described as 'bandwagon politics', which predominated political behaviour in China up until 1966.

production, while children were given the name ‘Weixing’ (Kulacki and Lewis, 2008: 6; Chang, 1995: 226). CAS even announced the unattainable target of sending a satellite into orbit in October 1959 to coincide with the tenth anniversary of the founding of the People’s Republic of China (PRC) (Kulacki and Lewis, 2008: 6).

However, throughout the tumultuous years of the Great Leap Forward (1958-1961), key scientists and engineers involved in the missile and space programmes were protected from the excesses of this highly politically charged period. This is not to say that they totally escaped from the destructive forces that were unleashed by the political campaign. In fact, members of the Fifth Academy, including Qian himself, were forced to spend considerable time in counterproductive activities aimed at mobilising the masses and ideological remoulding (Chang, 1995: 237-8). But when compared to other research institutions, the Fifth Academy remained rather insulated and its members received support from the political leadership (Zhang, 1992: 463). For instance, during the famine, Nie intervened by requesting the Navy and other military units to deliver special supplies of food to the scientific and technical personnel of the Fifth Academy (Zhang, 1992: 468).

The upshot of Nie’s efforts to secure the uninterrupted progress of the nuclear and missile programmes was the establishment of two new powerful institutions pertaining to science and technology. In 1958, the State Science and Technology Commission (SSTC) was set up, which was followed by the creation of the National Defence Science and Technology Commission (NDSTC) (Guofang Kewei) under the Ministry of Defence in 1959. Appointed chairman of the two newly founded commissions, Nie could now exert an important influence on the course of the strategic technology programme amid the social and political upheaval (Feigenbaum, 2003: 54-6). As the marshal notes, this restructure helped to create a ‘fairly complete system of leadership’ based on the SSTC, the NDSTC and CAS, which essentially established complete control over scientific research (Nie, 1988: 678-9).

The Development of Sounding Rockets

In light of this rearrangement of priorities, however, Chinese leaders soon recognised that launching a heavy satellite by 1959 was an unrealistic goal that could potentially divert the limited resources available from the development of China’s missile programme. Instead, the focus should be shifted towards sounding rockets. Therefore, the CAS Party Group decided to suspend the satellite project, and directed the focus on sounding rockets for training (Zhang, 1992: 21, 71).

As a result, significant progress was made in sounding rockets between 1959 and 1960. Sounding rockets were used in a series of experimental missions, including the meteorological rockets, the biological experiment rockets (carrying albino rats and dogs), and rockets for technical experiments (Zhang, 1992: 21-2, 74-88). But despite these small steps in sounding rockets, not surprisingly, the nuclear and missile programmes remained the prime concern of the Chinese leadership.

From the Withdrawal of Soviet Experts to the Chinese Bomb: Techno-nationalism Consolidates

By August 1960, the Soviet Union had withdrawn all of its technical experts from China. Although there has been a great deal of debate about the extent to which Soviet technology transfer contributed to the Chinese nuclear and missile programmes, it is clear that the sudden Soviet withdrawal had an important impact on the management of numerous projects that were designed and executed under Soviet tutelage (Wang, 1993: 59).[110] However, as Nie (1988: 700-1) point outs, in assessing the implications of the termination of the Soviet assistance at the Fifth Academy 'we concluded that the withdrawal of Soviet specialists would have little effect on our research and development, because they had never helped us in this work when they were here'.[111] Nie (1988: 701) also recalls Mao saying that Khrushchev should be awarded 'a massive, one-tone medal' for compelling China to advance its strategic weapons programme on its own earlier than expected. Indeed, not only did the Soviet withdrawal precipitate the focus from licensed-copying 1059 missiles to 'self-design and independent development' of missiles, but it also strengthened the determination of those involved with the effort 'to win honor for the motherland and bring credits to the Chinese people' (Zhang, 1992: 92, 475; Nie, 1988: 699, 701).

[110] For an account of the impact of Soviet technology transfer on China's nuclear programme, see Liu and Liu (2009).

[111] In a report sent to Mao, Nie (1960) noted that the Soviet Union had tried to 'delay', 'put off', and 'withhold' the transfer of sensitive technology to China.

Therefore, one of the most immediate consequences of the abrupt cancellation of the Soviet assistance was that it compelled China to accelerate the progress of its own indigenous technologies. By the early 1960, the Central Military Commission (CMC) had made missile development an even greater priority than building the atomic bomb (Erickson, 2014: 147). Consequently, China soon launched a Soviet-made R-2 missile in September 1960 and a Chinese version of the R-2, designated *Dongfeng* 1 (DF-1), on 5 November of the same year. A product of the 1059 project, DF-1 was the first of the DF or East Wind series of ballistic missiles with a range of 2,000 km capable of hitting Japan from East China (Lewis and Hua, 1992: 8, 13; Erickson, 2014: 147).

But even in this seemingly more permissive environment for strategic technology of the early 1960s, there was nothing inevitable about it. As indicated previously, Nie and his aides had to put a lot of effort in ensuring that the conditions were conductive to carrying out the high technology projects. More specifically, a number of factors, including the Soviet withdrawal and the limited financial and technical resources in the immediate aftermath of the Great Leap Forward, gave rise to two broad constituencies within the Chinese government that opposed the significance attached to the strategic weapons programme. The first of these was civilian consisting mainly by central economic planners, like Bo Yibo, who believed that a preference for R&D on sophisticated technology would threaten to derail the creation of a basic technological infrastructure. The second constituency was within the military establishment and supported the view that, except for a basic nuclear deterrent, priority should be given on the urgent need to modernise conventional weapons, such as armour, artillery, and aircraft (Feigenbaum, 2003: 26-7). Some even suggested the termination of all the high technology projects (Nie, 1988: 702).

It was against this backdrop of challenges stemming from this broad civilian-military coalition that Nie successfully articulated a postcolonial techno-nationalist approach to strategic technology. In addition to the importance of industrial 'spin-off', Nie's argument also highlighted that investments in strategic weapons had broader implications than the civilian-military coalition suggested. According to Nie, whereas the civilian constituency mistakenly saw the strategic weapons programmes simply in terms of 'greater firepower', the proponents of conventional weapons were equally wrong in downplaying the ways in which building strategic weapons could allow China to evade 'the trap of future obsolescence'. In doing so, Nie and his colleagues formulated a comprehensive approach to strategic technology that offered a path towards stimulating much needed innovation and cementing an advanced technological base, while also being attentive to great power status (Feigenbaum, 2003: 28).

A high-level conference that took place at the resort town of Beidaihe from 18 July to 14 August 1961 proved to be a turning point for the issue of whether the high technology projects should be continued. Before the opening of the conference, in the spring and early summer of 1961, a highly classified report on Japanese science and technology policy was distributed to senior members of China's party and military leadership. By highlighting the relationship between defence technology and industrial competitiveness, the report suggested that Japan was about to invest heavily on state-of-the art technology as an indicator of its national standing. The report provided Nie with an opportunity to advance the merits of his techno-nationalist thinking, so he prepared a document based on the Japanese report and sent it to Mao (Feigenbaum, 2003: 30). After readying Nie's report, Mao intervened in the debate in support of Nie by instructing that 'China being far behind Japan in industrial technology, what policy we should take was worth careful consideration'. Therefore, thanks to Nie's vigilance, Mao's pronouncement settled the debate of the conference in favour of the continuation of the strategic weapons programme (Nie, 1988: 702; Lewis and Xue, 1988: 129; Feigenbaum, 2003: 30-1). Subsequently, in the summer of 1961, at a special meeting, Mao declared 'We should make up our minds to develop sophisticated technologies. We can't relax our efforts or discontinue [the sophisticated defense projects]' (cited in Lewis and Xue, 1988: 130). Apparently, this marked an important victory for Nie and the strategic weapons programme (Lewis and Xue, 1988: 130).

However, concerned with the impact of the Great Leap Forward on scientific progress, Nie also made great strides towards ensuring that key scientific institutions were conductive to research. In this regard, Nie introduced the 'Fourteen Articles on Scientific Work'. Approved by the Central Committee in July 1961, the 'Fourteen Articles' were essentially guidelines with the aim to foster a stable environment for scientists by highlighting the 'primacy of the experts' in the conduct of scientific research (Nie, 1988: 713-21; Feigenbaum, 2003: 46-7).

In such circumstances, therefore, the stage was set for the nuclear and missile programmes to yield results. On 16 October 1964, China detonated its first atomic bomb, becoming the fifth member to join the nuclear club. When Mao was informed about the news, he wanted to confirm 'whether it really was a nuclear explosion so as to convince the foreigners' (Lewis and Xue, 1988: 188). As far as the missile programme was concerned, the first DF-2 was successfully launched on 29 June 1964 (Erickson, 2014: 147). By that time, missile development was based on an incremental logic: DF-2 was capable of reaching Japan; the DF-3 the Philippines; the DF-4 Guam; and the DF-5 the continental United States (Lewis and Hua, 1992: 14, 20). In November 1965, the Chinese proceeded with the successful launch of a more advanced missile, the DF-2A. Eventually, on 27 October 1966, a DF-2A carried a 12-kiloton nuclear device over populated areas, and henceforth, China's first strategic missile system had entered its operational phase (Lewis and Hua, 1992: 15).

Revitalising the Satellite Programme: Project 651

While the pursuit of the nuclear and missile programmes was clearly the highest priority of the Chinese leadership throughout the early 1960s, progress was made not only in the R& D of sounding rockets, but also in space sciences and test equipment. At the same time, inspired by Yuri Gagarin's orbital space flight in April 1961, CAS created a spaceflight committee to outline a plan for spaceflight and other advanced research areas of space technology (Zhang, 1992: 23).[112]

But the significant advancement of missile technology in the early 1960s also meant that the conditions for reconsidering the issue of launching a satellite had been established. Aware of this possibility, on 21 December 1964, Zhao Jiuzhang submitted a proposal to Zhou Enlai, arguing for launching a satellite. In his report, Zhao suggested that using a ballistic missile to put a satellite into space would 'get the benefit of hitting two birds with one stone'. Zhou requested from Zhao to prepare a more extensive proposal. Consequently, Zhao, together with one of his colleagues, prepared a detailed proposal, which was submitted to the Party Central Committee (Kulacki and Lewis, 2009: 9). In January 1965, Qian followed suit with handing in his own report to NDSTC. This move was crucial, given that NDSTC headed by Nie was charged with the missile programme. In his proposal, Qian noted that building 'the planned intercontinental ballistic missile can also launch a satellite' (Kulacki and

[112] The committee was named 'Interplanetary Flight Committee' after Qian's book called 'Interplanetary Flight' (Kulacki and Lewis 2009: 9).

Lewis, 2009: 10). Nie, who was also aware of the military significance of a satellite, told Qian: 'Last year, before we detonated our atomic bomb, the Americans had already seen it with one of their satellites. Now that's something' (cited in Kulacki and Lewis, 2009: 10).[113]

Eventually, in April 1965, NDSTC sent a report to the Party Central Committee that suggested placing a 100-kilogram satellite into orbit between 1970 and 1971. In July 1965, CAS drafted the 'Proposal on Development Programme for China's Artificial Satellite', which was later approved by the Party Central Committee and was included in the national plan. It was designated 'Project 651' (Zhang, 1992: 29; Kulacki and Lewis, 2009: 11). As Kulacki and Lewis (2009: 11) point out, the CAS proposal was not merely about launching a single satellite, but a long-term plan for an extensive national satellite programme. What should be noted is that emphasis was placed on the political benefits that could accrue from the first Chinese satellite. In this regard, given that China was a latecomer in the Space Age, a consensus emerged that the first satellite should be more sophisticated than the first satellites of the Soviet Union and the United States and all the technical measures should be taken into account in order to ensure that 'the world would be able to "see it and hear it"' (Zhang, 1992: 235).

Consequently, between October and November 1965, a lengthy conference was convened, known as the '651 conference', which set the parameters of the satellite project (Zhang, 1992: 235; Harvey, 2013: 39). This resulted in the establishment of the CAS 651 Design Institute, under the leadership of Zhao Jiuzhang, and the 701 Project Bureau, which was in charge of the management of the ground stations. CAS allocated numerous research projects associated with the R&D on the satellite programme (Zhang, 1992: 31; Kulacki and Lewis, 2009: 12). Then, in May 1966, Qian and other key members of the institutions involved with the 651 project decided to name the first satellite *Dongfanghong* (DFH)-1 (The East is Red -1) and its space launch vehicle *Changzheng* (CZ)-1 (Long-March-1), while the launch of China's first satellite was set for 1970 (Zhang, 1992: 30).

Rather than focusing solely on the satellite project, Chinese leaders and scientists had more ambitious goals. In August 1965, the Central Special Committee presided by Zhou Enlai approved a plan for a first human flight space mission in 1979 (Zheng, 2007: 167). As we shall see, discussions and plans regarding human spaceflight

[113] It is worth noting that in his report Qian also recommended the development of navigation satellites (C. Li 2013: 9).

remained a constant throughout the late 1960s and early 1970s. Yet, again, another political campaign initiated by Mao, the Cultural Revolution, threatened to halt China's forays into space.

The Second Phase: The Cultural Revolution Years (1966-1976)

The Cultural Revolution: 'Reds' and Revolution Over 'Experts' and Modernisation

Before considering the development of the space programme during this period, it is important to say briefly something about the Cultural Revolution, as this was a major event with long-lasting implications for scientists and science and technology in China. The Cultural Revolution was essentially a mass movement that unleashed destructive forces that had the effect of turning the whole society against itself. As violence soon went out of control, Mao announced its termination in 1969, but radicalism, factionalism, and upheaval did not end until his death in 1976. Although the principal features of the Cultural Revolution are by now well known, a few points are worth making about this period. First, historians agree that the Cultural Revolution was largely the product of Mao's fixation with his personal power and what he saw as the growing ideological impurity of Chinese leaders and bureaucrats.[114]

Second, as Mitter (2004: 234-5, 200-43) shows, in some ways the Cultural Revolution was part of China's enduring struggle with modernity, which can be traced back to key ideas associated with the May Fourth Movement, including an obsession with 'catching up with foreigners' and technological modernity, especially space technology. Yet, according to Mitter (2004: 235), unlike Republican China, this technological fixation during the Cultural Revolution shared similarities with the Qing, in the sense that, even though technology was desired, 'the means of creating the knowledge base that went with it', and which were usually associated with western (or Soviet) modernity, were not accepted. This clearly points to the enduring relevance of the ti/yong dichotomy (Schram, 1989: 191; Wang, 1993: 69). But the Cultural Revolution was also reflective of a radical shift in Mao's thinking over the proper balance between revolution and modernisation (Wang, 2010: 269). However, what suffice at this stage to say is that while Mao's worldview about the role of

[114] On the Cultural Revolution, see, among others, MacFarquhar and Schoenhals (2006); and Mitter (2004: 200-43).

military power in attaining national goals by linking politics and strategic weapons had created a powerful synergy with the worldview of the postcolonial techno-nationalists, the Cultural Revolution had the effect of gradually disrupting the congruence of these two views (Lewis and Xue, 1994: 151).

Third, therefore, one of the most important aspects of the Cultural Revolution was the resurfaced issue of the 'red and expert', as once again being ideologically 'red' was considered far more important than being an 'expert'.[115] Consequently, given that scientists and intellectuals were regarded as 'white experts', they were usually subjected to purges and suffering. Apart from personal suffering, not only did the prevailing anti-intellectualism of this period lead to the closure of schools and universities for several years, but also put in jeopardy the institutional scientific infrastructure of the country (Cao, 2013: 123-9).

The Strategic Technology Programme during the Cultural Revolution

It was in this political atmosphere of generalised radicalisation and anti-intellectualism that the strategic technology programme achieved some remarkable feats, including the successful explosion of China's first hydrogen bomb in June 1967, the flight of the intercontinental ballistic missile (ICBM), the DF-5, in September 1971, and the launch of the first satellite carried on a CZ- 1 space launch vehicle in April 1970. Intuitively we might expect that these successes can be explained by the fact that strategic technology projects were regarded as top priority during the Cultural Revolution due to national security and prestige considerations. True, coping with possible Cold War predations, especially after the Sino-Soviet split, forced China to continue advancing its nuclear and missile capabilities. As a consequence, the strategic weapons programme was not hit as hard as its conventional counterpart, not to mention non-defence related research (Wang, 1993: 72; Cheung, 2009: 29).[116]

Nevertheless, reality was rather different and more complex. For even the nuclear programme was convulsed by the violence and disturbance that had engulfed the entire society during the most intensely radical phase of the Cultural Revolution

[115] For an overview of key aspects related to science and technology during the Cultural Revolution, see the contributions in Brock and Wei (2013).
[116] For a comparative analysis of the conventional and strategic weapons programmes during the Maoist era, see Cheung (2009: 22-51).

(1966-1969). As anarchy was spreading throughout the country, Nie and Zhou were facing much difficulty in protecting the strategic weapons programme from growing factionalism and radicalism (Lewis and Xue, 1988: 202-6). In fact, between 1967 and 1969, even the politically dexterous Nie became the target of Maoist 'rebels' (Cao, 2013: 126; Wang, 2010: 271). As to the missile programme, by September 1966, two contenting factions had emerged in the Seventh Ministry of Machine Building.[117] On 23 January 1967, Qian Xuesen and other leaders of the Seventh Ministry were removed from power by what was a 'top-down coup' backed by the central government (Chang, 1995: 248-9; Lewis and Xue, 1994: 146-7). The situation was improved in 1967, when the Seventh Ministry of Machine Building was placed under military control, but factional violence continued (Zhang, 1992: 43). Then, one of the most noted casualties of the Cultural Revolution occurred: the Birmingham University educated Yao Tongbin, who was a missile expert and the first director of the Aerospace Research Institute of Materials and Processing Technology, was beaten to death by Red Guards in June 1968 (Solomone, 2013: 243).

The death of Yao prompted Zhou to instruct a thorough investigation into what caused this tragic event along with a directive that forbade attacks on scientists. Shortly after, Zhou ordered the Military Control Committee of the Seventh Ministry to draft a list of those scientists that were deemed indispensable for the missile programme in order to be put under special protection (Lewis and Xue, 1994: 147). Qian Xuesen was one of those scientists placed under state custody (Chang, 1995: 250). Zhou also participated in several meetings of the Seventh Ministry as a mediator trying to convince the contending factions that unity was necessary for the advancement of the missile programme (Zhang, 1992: 45; Erickson, 2014: 150). As a result of these efforts, relative stability was brought to the Seventh Ministry and, so, progress was made in missile development, albeit rather slowly. The space programme suffered from similar problems, but it also received vital support for the most part of the Cultural Revolution.

[117] In January 1965, the Fifth Academy was transferred from the military to the state. It was restructured and renamed the Seventh Ministry of Machine Building.

The Space Programme During the Cultural Revolution

Certainly, the space programme did not remain completely immune to the political and social turmoil. As was the case with the nuclear and the missile programmes, in early 1967, many scientists working on space projects were subjected to purges and mistreatment (Kulacki and Lewis, 2009: 12). But again Nie, Zhou, and others played a key role in trying to minimise the effects of the Cultural Revolution. In early 1967, Nie proposed to the Central Party Committee the formation of the Chinese Academy of Space Technology (CAST) with the aim of uniting all the space research units from different departments into one body, which would be part of the military, and, so exempted from Cultural Revolution excesses. The Central Party Committee and the State Council accepted the proposal. Then, on 17 March of the same year, Zhou brought the Seventh Ministry of Machine Building and other defence ministries under PLA control. On 20 February 1968, CAST was formally established and Qian Xuesen was appointed its director. The newly founded academy was placed under the aegis of NDSTC (Zhang, 1992: 33).

The First Satellite DFH-1: China Joins the Space Club

Consequently, the plan for launching the DFH-1 satellite in 1970 was resumed, under the leadership of Qian and Sun Jiadong, a young ex-force officer. Sun proposed straight away to move on with a basic satellite design in order to accommodate the installation of a music device to broadcast the melody 'The East is Red'. This was one of the most emblematic revolutionary songs associated with the Cultural Revolution that praised Chairman Mao.[118] The proposal was approved by NDSTC in October 1967 (Kulacki and Lewis, 2009: 13). To ensure the observation of the satellite from Earth, an 'observation skirt' was installed on the final stage of the rocket (Zhang, 1992: 246).[119] Significantly, Zhou showed a particular interest in ensuring the successful implementation of the DFH-1 satellite project (Zhang, 1992: 45, 142, 252).

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118 The idea of transmitting the song is attributed to He Zhenhua, who was the chief designer of the DFH-1 project. See, Wang, Yu and Yang (2016).

119 As was noted in Chapter 1, these considerations were not unsimilar to what the Soviets did with Sputnik (Harvey, 2013: 39).

Eventually, on 24 April 1970, China successfully launched its first satellite from the Jiuquan Satellite Launch Site, becoming the fifth country to join the space club.[120] Upon Zhou's insistence, the press communiqué that was released after the launch noted: 'We did it through our own unaided efforts' (Harvey, 2013: 43).[121] Undoubtedly, putting the satellite into orbit was no small feat, especially if we take into consideration the political circumstances under which it was achieved. But given that the purpose of the satellite was simply to broadcast the 'East is Red' song, as Hanberg and Li (2006: 71) point out, it was 'propaganda pure and simple'. One week later, Qian was acclaimed as a national hero as he stood together with other scientists in Tiananmen Square, while Mao and other leaders praised Qian for his contribution to China's historic achievement in space (Chang, 1995: 227).

An article published in Peking Review in June 1970 highlighted some key themes related to China's formative space effort. It noted that the Chinese space feat was a source of encouragement for the Asian, African, and Latin American peoples and a 'heavy blow to the U.S. imperialists and the socialist imperialists' that smashes 'their fond dream of monopolizing space technology'. More tellingly, perhaps, links were made between China's colonial experience and space technology: 'we can see what a tremendous change has taken place in the transformation of semi-colonial and semi-feudal old China into a socialist country which has mastered atom and space technology and stands like a giant in the East of the world!' (Yu, 1970: 30).

Satellite Development: 1971-1976

After the launch of DF -1, satellite development gained momentum. On 3 March 1971, China successfully put in orbit its second satellite named Shijian (SJ) -1 (Practice -1), which was essentially an experimental satellite (Johnson-Freese, 1998: 49; Solomone, 2013: 236). But domestic politics entered into a new phase of turmoil and factional strife marked by the mysterious death of Lin Biao in 1971, the then Minister of Defence and Mao's putative successor, and the ascendancy of the Gang of

[120] In 2016, the State Council set this date as China's Space Day to celebrate space flight (China Central Television, 2016a).
[121] The Xinhua News Agency noted, among other things, that the Chinese first satellite was the successful result of the Chinese people under the leadership of Mao and the Party Central Committee under Mao and Lin, 'adhering to the principle of *maintaining independence and keeping the initiative in our own hands and relying on our efforts*' (Xinhua, 1970: 5, emphasis in the original).

Four. This was significant because Lin Biao and the Gang of Four tried to use the space programme as a way to enhance their political power and legitimacy (Chen, 1991: 120).

Thus, key space projects became an important area where different factions competed to take over control (Hanberg and Li, 2006: 66, 74-77). Indeed, Shanghai, which was politically associated with Mao and the Gang of Four, was turning into a new centre of space operations, focusing on building both launchers and satellites under Project 701. This led to duplication among space projects undertaken in Beijing and Shanghai (Chen, 1991: 122). Regardless, the 'Shanghai team' managed to build the Fengbao (FB) -1 (Storm -1) launcher, which put into orbit the *Ji Shu Shiyan Weixing* (JSSW) -1 (Technical Research Satellite -1) in July 1975. This was followed by the successful launch of two other JSSW satellites. However, it appears that the JSSW satellites performed poorly and the project was called off one month after Mao's death (Solomone, 2013: 235-6; Harvey, 2013: 47-8; Hanberg and Li 2006: 79-80).[122] Another series of satellites, *Fanhui Shi Weixing* (FSW) (Recoverable Model Satellite), under Project 911, was more successful. In 1975, China put in orbit its first FSW satellite, FSW -01. More advanced versions of the FSW series were introduced in the next decades (Harvey, 2013: 105-33).

Human Spaceflight: Project 714

As indicated above, during the Cultural Revolution years there was a continuing interest in human spaceflight. But while some preliminary studies were taken on scientific and technical aspects of human spaceflight, there was a constant debate about whether China should pursue such a project considering the urgent needs of the country. In September 1967, a report was submitted that proposed flying one astronaut, but Qian Xuesen argued that this would promote 'individual heroism'. Instead, Qian suggested that orbiting five astronauts would symbolise 'collective heroism'. By 1967, there were complete blueprints of flying astronauts (Zheng, 2007: 168). Shortly after, the programme was named *Shuguang* (Dawn's Early Light) (Kulacki and Lewis, 2009: 20).

[122] The exact purpose of the JSSW satellites remains a mystery, as there is little information available. According to Harvey (2013: 48), there is agreement among Western analysts that their purpose was electronic intelligence (ELINT).

The launch of China's first satellite in 1970 spurred further research on a human spaceflight mission, the first of which was planned to take place by 1973. On 14 July 1970, Chairman Mao, Zhou Enlai and Lin Biao approved a joint report on the *Shuguang* project, which was designated 'Project 714'. We do know now that the Air Force then started recruiting China's first astronauts to form an astronaut corps. In turn, in May 1971, a group of twenty astronauts was selected for a two-year training programme as part of the scheduled first flight of *Shuguang* (Kulacki and Lewis, 2009: 20; Harvey 2013: 259-60). Yet, given Lin's association with the human spaceflight project and his close ties with the Air Force, shortly after his death, Mao decided to cancel the training of astronauts by saying 'We should take care of affairs here on earth first, and deal with extraterrestrial matters a little later'. Another obstacle to China's lofty ambitions, of course, was the lack of funding due to the economic hardship and different priorities (Kulacki and Lewis, 2009: 20-1). As a result, by 1974, the programme was essentially suspended (Zheng, 2007: 168).

The Third Phase 1976-1989: China Engages with the Nascent International Space Society

Mao died in 1976, and after a short succession struggle, Deng Xiaoping consolidated his power and took China in a startlingly different direction by initiating his policy of 'reform and opening up'. Plainly, this has had a profound impact on the pursuit of space related activities, not the least of which was China's engagement with the ever evolving international space society of states. Before considering this, however, it is worth making a number of points about the wider context in which the space programme was pursued during this era. First, it is clear that Deng's modernisation programme of opening up China's economy to market forces led to an unprecedented integration with international society (Zhang, 1998: 98, 99-125). Yet, Deng's policy of integrating China within the existing international order coexisted rather uneasily with fostering his appeal to patriotism and nationalism (Hughes, 2006: 11-54).

Second, a focus on science and technology became a notable theme of China's multifaceted and often contradictory modernisation push under Deng.[123] Perhaps, nowhere was this more evident than in the revival of the 'Four Modernisations' by

[123] For useful early accounts on science and technology in the post-Mao era, see the contributions in Goldman and Simon (1989).

Deng at the Third Plenum of the Eleventh CCP Central Committee in 1978. Originally introduced by Zhou Enlai, the 'Four Modernisations' of agriculture, industry, defence, and science and technology would pave the way for China's genuine modernisation and economic development. In March 1978, a major conference of 6,000 scientists and engineers, the National Science Conference, reconfirmed the high priority attached to science and technology policy by the Chinese leadership (Suttmeier, 1980: 2). In his address to the conference, Deng (1978) noted:

> The key to the four modernizations is the modernization of science and technology. Without modern science and technology, it is impossible to build modern agriculture, modern industry or modern national defence. Without the rapid development of science and technology, there can be no rapid development of the economy. The Central Committee of the Party decided to call this national science conference in order to bring home to the Party and country the importance of science, to map out a programme, to commend advanced units and individuals and to discuss measures for speeding up the development of science and technology in China.

In what was an important departure from Mao's views about 'reds' over 'experts', Deng (1978) also recognised science and technology as productive forces and defined scientists and technicians as 'both red and expert' that formed a contingent of the working class.[124]

Third, Deng's confidence that the overall strategic environment was conductive to peace and economic development rather than war had profound implications for the defence economy. Soon after he took office, Deng introduced a major transformation of the defence industry based on spinning off a large part of the defence economy from military to civilian activities (Cheung, 2009: 52-100). This defence conversion and demilitarisation process had the effect of empowering the civilian technology elites, while the prominence of strategic weapons began to erode for the first time since the mid-1950s. The precarious position of the erstwhile influential weapons scientists was further compounded by Deng's decision to prioritise conventional weapons and equipment (Feigenbaum, 1999b: 98). As a result, by September 1977, the strategic technology programme was confined to the completion of the three principal tasks of the 1960s and 1970s, dubbed the Three Grasps (san zhua): a fully

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[124] For incisive analysis of the place of science and technology under Deng, see Wang (1993: 78-80). Also see Hughes (2006: 30-49).

operational intercontinental ballistic missile (ICBM), a submarine-launched ballistic missile (SLBM), and a communications satellite (Feigenbaum, 2003: 79; Zhang, 1992: 47).

It was in this reconfigured geostrategic and political context that China's space programme moved towards a focus on economic development. In 1978, Deng made explicitly known his view about where the priorities of the space programme should lie when he remarked that 'China, as a developing country, was not to take part in the space race'. According to China's paramount leader, there was no need for China to land on the Moon, but it was vital to focus on application satellites instead (Zhang, 1992: 50). Yet, the space programme can be analytically divided into two distinct periods. The first period (1976-1984) was shaped by a focus on a few projects that could contribute to the economic construction of China, such as satellites (and their launchers), based on Deng's aforementioned direction. Meanwhile, China started to seek international cooperation in the space field as part of its broader opening up to the world. What is noteworthy, however, is that the space programme was left for the first time without strong support from the Chinese leadership (Chen 1991: 123). This was also the case for the overall strategic technology programme.

The succeeding period was defined by a continuing interest in application satellites and the steady adjustment of the Chinese space community to civilian operations and commercialisation as part of major reforms in the defence sector. Hence, China's further integration with the international space society sustained momentum. Equally, this period marked the reconsolidation of a postcolonial techno-nationalist vision that was encapsulated in the '863 Plan'. Launched in March 1986, this was an ambitious long-term plan to narrow the gap between China and advanced countries in a number of cutting-edge R&D areas, including space.

All in all, three main themes underpinned the third phase of the space programme: the development of application satellites and launch vehicles, international cooperation, and the reconsolidation of postcolonial techno-nationalism. The rest of this chapter will deal in some detail with these three themes.

The Communications Satellite: Project 331

As Handberg and Li point (2006: 85) out, the immediate post-Mao era signalled what can be called 'a period of relative normalcy' in the sense that the Chinese space programme entered into the phase of space applications development. True, prestige considerations were still relevant, but now the programme had to be justified in terms of its contribution to economic construction. Thus, two series of satellites became the focus, reflecting the utilisation of space assets for socio-economic development: the *Dongfanghong* (DFH) (East is Red) communication satellites and the *Fengyun* (FY) (Wind and Cloud) meteorological satellites.

The launch of a communications satellite was clearly the most advanced and ambitious space project of the early 1980s, so it is worth spelling out in some detail just how it came about (Zhang, 1992: 48).[125] In general, for a country with diverse topographical features and vast territory like China the utilisation of communications satellites makes a valuable contribution to the improvement of communications and data transmission from a central location to remote areas. This, in turn, benefits education, government, transport, and the economic and financial sector development (Wu, 1988; Zhu, 1993: 171-2; Gilks, 1997: 217-9). Therefore, in February 1975, the development of a communications satellite was endorsed by the Central Military Commission, and later by Mao and Zhou. The communications satellite programme was codenamed 'Project 331' (Zhang, 1992: 48).

Nonetheless, by 1978, unhappy with the inert pace of the project, Deng began entertaining the idea of purchasing a communications satellite from the United States. This prospect seemed even more attractive as China was negotiating the normalisation of its diplomatic relations with the United States. As part of this process, an unusually large US science and technology delegation was about to visit Beijing in July 1978, led by Frank Press, President Carter's scientific advisor, and consisted of, among others, Robert Frosch, a NASA administrator (Suttmeier, 1980: 84-6; Ross, 1994: 159-60). The visit presented an opportunity to raise the issue of purchasing a satellite. But after lengthy negotiations, no deal was reached (Kulacki and Lewis, 2009: 16-7).

[125] On the meteorological satellites, see Harvey (2013: 173-4). It should also be added that this period also saw the development of the CZ-2, CZ-3, and CZ-4 space launch vehicles (Chen et al., 2000: 560-1; Johnson-Freese, 1998: 50; Handberg and Li, 2006: 87).

Then Deng intervened to reinvigorate Project 331. Reflecting a techno-nationalist rationale, a consensus soon emerged that it would be difficult for China to obtain sophisticated space technology from abroad in the future (Kulacki and Lewis, 2009: 17). Consequently, on 29 January 1984, China attempted the first launch of its communications satellite, DFH -2, from the Xichang Satellite Launch Centre in southwest China.[126] However, there were technical problems, which resulted in putting the satellite in an elliptical orbit. The Chinese described the launch of what was now referred to as an 'experimental satellite' successful (Zhang 1992: 58; Kulacki and Lewis, 2009: 18). As Kulacki and Lewis (2009: 18) observe, notwithstanding that the satellite was not placed into the intended orbit, it was still remarkable that the Chinese managed to track the satellite and manoeuvre it into another position. On 8 April 1984, the second launch of a geostationary communications satellite took place. The DFH -2 was initially placed into an elliptical orbit, and after eight days, it was successfully sent into the 'quasi-geostationary' orbit (Zhang, 1992: 58, 332-5). Subsequently, China's first operational communications satellite was put in orbit in February 1986 (Handberg and Li, 2006: 86).

International Cooperation

Certainly, one of the most important features of this period was China's growing appreciation and sharing in the working of key common institutions of the expanding and evolving international space society, including space diplomacy, space law, and space commercialisation. The official history of the Ministry of Space Industry captures this nicely when it notes that since 1978 China 'made friends broadly within the world space circle', 'introduced [its] achievements in space technology', and spread its 'influence internationally' (Zhang, 1992: 490). A detailed analysis of China's engagement with the institutions of the international space society is taken up in Chapter 6, but a number of points are worth noting here. First, although it is clear that the level of sophistication of China's space capabilities had enabled China's integration in the international space society, international cooperation was now imperative for China in order to sustain the further advancement of its space

[126] By 1983, the Xichang Satellite Launch Centre had been completed as part of the 331 Project (Zhang, 1992: 50, 58). This new launch site would be mainly used to launch geostationary satellites on powerful rockets.

endeavour (Handberg and Li, 2006: 88).[127] At the same time, given the remarkable progress of their space programme, the Chinese were feeling self-confident enough to see space cooperation as an exchange between equal partners rather than as an unequal partnership that was so characteristic of China's encounter with the colonial expansion of international society (Handberg and Li, 2006: 88-9). In other words, what was emerging was a process of mutual engagement (Zhang, 1998: 73).

Second, and consequently, China's engagement with the international space society was evident in its expanding international relations in the space sector. In particular, to facilitate international cooperation and exchanges with foreign agencies and organisations in space technology, the Chinese Society of Astronautics (CSA) was formed as an academic organisation. In this vein, the Seventh Ministry of Machine Building was renamed the Ministry of Space Industry (MASI) in 1982. With an expanded mandate as a governmental department, the newly founded Ministry played a key role in increasing contacts and ties with foreign countries and regional organisations. Overall, throughout this period, China established relations with more than 40 countries, including bilateral agreements with key space players, such as France, Japan, Germany, the United States, Brazil, Italy, the United Kingdom, and the European Space Agency (ESA) (Zhang, 1992: 494-502).

Third, in addition to bilateral space diplomacy, China also entered a number of key international governmental and non-governmental organisations related to space activities. China rejoined the International Telecommunication Union (ITU) in 1972 and the International Standardisation Organisation (ISO) in 1978. More importantly, perhaps, China was accepted as a full member of the UN Committee on the Peaceful Uses of Outer Space (COPUOS) in 1980 and ratified the 1967 Outer Space Treaty (OST) in 1983, which is regarded as the cornerstone of space law. In terms of international non-governmental organisations, China received an invitation to join the International Astronautical Federation (IAF) in 1979, and the membership of CSA, representing China, was eventually admitted one year later at the IAF congress in Tokyo (Zhang, 1992: 502-5).

Fourth, a noteworthy expression of China's integration with the international space society was the commercialisation of China's launch industry. This involved the

[127] As the official history of the Ministry of Space Industry acknowledges, the international nature of space activities rendered international cooperation 'an inevitable trend for the development of space technology' (Zhang, 1992: 491).

establishment of the China Great Wall Industry Company (CGWIC), which was officially tasked with marketing Chinese made-satellites and commercial launches of the CZ-3 space launch vehicle in 1985 (Chen, 1991: 125; Freese-Johnson, 1998: 55). The first time China provided space related services was in August 1987, when it successfully launched an experimental payload for the firm MATRA of France (Zhang, 1992: 509). Crucially, as part of its effort to further enhance international cooperation in space and to establish a legal framework that safeguards the provision of launching services, China was also prompted to ratify the 1968 Rescue Agreement, the 1972 Liability Convention, and the 1975 Registration Convention in December 1988. This allowed China to sign three memoranda with the US government regarding: satellite technical security, satellite launches, and commercial launch services (Zhang, 1992: 508-9). Given the US strict control over technology transfer, the conclusion of these agreements with the US government opened the way for contracting US satellite manufacturers. Contracts with other countries followed suit (Zhang, 1992: 509; Johnson-Freese, 1998: 56-7).

As was true of the entire defence sector, this engagement was partly a deliberate response of the space community to the government's call for prioritising civilian-sector needs. Put simply, the space community had to adjust to a more entrepreneurial model if it wanted to avoid fading into obscurity (Chen, 1991: 124-5). However, this change was also partly reflective of China's expanding international relations in science and technology, including space technology, which exposed Chinese scientists to a wide range of new ideas and influences through various academic, governmental, and industrial channels.[128] In this sense, this change was also the result of a gradual process of socialisation into the emerging institutions of the international space society.

Techno-nationalism Redux and the '863 High Technology Plan': The Space Programme Strikes Back

Despite the fact that the strategic weaponeers found themselves in a tenuous position in the immediate post-Mao era as a consequence of Deng's reforms, they gradually managed to re-consolidate their power base by spreading successfully their influence from the military research and development system to the civilian sphere of science

[128] For an overview of China's international scientific relations of this era, see Suttmeier (1980: 67-81).

and technology and other key related bureaucratic systems. The creation of the Commission of Science, Technology, and Industry for National defence (COSTIND) in 1982, which brought Nie's erstwhile NDSTC and the National Defence Industries Office (NDIO) under the oversight of an integrated military industry commission directed by Zhang Aiping, was the first step towards this direction.[129] By 1987, COSTIND was known within the defence industry as the 'Nie family army', as Ding Henggao, Marshall Nie's son-in-law, became director of the commission and Nie's daughter and Ding's wife, Nie Li, the head of the commission's electronic bureau (Feigenbaum, 2003: 107-10).

The influence of the strategic weaponeers increased further, when Song Jian, who had been chief designer of China's SLBM and a specialist in astronautics, was appointed director of the SSTC in 1985, and Zhou Guangzhao, a prominent physicist of China's nuclear programme, became president of the Chinese Academy of Sciences in 1987. Both Song and Zhou were two of the most distinguished and younger scientists of Marshal Nie's strategic technology programme. Therefore, by 1987, the three principal agencies concerned with China's science and technology policy agenda, COSTIND, SSTC and CAS, were headed by former strategic weaponeers. Not only did these members of the strategic weapons elite share a common professional heritage and organisational practices, but also a techno-nationalist vision about the place of science and technology in China. Consequently, coalition building and cross-agency coordination regarding science and technology were facilitated (Feigenbaum, 2003: 147, 143-53).

At the same time as the successful ideological, bureaucratic, and institutional consolidation of techno-nationalists was occurring, the Strategic Defence Initiative (SDI), which was announced by Ronald Reagan in March 1983, assumed an important place in debates about whether China should follow a similar path to technology that is based on state-directed S&T planning (Feigenbaum, 2003: 134). To be sure, many Chinese analysts viewed the SDI as a US attempt to attain strategic superiority over the Soviet Union in space, which essentially meant first strike capability.[130] However, apart from this grand geopolitical view, others suggested that the SDI was a political programme intended to maintain the powerful position of the

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[129] Zhang Aiping was a key member of Nie's patronage network since the late 1950s (Feigenbaum, 2003: 54, 83).

[130] For contemporary analyses of Chinese views about the SDI, see Glaser and Garret (1986); and Garver (1986).

United States by targeting the advancement of high technology and economic development (Kulacki and Lewis, 2009: 22). By the mid-1980s, many strategic weaponeers, who shared the view that the SDI would have far-reaching implications, saw the US programme as evidence that China needed a techno-nationalist response (Feigenbaum, 2003: 134).

It was against this backdrop of techno-nationalist consolidation and external influences that the '863 High Technology Plan' emerged. On 3 March 1986, four leading strategic weapons elders and senior scientists, Wang Daheng, Chen Fangyun, Wang Ganchang, and Yang Jiachi, took the initiative to draft a formal proposal, 'Recommendations Concerning Research to Keep Pace with Foreign Strategic High Technology Development', which they sent directly to Deng Xiaoping (Kulacki and Lewis 2009: 22).[131] The scientific and political status deriving from their association with the strategic technology programme, gave the four senior scientists the necessary confidence and credence to circumvent standard channels of bureaucratic communication by appealing directly to Deng (Feigenbaum, 2003: 141-2). When the Chinese leader read the letter he reportedly responded, 'this suggestion is very important…Find experts and discuss it. Do it immediately' (cited in Zheng, 2007: 169). Consequently, four months' deliberations with two hundred experts culminated in the document 'An Outline for National High Technology Planning'. Significantly, although experts were soon divided over whether the focus should be on building military capabilities or a more comprehensive plan that could contribute to the economy, Deng stepped in the dispute suggesting the development of dual-use technology with an emphasis on civilian applications (Kulacki and Lewis, 2009: 23).

By that time, Deng's thinking had evolved into a far more broad understanding of the role technology in China's economic construction. As Feigenbaum (2003: 159, 162) notes, while Deng did not go as far as to agree with Nie's view about the role of 'spin-offs' from the military to the civilian system, he did share marshal's main argument about the important impact of strategic technology on China's position within the global order. Indeed, expounding on the significance of China's high technology development to an audience of physicists in Beijing in 1988, Deng

[131] For the profile of the four senior scientists, see Feigenbaum (2003: 154-6).

provided a postcolonial techno-nationalist rationale, after referring to the SDI and Europe's Eureka programme,[132] which is worth quoting at length:

> China must develop its own science and high technology. [We] must take our place in the world in these areas. From the 1960s, if China hadn't had the atomic bomb, the hydrogen bomb, if we hadn't launched satellites, it couldn't be said that China is an influential great power. We wouldn't occupy our present international position. The issue reflects a people's abilities. It symbolizes [whether] a people's and a country's development is flourishing. As the world is now developing, science and high technology are moving at an extremely rapid pace. China cannot afford to fall behind. [We] must take our proper place…China cannot afford not to engage in spite of the fact that we are poor. Because if you aren't engaged, if you don't develop in these areas, the gap will only become greater and it will become extremely difficult to catch up. We are at present backward in some areas. But we are not backward in all areas (cited in Feigenbaum, 2003: 160).

Crucially, the 863 programme received vital and enthusiastic support by Deng. In fact, a formal 863 system was created within merely nine months after the four scientists sent their letter to Deng. This system mirrored, in many ways, the techno-nationalist ideological and organisational principles of Nie's strategic technology programme (Feigenbaum, 2003: 141-3). The 863 programme focused on seven technological fields, where China should attempt to 'follow international developments, decrease the gap between China and more advanced nations, and look for advantages where China could make a breakthrough' (Kulacki and Lewis, 2009: 24). These were: automation, biotechnology, energy, information technology, lasers, new materials, and space technology.[133]

Consequently, in February 1987, a special committee was formed to elaborate on a plan for space technology (Plan 863-2). What is noteworthy is that the committee identified the building of a space station as one of the long-term goals of China's space programme due to the fact that such a space feat could confer the status of a twenty-first century great power (Kulacki and Lewis, 2009: 24; Chen, 1991: 126). The general point to make is that the space programme was once again a priority for the Chinese leadership. As we shall see in chapter 6, the remarkable progress of China's human spaceflight programme over the last years owes much to the postcolonial techno-nationalist vision enshrined in the 863 Plan.

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[132] As a response to SDI, European countries established their alternative high tech industrial R&D programme, named Eureka. See Westwick (2010).

[133] For a detailed account of the history, organisation, and specific projects of the 863 programme, see Feigenbaum (2003: 153-88).

Concluding Remarks

While a complex amalgam of external and internal factors shaped China's decision to develop a space programme, a key question is how this was achieved given the wider geopolitical, political, and economic context in which it was embedded. As this chapter has suggested, the success of China's space effort can be largely explained by the enduring and powerful influence of a composite ideology of postcolonial techno-nationalism that rendered the pursuit of space projects appealing to China's political and scientific elite as a normative marker of the state's scientific prowess, great power status, and modernity. In other words, there was nothing preordained about the pursuit of a space programme. It was the influence and the composite nature of a postcolonial techno-nationalist ideology that helped to secure the development of key space programmes amid political turmoil and limited financial resources in the Maoist era.

An important aspect of this process was the crucial role of Marshal Nie Rongzhen, who managed to articulate successfully a postcolonial techno-nationalist vision that has had a profound impact on the development of the strategic weapons programme, and, consequently, on the space programme. Yet, this postcolonial techno-nationalist approach was shared by key leaders and numerous scientists and engineers, including Zhou Enlai, Qian Xuesen and others. In terms of organisation, forging strongly professional and flexible institutions premised on the autonomy of experts created an environment conductive to large-scale and ambitious space projects. Crucially, however, this process was accompanied by the construction of a strong professional identity related with those working for the space programme, which was woven into a sense of nationalist commitment and mission.

Notwithstanding that the advent of the Deng leadership initially marked a focus on a few space projects that could contribute to economic construction, the reconsolidation of a postcolonial techno-nationalist ideology by the mid-1980s embodied in the 863 Plan spurred a new interest in space-related research and capabilities and brought human spaceflight back in the agenda. Equally importantly, this period saw China's entry into the international space society.

Chapter 5. Leapfrogging Into Modernity: India's Space Programme (1955-1989)

One of the most distinctive qualities of India's space programme has been its emphasis on the civilian uses of space science and technology for the promotion of socio-economic development. As we shall see in this chapter, therefore, the focus of the Indian space programme, from its inception, was the development of space applications such as communications and remote sensing to deliver practical benefits that could meet the specific social and economic needs of a developing and large country like India (Sankar, 2007: 2; Raj, 2000: 22). In explaining the rationale behind the development of India's space programme, Vikram Sarabhai (1968: 39, emphasis added), who is generally considered by many observers to be the father as well the scientific visionary of India's space programme, famously noted:

> There are some who question the relevance of space activities in a developing nation. To us, there is no ambiguity of purpose. We do not have the fantasy of competing with the economically advanced nations in the exploration of the moon or the planets or manned space flight. But we are convinced that *if we are to play a meaningful role nationally and in the community of nations,* we must be second to none in the application of advanced technologies to the real problems of man and society, which we find in our country. The application of sophisticated technologies and methods of analysis to our problems is not to be confused with embarking on grandiose schemes whose primary impact is for show rather than for progress measured in hard economic and social terms.

In the absence of any comprehensive policy framework articulated by the Indian government within which to make sense of the key motivations behind the early development of India's space programme, it is plausible to say that Sarabhai's words represented what was as close to a policy framework that one was likely to come (Sachdeva, 2013: 303-4). That Sarabhai's vision served as one of the earliest expressions of India's policy goals in space has been manifested in the ways in which India has been successful in utilising space systems for key developmental and human security applications, such as tele-education and telemedicine, disaster monitoring, meteorological observation and forecasting, and the management of natural and earth resources (water, fishery, agriculture, forestry) (Reddy, 2008: 237-8; Das 2007; Rao 2007).

This is, of course, not to say that national security and prestige considerations were absent from the development and deployment of space technologies. In fact, India's missile programme benefited from its space launch vehicle technology - albeit for most of the established space powers it has been the other way around (Pant and Gopalaswamy, 2008a; Mistry, 1998: 156-7). Rather, the point to emphasise here is that in contrast to the overt military applications of other national space programmes, the Indian space programme gave priority to a number of civilian space-based applications and projects for societal and developmental benefits.

Although earlier works have focused on the security and military aspects of India's space programme,[134] International Relations scholars have recently paid much attention to the strategic, political, and economic drivers of India's growing profile in space, especially with regards to the purported Asian space race.[135] Yet, while this body of literature is a welcome contribution to our understanding of the factors that have shaped India's space goals and ambitions, there is generally little consideration of the wider historical context in which India's space programme has emerged.[136] Even when there is consideration of the earlier stages of India's space programme, this usually tends to be rather descriptive and technical in its empirical focus and rather uncritical or hagiographic in its normative expectations.[137] Having said that, these studies should not be treated as unworthy of our attention, as they offer very helpful insights about key developments in the history of India's space programme and policy. It should also be noted that, even though the political history of the Indian space programme has not been the focus of extensive analysis in the scholarly literature, specific projects and programmes have recently attracted the attention of space historians.[138] The following analysis builds on these recent works as they help to highlight some of the key issues considered in this chapter.

What merits emphasis for the purposes of this discussion is that most of International Relations accounts seem to be interested only in making sense of why the Indians decided to pursue a space programme and how they decided to utilise their

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[134] Examples include: Elkin and Fredericks (1984); Bhatia (1985); and Thomas (1986).
[135] See, inter alia, Clegg and Sheehan (1994); Mistry (1998); Pant and Gopalaswamy (2008b); Sheehan (2007: 142-57); Siddiqi (2010); Pant and Lele (2010); Moltz (2012: 110-35); and Lele (2013).
[136] One exception is Reddy (2008).
[137] See, Raj (2000); Suresh (2008); Rao and Radhakrishnan (2012); Harvey, Smid and Pirard (2010: 141-253); Rao (2014); and Rao, Suresh, and Balagangadharan (2015).
[138] See, inter alia, Srinivasan (1997); Maharaj (2013a); Maharaj (2013b); Siddiqi (2015a); and Siddiqi (2015b).

space assets once they were developed. And yet, one of the most important and relevant questions about India's space programme is how India's space project succeeded in joining the space club as a developing country. This involves saying something not only about the strategic, political, and economic factors that shaped India's space programme, but also about the ways in which it was justified and implemented efficiently.

The key point that emerges from this discussion is that the effectiveness and efficiency of India's space programme can be explained – to a great extent – by the influence of a postcolonial techno-nationalist ideology with Indian characteristics. As we shall see, it was the prevalence among India's political and scientific elites of a postcolonial techno-nationalist approach to space utilisation that led them to instil the notion of the need for a extensive space programme, from its inception, as a powerful symbol of the state's scientific prowess, great power status, and modernity. Consequently, this postcolonial techno-nationalist ideology played an important role in turning the widely held perception, especially in the West, that India as an underdeveloped and poor country should not have a space programme to a perception that justified space capabilities precisely on the grounds that it was a poor and underdeveloped country (Siddiqi, 2010b: 436). Therefore, it is striking, perhaps, that it is still difficult to quantify the costs and benefits of India's space programme, as a recent study contends (Sankar, 2007: 291-2).

Before moving on, however, for the sake of convenience, it is helpful to conceptualise India's space programme as falling into four time periods. The first era began in 1955 with the establishment of the Indian national committee for the International Geophysical Year (IGY) and ended with the formation of the Department of Space (DoS) in 1972. The second period from 1972 until the mid-1980s saw the development of principally experimental, low-capability projects, including the construction and operation of satellites, and the development of indigenous launchers. The third period commenced in the second half of the 1980s and marked the beginning of the operational stage of the space programme with a focus on larger and mission-specific systems (Mistry, 2001: 1025-6).[139] The last

[139] Baskaran (2005) also identifies four phases, each of which lasted roughly a decade long: a) the scientific phase (1960s); b) the learning phase (1970s); b) the threshold phase (1980s); c) and the commercial phase (1990s). While the phases put forward here largely overlap with the ones suggested by Baskaran, it is important to note that the author traces the origins of the space programme in 1961 (Baskaran 2005: 159).

period, from the 1990s to the present, finds India with a coherent and growing programme, including space exploration. The first two periods are considered in some detail in this chapter because they saw the establishment of an institutional framework that defined the course of India's space programme underpinned by Sarabhai's postcolonial techno-nationalist vision. Given that, in large part, the third era in effect signified the implementation of this vision, it is briefly described and analysed in this chapter. Chapter 7 covers the last period.

This chapter proceeds in the following way. The first section provides a brief sketch of the principal scientist who has been associated with India's space endeavour, Sarabhai, because I argue that his postcolonial techno-nationalist vision exercised a profound influence on the direction of the programme even after his sudden death in 1971. I do this by considering two other key figures that have had an important impact on the place of science and technology in post-independent India, Jawaharlal Nehru and Homi J. Bhabha. Following this, the second section provides a detailed analysis of the first period of the space programme by highlighting the key external and internal factors that created a permissive environment for its establishment. The third section considers the second period of India's space activities and then moves on to briefly describe the operational stage of the programme. By way of conclusion, the chapter argues, that although the relative weight of the key drivers behind India's space activities may have varied over time, with national security considerations becoming more salient – or at least more overt – in the 1980s and beyond, it was an Indian version of postcolonial techno-nationalism, as a complex and composite ideology centred on the belief of technology as an indicator of the state's power, status, and modernity, which largely explains the effectiveness of India's space endeavour.

Techno-nationalism, Modernity, and Modern India

To understand the overall context in which the space programme emerged, it is important to say something about the small, albeit influential, scientific elite, or what Abraham (1992) calls the 'strategic enclave', which played a vital role in India's early space effort. In doing so, the principal focus of attention in this section is the two key architects of India's space programme, Homi Bhabha and Vikram Sarabhai, who shared in common a postcolonial techno-nationalist ideology couched in the language of social progress, economic development, and modernity. However, the starting point of this analysis is that the underlying logic of this postcolonial techno-nationalist ideology was nurtured and facilitated by the dominant political figure of post-independent India: Jawaharlal Nehru.

Nehru and Foreign Policy

There is already a growing literature that seeks to highlight the key tenets of Nehru's foreign policy. Nevertheless, my goal here is simply to consider what these tell us about his understanding of the place of science and technology in post-independence India. To begin with, Nehru's attitude towards foreign policy has been complex and frequently contradictory and ambiguous. The potential relevance of this claim has been evident in the continuing debates about whether Nehru's policy of nonalignment was an expression of idealism or realism. Yet, as Cohen (2001: 39-40) notes, it makes more sense to consider Nehru's foreign policy and strategic outlook as reflective of a constant tension between idealism and realism. Besides, to treat his foreign policy outlook along these Manichean lines merely has the effect of attributing to Nehru's thinking a static quality, which does not do justice to his complex view about world affairs. The fact that he stayed in office for nearly twenty years also means that his worldview was susceptible to change (Nayar and Paul, 2003: 116).

Having said that, it is possible to identify some of the principal influences that have underpinned the foreign policy orientations and views of Nehru, as this can help to illustrate the role of science and technology in the immediate post-independence period. One of these is the long-standing aspiration of India to become a great power that 'is fully autonomous, influential and respected by the world' (Ogden, 2014: 3). As Nayar and Paul (2003) persuasively demonstrate, India's desire to attain the role of a major power has been a key determinant of its international behaviour since independence.

But while it is clear that India's quest for great power status has been a material expression of its national attributes, including its sub-continental size, large population, and its hegemonic presence in South Asia, it is also apparent that it had a vital ideational and normative dimension (Nayar and Paul, 2003: 3). On the one hand, Nehru's efforts to carve out a greater role for India as the leader of the non-alignment movement were partly a response to the structural and geopolitical pressures of the Cold War. On the other hand, his orientations and calculations were entrenched in India's 'civilisational exceptionalism' (Chacko, 2012). This was reflected in the widely held belief among Indian elites, that, as an enduring and distinct civilisational entity, India is entitled to play a global role in international society (Cohen, 2001: 52; Nayar and Paul, 2003: 3).

This leads to another key feature of Nehru's worldview, which is often interwoven with India's quest for great power status and 'civilisational exceptionalism', that is, the profound and enduring impact of the legacy of colonialism on India's interaction with international society. Like Mao and other nationalists, Nehru's writings display the pride taken in the past achievements of his motherland embodying an ancient civilisation as well as the blame of the colonial powers for the loss of this past greatness and the suffering and humiliation henceforth caused (Miller, 2013: 32). Thus, not only was the support of the anti-colonial movements a principal theme of India's diplomacy under Nehru's leadership (Cohen, 2001: 38), but Nehru also believed that India was entitled to a leadership role in international society because of its colonial past and its anti-colonial struggle (Miller, 2013: 93).

Nonetheless, focusing merely on Nehru's foreign policy outlook provides a very narrow understanding of his thinking for he was, perhaps, more than anything else, an intellectual (Nayar and Paul, 2003: 116). To be sure, non-alignment was a key feature of what has come to be called the 'Nehruvian consensus' in the scholarly literature, which is indicative – to some extent, at least – of his perceived centrality in the making of the modern Indian nation state since 1947. Yet, the 'Nehruvian consensus' was consisted of two other main themes: the construction of a modern Indian society centred on the ideals of freedom, equality, and democracy within a secular state and the creation of a self-sufficient economy through import-substitution and rapid industrialisation in order to do away with poverty and dependence on advanced industrial countries (Stein, 2010: 399-400).

Nehru, Science, and Technology

It was against this backdrop of ideas and influences that Nehru succeeded in fostering an environment conductive to science and technology, which bears the characteristics of a postcolonial techno-nationalist ideology. Certainly, even before independence Nehru had identified science with the future of modern India. But it was in the early postcolonial period that the full impact of his personal involvement with the formation of India's science and technology policy and his interaction with scientists and their ideas became more apparent (Anderson, 2010: 249). While many writers have drawn attention to the salience of science in modern India, Arnold (2013) has provided an especially useful analysis of what he calls 'Nehruvian science', a concept that has particular relevance for this discussion. Even though Nehruvian science embraced many different things, according to Arnold (2013: 361), four aspects are especially noteworthy. Firstly, Nehruvian science placed science at the centre of the autobiography of the Indian nation by forming 'a space for postcolonial ownership and subjectivity'. Secondly, it was intended to defy the Eurocentric belief about a monopoly of science by placing modern science in India's history and traditions through a process of cultural appropriation. Thirdly, although Nehru emphasised the transnational nature of modern science, he primarily saw science as a means to meet India's national needs and fulfil its Cold War ambitions. Fourthly, his was a programme of socio-cultural change with the aim to transform Indian society through the cultivation of a scientific outlook or what Nehru usually referred to as the 'scientific temper'.

What is distinctive about Arnold's concept of Nehruvian science is that it makes the link between Nehru's commitment to the cultivation of a 'scientific outlook' and ideas about postcolonial science. Building on Arnold's concept, it is not too fanciful to suggest that Nehruvian science was also a postcolonial techno-nationalist vision with Nehruvian characteristics. More specifically, Nehru's techno-nationalist ideology favoured an approach to science that was state-driven and controlled by the state. This was because he saw the development of science and technology as too important and strategic to be left to either the states of the Indian Union or local universities. Therefore, as prime minister, Nehru sought to build a scientific establishment that was favourably inclined to his vision about the role of science by using the central government, its scientific institutions, and controlling science expenditures. Crucially, this involved not only institution building, but also the establishment of a nexus of relationships with like-minded scientists and advisors around Nehru, including amongst others, S.S. Bhatnagar, Patrick Blacket, and Homi K. Bhabha (Arnold, 2013:

366-8).[140] Equally, for Nehru, not only did science and technology offer a way to get rid of India's former scientific dependence on Britain and to form relations with other scientific powers, but it also 'gave India a new authority, a new moral stature, in the world' amid the Cold War (Arnold, 2013: 368).

Nehru, Techno-nationalism, and the Nuclear Programme

The epitome of India's early postcolonial techno-nationalism was, of course, India's nuclear programme and the discourse around it. Despite the fact that there is still a good deal of debate about the drivers behind India's nuclear programme, there is agreement among observers that nuclear technology and nuclear weapons served as powerful markers of India's independence, its technological advancement and modernisation (Ogden, 2011: 290). Yet, even though techno-nationalism has not been explicitly used as an analytical framework in the relevant literature that deals with the Indian nuclear programme, a postcolonial techno-nationalist ideology, as has been defined in this study, was pivotal in creating the sort of thinking and institutions, which in turn, encouraged the successful undertaking of a techno-political project of such a large scale and investment.

Certainly, Nehru played a crucial role in articulating an influential discourse around science and the nation, and atomic energy, as part of the postcolonial state's project of modernity (Abraham, 1998: 28-30). This discourse was also enmeshed in narratives about India's civilisational backwardness and civilisational exceptionalism (Chacko, 2012: 21-45). In this regard, Nehru's decision to establish an Indian nuclear programme reflected his belief that the mastery of modern science would allow postcolonial India to reach the Western standards of modernity (Chacko, 2011: 192-7) and take part in the 'universal ideal of scientific competence' (Harrison and Johnston, 2009: 1). As Nehru noted in 1955:

> Often our people fail to recognize what the modern world is all about. How did Europe and the US advance? Why were they able to conquer us? It is because they had science through which their wealth and economic and military strength grew. Now they have even produced the atom bomb. All these things stem from science

[140] Anderson (2010) provides a detailed study of the influence of this network of scientists and advisors associated with Nehru on India's science and technology policies and practices since independence.

> and if India is to progress and become a strong nation, second to none, we must build up our science' (cited in Chacko, 2012: 32).

Therefore, Nehru was keen to emphasise that India's response to science as an expression of modernity had to be an alternative modernity, that is, an ethical modernity. This was based on the perception that India is armed with unique civilisational qualities to furnish an ethical modernity, which is in contrast to the violent and materially-oriented modernity of the West. As Chacko (2012: 34) argues, this move allowed Nehru to use science as a tool to 'reconcile India to a modernity in which the West was seen as the standard of material development', without being accused of Western mimicry. Such perceptions of India's 'civilisational exceptionalism' help to explain why India decided to become a nuclear power, while at the same time was a key supporter of nuclear disarmament during the Cold War (Chacko, 2012: 21-45). Remarkably, perhaps, this principal paradox between weaponisation and disarmament has remained a constant in India's nuclear programme ever since (Ogden, 2011: 297).

Indeed, one of the most important aspects of this ambivalent response to modernity was an equivocal stance towards the possibility of the use of the Indian atomic energy programme for military purposes (Abraham, 1998: 46-8; Chacko, 2012: 21-45). This stance can be traced at least back to the 1948 Constituent Assembly debates about the Atomic Energy Act to establish an Atomic Energy Commission (Abraham, 1998: 50-1). In discussing the merits of developing an atomic energy programme, the Indian prime minister recognised the Indian nuclear project as a potential source of both economic and military power:

> Consider the past few hundred years of history, the world developed a new source of power, that is steam – the steam engine and the like – and the industrial age came in. India with all her many virtues did not develop that source of power. It became a backward country in that sense; it became a slave country because of that…Now we are facing the atomic age; we are on the verge of it. And this is obviously something infinitely more powerful than either the steam or electricity…The point I should like the House to consider is this, that if we are to remain abreast in the world as a nation which keeps ahead of things, we must develop this atomic energy quite apart from war – indeed I think we must develop it for the purpose of using it for peaceful purposes…Of course, if we are compelled as a nation to use it for other purposes, possibly no pious sentiments of any of us will stop the nation from using it that way (cited in Perkovich, 1999: 20).

Therefore, Nehru was careful not to rule out the military use of atomic energy due to its inherent dual-use nature. As Perkovich (1999: 20) points out, the founders of the Indian atomic establishment welcomed this possibility in 1948, even before Mao's communists took over China and without any serious external threat to India's national security. In this context, this phrasing by Nehru can be seen as a typical articulation of a techno-nationalist discourse in the sense that it acknowledges the importance of science and technology as a source of national power both in military and economic terms. But, at the same time, as Abraham (1998: 29) notes, what is interesting in Nehru's phrasing is the exegesis he puts forwards for the reason why India was rendered a colony: 'because of its lack of technological sophistication'. Equally, references to India as a 'backward' and 'slave country' on the grounds of its scientific and technological advancement vis-à-vis the colonial powers serve to illustrate the enduring impact of India's colonial experience on Nehru's understanding of science and technology as a modern 'standard of civilisation'.

The Atomic Energy Act was eventually passed in 1948 and led to the creation of the Indian Atomic Energy Commission (AEC) on 10 August 1948. Not surprisingly, Nehru was personally engaged with overseeing the trajectory of the atomic programme. In practice, however, it was Bhabha who guided its early conceptualisation and implementation (Perkovich, 1999: 20-1).

Homi J. Bhabha and Postcolonial Techno-nationalism

Homi Jehangir Bhabha (1909-1966), like Nehru and Sarabhai, articulated a vision about the role of science and technology that was keeping in line with postcolonial techno-nationalist thinking.[141] A key feature of this thinking was Bhabha's determination to build strong research institutions in India characterised by strong professionalism blended with nationalist motivation. Using his family connections with the Tata family, he wrote a letter to the Sir Dorab Tata Trust in 1944 with a proposal to set up a world-class scientific institute of fundamental research. In the often quoted letter, Bhabha (1944: 2-3) somewhat presciently noted that 'when nuclear energy has been successfully applied for power production in say a couple of

[141] Accounts of Bhabha's life and legacy include: Venkataraman (1997); Dasannacharya (2009); Chowdhury and Dasgupta (2010); and Menon (2010).

decades from now, India will not have to look abroad for its experts but will find them ready at hand'. In turn, the Tata Trust accepted Bhabha's proposal and the Tata Institute of Fundamental Research (TIFR) began functioning in 1945 with Bhabha as its founder director. What is worth noting is that the TIFR enjoyed a remarkable freedom of interference from the central government and generous financial resources available from the very beginning of its formation (Perkovich, 1999: 17).

Bhabha, of course, has been synonymous with the early direction of India's nuclear programme. He was chair of the Atomic Energy Research Committee, which was formed in 1946 and one of the three members of the AEC. In 1954, the new Department of Atomic Energy (DAE) was created as a separate ministry. Bhabha was appointed as the secretary and he reported directly about the progress of India's nuclear programme to Nehru. This eventually elevated Bhabha to 'a science policymaker without equal in the country (Anderson, 2010: 254). Bhabha's close relationship with Nehru was a key factor in this development. Besides, the two men shared the view that Indian science could transcend India's colonial legacy and achieve the principal marker of modernity at the time, that is, atomic energy (Perkovich, 1999: 17). According to Anderson (2010: 260), Bhabha exerted a subtle influence on Nehru, something that was evident in Nehru's belief that atomic scientists should be treated as a special category. Thus, in contrast to other research centres in India, Bhabha's institutes or projects were not subject to the same review and assessment processes (Anderson, 2010: 270). In this light, the Nehru-Bhabha relationship was effectively the only form of checks and balances in the early stages of India's nuclear endeavour (Perkovich, 1999: 21).

By the mid-1950s, Bhabha was not only the indisputable leader behind India's nuclear programme, but he had also become 'the sole power in Indian science'. Therefore, Nehru's considerable reliance on him further increased (Anderson, 2010: 252). Indeed, it was Bhabha who drafted the influential 1958 'Scientific Policy Resolution' embodying the spirit of self-reliance*,* which was passed within less than a year after the launch of Sputnik. An illustrative example of the advent of India's postcolonial techno-nationalist thinking under Nehru's leadership, the resolution also provides insights into Bhabha's views about the role of science and technology. While this brief resolution policy was primarily designed to 'foster, promote, and sustain, by all appropriate means, the cultivation of science and scientific research' by 'offering good conditions of service to scientists', it was also framed around a postcolonial techno-nationalist ideology. According to the document (Government of India, 1958), 'the dominating feature of the contemporary world is the intense cultivation of science on a large scale, and its application to meet a country's requirements' and 'the wealth and prosperity of a nation depend on the effective utilisation of its human and material resources through industrialisation'. It also states that 'an early and large scale development of science and technology' is necessary in order to 'reduce the drain of capital', which otherwise has to be spent on importing science and technology and 'highly paid personnel and technical consultants'. More tellingly, perhaps, the policy resolution (Government of India, 1958) notes that:

> Science had developed at an ever-increasing pace since the beginning of the century, so that the gap between the advanced and backward countries has widened more and more. It is only by adopting the most vigorous measures and by putting forward our outmost effort into the development of science that we can bridge the gap. It is an inherent obligation of a great country like India, with its traditions of scholarship and original thinking and its great cultural heritage, to participate fully in the march of science, which is probably mankind's greatest enterprise today.

In this regard, the policy resolution codified and institutionalised, perhaps, for the first time in public, a postcolonial techno-nationalist framework based on two rather subtle moves. In the first place, it articulated the familiar narrative about how science had generated the gap between advanced and backward countries and how this compelled India to bridge this gap. In the second place, the necessity to participate in 'the march of science' and modernity was also rendered inescapable due to India's sense of 'civilisational exceptionalism'.

Another important and revealing example of Bhabha's postcolonial techno-nationalist thinking was his last speech in 1966.[142] In his speech, Bhabha articulated his views about the role of science and technology in a developing country like India. Echoing the Scientific Policy Resolution, Bhabha (1966: 541, emphasis added) noted:

> Western Europe is in fact a small area of the globe which outstripped the rest, essentially from the time of the Industrial Revolution, because of its development of modern science and the enhanced ability this gave it to utilize the forces of nature and to thus achieve a much higher material standard of life for its people…A major part of the world, however, still remains underdeveloped by these standards.

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[142] The speech was delivered on the occasion of the latest of the biennial assemblies of the International Council of Scientific Unions hosted by TIFR in January. However, Bhabha's speech was published posthumously in the prestigious *Science* magazine.

What the developed countries have and the underdeveloped lack is modern science and an economy based on modern technology.

Nevertheless, the point to make is that Bhabha, as the most powerful scientist of the period under consideration, played a crucial role in identifying and promoting other important areas of research, including electronics and space technology. Despite the fact that he did not live long enough to see India's first steps in space, he provided important support to Sarabhai's plans for the creation of a space programme. Inaugurating a seminar on Space Science in January 1963, Bhabha provided a rationale for the development of space research in India along postcolonial techno-nationalist lines that it is worth quoting at length:

> If we do not do so now, we will have to depend later on buying know-how from other countries at a much greater cost…[s]ome people may well ask whether it is appropriate that we should spend some of [our limited resources], even if in a modest way, on space research. I am convinced that the answer to this is 'Yes'. Science and technology provide the very basis upon which the future of the country rests; and it is not possible for us to develop the best that our scientists are capable of, and to attract our best and most able people to scientific work, unless one can also provide them the opportunities of making discoveries in the fields of scientific endeavour, which are the most active and exciting today. The second reason for going into space research is that there are many areas in which it is likely to yield results of great practical interest and importance in the near future, and we would again be falling behind the advanced countries in practical technology if we were not to look ahead and prepare ourselves to take advantage of these new developments also (cited in Rao and Radhakrishnan 2012: 5-6).

It was in this reconfigured context conductive to 'highly visible technology' that Sarabhai managed to promote his ambitious plans for an Indian space programme. In many ways, he shared with Bhabha similar assumptions about the role of science and technology premised on a postcolonial techno-nationalist ideology.

Vikram Sarabhai

Vikram Ambalal Sarabhai (1919-1971) was born to an established, political, and wealthy family of industrialists in Ahmedabad.[143] He completed an undergraduate degree in natural sciences at Cambridge in 1939, but although he was about to embark upon graduate studies in physics, he had to return to India because of the break of the

[143] On Sarabhai's life and legacy, see the contributions in Joshi (1992); and Shah (2007).

Second World War. This didn't prevent him from joining the Indian Institute of Science (IISc) at Bangalore in 1940 to study cosmic rays, where he also met Bhabha. When the war ended in 1945, Sarabhai returned to Cambridge and completed his PhD in 1947, but the next year he went back to India. Utilising his family resources and ties, he established the Physical Research Laboratory (PRL) in 1952, which would be an important vehicle for his scientific work on cosmic ray physics and space research.

A detailed analysis of Sarabhai's involvement with the early stages of India's space programme will be taken in the next section. For now, given that Sarabhai combined the roles of 'an innovative scientist, forward-looking industrial organiser' and institution builder (Ramanathan, 1992: 111), his thinking about science and technology merits consideration in its own right. This is no easy task, not least because soon after Bhabha's death Sarabhai was appointed as chairman of the AEC, secretary of the DAE, and chairman of the Electronics Committee, key positions that he held until his sudden death in 1971. In short, Sarabhai was not only the scientific visionary and leader of India's space effort, but for the span of five years (1966-1971) he was also responsible for the country's nuclear programme. But although it is not possible to do justice even to Sarabhai's contribution to India's space effort in the course of one chapter, it is necessary to have a sense of his approach to science and technology and his influence over what, over time, resulted in a full-fledged space programme.

Sarabhai's Vision: A Subtle and Ambivalent Postcolonial Techno-nationalism?

As Siddiqi (2015a: 38-9) points out, apart from similar backgrounds and being institution-builders, Bhabha and Sarabhai shared a rather ahistorical technological enthusiasm embedded in deep-rooted beliefs about science and technology as a powerful catalyst for progress, socio-economic development, and modernity in a postcolonial context, which was reinforced by theories of modernisation that were so influential in the West during the 1950s and 1960s. This made the two men the ideal agents of Nehru's vision of promoting the creation of a 'scientific temper' and a 'scientific outlook' in the newly independent country. In doing so, Bhabha and Sarabhai also believed that the state should play a key role in India's modernisation (Siddiqi 2015a: 38-9).

For all the attention given to Sarabhai's distinctive approach to science and technology, it is important to recognise that it is difficult to disentangle the enduring influence of Sarabhai's vision and ideas without a reference to a postcolonial techno-nationalist thinking. However, as we shall see below, his sort of postcolonial techno-nationalist thinking is best conceived as more complex, subtle, and ambivalent than Bhabha's. In this regard, a number of key features of Sarabhai's ideas are particularly germane here, to which I now turn.

Security or Development?

One of the most important aspects of Sarabhai's approach to science and technology is the relationship between the civilian and military uses of nuclear and space technology. This is an important consideration, especially given that there has been a great deal of debate about what is usually seen as Sarabhai's aversion to nuclear weapons and the military uses of space. As Perkovich (1999: 123) notes, Bhabha was not much interested in nuclear weapons as military tools, but rather in their political and psychological value. But Sarabhai saw the possibility of developing nuclear weapons quite differently from Bhabha. In particular, whereas Bhabha believed that acquiring the capability to explode a nuclear device would allow India to enter him and India into 'the league of atomic scientists who symbolized the apogee of modernity', Sarabhai was quite sceptical about the material and practical benefits that would accrue from India's entrance into the nuclear club (Perkovich 1999: 124).

While there is clearly something in this argument, Sarabhai held a more ambivalent position towards the possibility of making a bomb throughout his AEC chairmanship than is usually acknowledged (Anderson, 2010: 434).[144] As Abraham (1998: 143)

[144] Not surprisingly, Sarabhai's seemingly position against nuclear weapons created tension and friction with the constituency within the Indian scientific community that favoured building nuclear weapons. Indeed, one of the first decisions that Sarabhai took as AEC chairman was to halt the plans for India's nascent bomb programme (Chengappa, 2000: 104). Notwithstanding Sarabhai's opposition, in 1968 key scientists at the Bhabha Atomic Research Centre (BARC) and the Defence Research and Development Organisation (DRDO) revived the project for developing a nuclear explosive. Significantly, it appears that Sarabhai was aware of the revived project, but he did not try to stop it (Perkovich, 1999: 141). It is likely that Sarabhai's view on nuclear weapons changed from opposition to acquiescence after his diplomatic mission with LK Jha to Washington and Moscow in order to secure a guarantee against nuclear attack on non-nuclear countries did not yield any results (Perkovich, 1999: 136-7, 148-9; Shah 2007: 194). In May 1970, under growing pressure from the 'bomb-for-security' lobby, Sarabhai declared that India retained the option for conducting peaceful nuclear explosions (Perkovich, 1999: 152).

points out, Sarabhai was not against the development of atomic weapons per se, but he was opposed to an aggressive military stance in the absence of the required infrastructure and the means to support it. Anderson (2010: 437-8) concurs with Abraham, adding that Sarabhai was also aware that going nuclear would bring about the wrath of the United States with important economic consequences.

Likewise, there is a widely held perception that Sarabhai was averse to the military uses of space. And yet, it seems that his vision did not preclude the utilisation of space for both economic and security purposes. Where his vision differed was in the means by which to link economic development with national security. For he thought that India's national security during that period could be safeguarded better through the use of space technology for socio-economic development without the overt use of military applications. We do know now that, in spite of the fact that the space programme was not directly related to the military, Sarabhai kept the lines of communication between the two open. As Pramod Kale, who joined the space programme in 1963, notes, 'We were very clear that space was for peaceful purposes but we had the capability that could help and if the government wanted it, it was there. Defence people would come to see us and vice versa' (Shah 2007: 132).

In November 1962, for instance, soon after the Sino-Indian war had made painstakingly obvious India's lack of adequate early warning systems or interceptors like missiles, a meeting of the Electronics Committee headed by Bhabha took place. During the meeting, Group Captain VS Narayanan, a radar expert, was asked by Sarabhai why India could not build a radar system to pick up both ballistic missiles and aircraft. Narayanan responded that India lacked the technology and the resources to build basic radars and noted that it needed its own ballistic missile in order to build a deterrent. Narayanan then asked: 'Are we ready for it?' During a break, Sarabhai approached Narayanan by clapping him on the shoulder and invited him for a breakfast to further discuss the subject (Chengappa, 2000: 89-90). K Subrahmanyan, who was the head of the Institute of Defence Studies and Analyses around that time, also recalls vividly an interesting conversation he had with Sarabhai about the possibility of developing a phased radar to detect missiles. He asked Sarabhai: 'If you are not keen on this sort of militarization then why is BARC vying for this contract?'

Sarabhai responded: 'Who am I to shut off all these options for future generations? I am only saying at present I am not for the bomb' (Shah, 2007: 194).[145]

There are, however, a number of additional points that can be made about Sarabhai's postcolonial techno-nationalist thinking. First, Sarabhai exhibited an understanding of the societal dimension of space activities and international cooperation. As we saw earlier, he believed that the development of India's space programme would allow India 'to play a meaningful role nationally, and in the community of nations'. Elsewhere, Sarabhai (1974: 23) noted that India's engagement with space activities would provide India with the opportunity to establish 'collaborative relationships with organisations as well as with scientists and technologists', which, in turn, would lead India to look outwards 'from its encapsulated existence born out of an emergent nationalism' to a process of learning to deal with peers by establishing mutuality. For Sarabhai, therefore, scientific cooperation was an essential vehicle for development in the postcolonial era.

Second, his was a typical techno-nationalist approach in the sense that he advocated 'a total systems approach' through the indigenisation of space technology and its diffusion throughout the economy, hence, his emphasis on self-reliance as part of his vision for India's modernisation and national independence (Sarabhai, 1974: 91). In other words, instead of following 'the black box approach' based on an 'imported turnkey solution', for Sarabhai India should promote the cultivation of an ongoing development of technology based on indigenous research and development in order to achieve self-reliance (Sarabhai, 1974: 92). Equally, under Sarabhai's leadership, the DAE embraced the combination of a new spirit of private corporate enterprise and the older spirit of public service associated in large part with Bhabha. Sarabhai himself epitomised the 'convergence between state science and technology, state industry, and private capitalist industry' (Anderson, 2010: 399).

Third, while modernisation theories have had some impact on Bhabha's approach to science and technology, Sarabhai articulated a vision about the role of science and technology in his utterances, which was typically expressed in terms of India's need to 'leap-frog' the stages of modernisation set by developed countries (Rao, 1992: 146-7). Sarabhai (1974: 92) also spoke of the need for a comprehensive approach to the

[145] Another useful illustration of Sarabhai's techno-nationalist approach to India's space endeavour, through a careful effort to integrate civil and military resources, was the development of indigenous rocket engines through reverse engineering (Anderson, 2010: 420, Chengappa, 2000: 148, Kalam with Tiwari, 2003: 31-2).

process of modernisation and development, according to which any effort to catch up with developed countries must encompass the build-up of a strong national technological infrastructure, the establishment of a scientific and managerial culture, and the cultivation of self-confidence. In his statement as vice-president and scientific chairman of the 53rd meeting of the UN Committee on the Peaceful Uses of Outer Space (COPUOS) in 1968, Sarabhai (1968: 36) elaborated on the ways in which developing countries could benefit from the peaceful uses of outer space in order to close the economic, social, and cultural gap with developed countries:

> A positive approach out of this predicament seems to lie in finding solutions where the particular disadvantages of developing nations, that they have little to build on, is made an asset rather than a liability. I suggest that it is necessary for them to develop competence in advanced technologies and to deploy them for the solution of their own particular problems, not for prestige, but based on sound technical and economic evolution involving commitment of real resources…Indeed, they would discover that there is a totality about the process of development which involves not only advanced technology and hardware but imaginative planning of supply and consumption centres, of social organisation and management, to leap-frog from a state of backwardness and poverty.

For Sarabhai, therefore, there was ‘a totality about modernisation’ that required developing countries to go beyond an ‘in-built culture’. In this view, developing countries ‘cannot have twentieth century atomic energy with nineteenth century industry’ grounded on outdated modes of management and organisation (Sarabhai, 1974: 98). However, it is important to remember that for some observers the process of modernisation in general and theories of modernisation in particular can be seen as a euphemism for contemporary standards of civilisations (Bowden, 2009: 69-72, Adas, 1989: 402-3; Adas, 2006).

Fourth, and related to the previous point, while Sarabhai’s somewhat technological apotheosis seems to be technocratic and apolitical couched in the language of modernisation and progress, it was also enmeshed in India’s postcolonial identity and ‘civilisational exceptionalism’. True, Sarabhai’s postcolonial techno-nationalist thinking was usually expressed in a more subtle way vis-à-vis the first generation of technological enthusiasts of the likes of Nehru and Bhabha, but it was postcolonial nonetheless. As such, it embodied the tension of appropriating and participating in the march of (Western) modernity without inviting the accusation mimicry. Therefore, Sarabhai (1974: 23) would warn against the enticement to use space technology for its ‘glamour’, which stems from the desire to device ‘a sham image nationally and internationally. Instead, India should utilise space for its specific national socio-economic needs. That said, Sarabhai also drew more direct links between India’s colonial experience and the space programme. As he noted in 1971: ‘Either we decide to remain a servile and repetitive state which does not take initiative and plays safe all along the line…or we must try to exert on our own and be innovative and do things which have never been done by us before’ (cited in Bhatt, 1976: 23).

The point to emphasise is that Sarabhai’s postcolonial techno-nationalist vision was also shared by many of his aides and his contemporaries who were involved with the development of India’s space programme. Crucially, it was in this ideological context that the space programme emerged based on the creation of strongly professional and flexible organisations of horizontal controls and flattened hierarchy, which operated with unusual autonomy from political and bureaucratic interference. At the same time, Sarabhai, as the indisputable visionary and leader of the space programme, was successful in fusing the strong professional motivation of the young scientific and technical workers involved in the space endeavour together with a sense of a national mission and commitment. As Raj (2000: 27) notes, ‘Sarabhai was able to give those he recruited and led the feeling that they were partners in a great venture which would benefit the country’. In short, Sarabhai engineered the construction of a strong professional identity associated with those working for the space programme, which was blended together with their national identity. As we shall see below, however, the high politics of the Cold War would also prove conducive to India’s forays into space.

India’s Space Programme: The Formative Years (1955-1972)

Most accounts identify either the formation of the Indian National Committee for Space Research (INCOPSAR) in 1962 or the launching of India’s fist sounding rocket in the next year as the beginning of India’s space programme. True, these were clearly key developments in the early phases of the programme. Yet, as we shall see in this section, one of the most distinctive features of India’s space programme has been the crucial role played by the Indian scientific community in contributing to the establishment of space research even before the launch of Sputnik in 1957. A key aspect of this process was the participation of leading Indian scientists in the

International Geophysical Year (IGY) of 1957-1958, which led to the establishment of the Indian space programme.

India and the IGY

As we saw in Chapter 1, the launch of the first artificial satellites occurred as part of the IGY. What is noteworthy is that India was an active participant both in the planning and the execution of the IGY. By the early 1950s, there were already a number of established research institutions and facilities for ionospheric, geomagnetic, and meteorological studies that could support India's participation in the IGY. The country's special geophysical characteristics, such as its vast size and its close location to the magnetic equator were also of considerable scientific interest and so they could contribute to IGY activities. IGY was, after all, a 'poor man's programme' because participation requirements were not related to the level of a country's scientific or economic development (Reddy, 2008: 221).

It was in this context that Indian scientists working on upper atmospheric studies sought to engage with IGY and the international scientific community early on. Sarabhai was one of the first to see the opportunities that were becoming available in the field of space research and exploration through India's involvement with IGY (Rao and Radhakrishnan, 2012: 4). It was his proposal that led to the inclusion of a worldwide study of cosmic ray variations with standardised equipment in the IGY agenda (Ramanathan, 1992: 113; Rao, 2001: 15). As a result, in 1955 a national committee for IGY was set up consisted of prominent Indian scientists. K S Krishnan, an internationally renowned physicist, was appointed as president, with Sarabhai as a member of the committee (Kochhar, 2008: 814).

India's participation in the planning and execution of the programme has had the effect of deepening the links between the Indian and the international scientific community as well as enhancing the image of Indian science and scientists within India and abroad. It also made policy makers more cognisant not only of the significance of science and technology, but also of the growing gap between the developed and developing countries (Reddy, 2008: 226). Equally, it led Indian scientists, like Sarabhai, to further appreciate the significance of satellites and missiles. As Kochhar (2008: 815) points out, it is no exaggeration to say that 'the IGY experience paved the way for the Indian space programme under Sarabhai'.

Establishing India's Space Programme

Despite the fact that Nehru had passed the scientific resolution in 1958, there was still a good deal of scepticism even about whether a modest rocket programme should be developed (Shah, 2007: 121). However, Indian decision makers soon became more responsive to the opportunities offered for international cooperation in space. Central in this context were the efforts by Bhabha and Sarabhai (Reddy, 2008: 229-30). More specifically, in August 1961, the Indian government, urged by Bhabha, recognised space research and the peaceful uses of space as an important issue and put it under the jurisdiction of the Department of the Atomic Energy (DAE). As a result, Sarabhai was appointed a member in the board of the Atomic Energy Commission (AEC) and the PRL was identified as the 'appropriate centre' for research and development in space (Shah, 2007: 122).

In the meantime, utilising his extensive network of personal connections, Sarabhai was exploring the possibility of India's participation in NASA's international cooperative programmes in areas that could be beneficial for both parties, such as sounding rockets. In his meetings with NASA, Sarabhai mentioned his plans of a space research programme through the formation of a government-sponsored Indian space research committee. Bhabha, who visited the NASA headquarters in November 1961, confirmed that such a committee was being established and he suggested that this should be the main point of contact with NASA (Maharaj, 2013a: 217-8).

Eventually, in February 1962, the DAE set up the Indian National Committee for Space Research (INCOSPAR), under the chairmanship of Sarabhai, to enable the promotion of international cooperation in space research and the peaceful uses of space (Rao and Radhakrishnan, 2012: 5). A key consequence of this institutional development was that it improved the organisation and coordination of the many space activities, which were conducted across the country, and it provided an institutional framework for facilitating collaboration with foreign agencies, especially NASA (Maharaj, 2013a: 218).

The Thumba Equatorial Rocket Launching Station (TERLS)

One of the immediate consequences of INCOSPAR was the effort to establish a rocket launching facility, which would culminate in the Thumba Equatorial Rocket Launching Station (TERLS). In 1962, a resolution by the Committee on Space Research (COSPAR) acknowledged the major gaps in the coverage of sounding rocket sites by stating that 'the equatorial region has a special interest for meteorology and aeronomy'.[146] It also suggested the importance of setting up a sounding rocket launching facility on the magnetic equator under UN sponsorship (Rao, 2014: 6). In response, COPUOS passed a resolution that recommended the formation of sounding rocket stations, especially in the equatorial region and the southern hemisphere with the aim to further international cooperation, advance human knowledge, and offer possibilities for training. Clearly, Sarabhai and Bhabha were keen to exploit a possibly unique opportunity to achieve the establishment of a sounding rocket station in India, given the country's location in the equator. Thus, after considering possible sites, the fishing village of Thumba near Thriruvanathapuram on the south west coast of India was selected mainly due to its half-degree latitude south of the magnetic equator (Rao and Radhakrishnan, 2012: 24).

However, it is worth noting that, although most accounts emphasise the pivotal role of Bhabha and Sarabhai in the selection of Thumba, there is little acknowledgement of the active involvement of US scientists and officials in the selection of the site and of their connections with Sarabhai (Maharaj, 2013a: 219). And yet, the creation of an international station in India was appealing to the United States for a number of reasons. First, American scientists were interested in the possible contribution of a sounding rocket facility in India to the forthcoming International Indian Ocean Expedition (IIOE) and the International Quiet Sun Year (IQSY) activities organised under ICSU. Second, such a facility had the potential to give the United States an opportunity to establish an indirect venue of relations with the Soviet Union in space science amid the Cold War (Reddy, 2008: 231). Indeed, Arnold Frutkin, who was the Deputy Director of the NASA international programmes office between 1957 and 1978, believed that the involvement of the Soviet Union 'might lift some of the veil of

[146] COSPAR is an international non-governmental organisation (INGO). It was established by the International Council for Science (ICSU) in 1958 to 'promote at an international scientific level scientific research in space'. For more information, see https://cosparhq.cnes.fr/.

secrecy from Soviet space activities' (Maharaj, 2013a: 220). Third, given India's policy of non-alignment during that time, collaborative research on space with NASA was part of the US effort to increase the number of Indian scientists that were positively oriented towards the United States (Maharaj, 2013a: 218).

Accordingly, NASA and DAE signed a memorandum of understanding in October 1962 for collaboration on research of the upper atmosphere through the use of sounding rockets. As part of the agreement, NASA's assistance included the offer of nine Nike-Apache launchers, crucial tracking and telemetry equipment, and the possibility of recruiting a small group of Indian scientists and engineers to visit NASA for training at the Goddard Space Flight Centre and the Wallops Island facility used for the launch of sounding rockets (Maharaj, 2013a: 218, 220). Under the agreement, therefore, Sarabhai initially selected a small group of young engineers for training in assembling and launching imported sounding rockets and their payloads, the safe launch of these rockets, tracking their flight, receiving data and gathering other information required. These young engineers were R Aravamudan, Pramod Kale, A S Prakasa Rao, B Ramakrishna Rao, H G S Murthy, A P J Abdul Kalam, and D Easwaradas. Upon their return, they would operate TERLS and play a key role in India's space endeavour (Raj, 2000: 14). Remarkably, Kalam would come to be known as the 'missile man of India' due to his crucial contribution to the development of ballistic missile and launch vehicle technology, before becoming the eleventh president of India.

The government announced its decision to build a sounding launching facility in Thumba in the parliament on 21 January 1963 and, then, India expressed its interest in offering the facility under UN-sponsorship. The first Nike-Apache rocket provided by NASA was launched on 21 November 1963, marking, thus, the operational phase of TERLS. Soon after, international cooperation with other countries was established in the form of joint scientific experiments, including collaboration with the Soviet Union in 1963 and France in 1964 (Baskaran, 2002: 213).

In December 1965, the 20th session of the UN General Assembly provided sponsorship for the 'continuing operation of the TERLS facility' and an International Advisory Panel for TERLS was established consisted of scientists from four countries (India, France, USA, USSR) chaired by Sarabhai. It is worth noting that in his memoirs the French scientist Jacques Blemont, who was a member of the advisory panel for TERLS, offers a rather orientalist account of his visit at Thumba fused with an admiration for Sarabhai. He recalls that upon arriving at the airport of Trivandrum, 'there were four coolies who weren't able to put our boxes and luggage in the trunk in the car', something which was indicative of 'the wound plaguing the subcontinent, the inability of the poor men to really perform effective actions' (Siddiqi, 2015b: 441). Notwithstanding Blemont's views about 'poor' Indians, the United Nations adopted TERLS as an international UN-sponsored facility in 1967. On 2 February 1968, a large number of scientists and officials, including Indira Gandhi, prime minister of India, gathered at Thumba to attend the historic ceremony of dedicating TERLS to the United Nations (Rao and Radhakrishnan, 2012: 23-8). Meanwhile, Sarabhai was contemplating India's indigenous path towards the utilisation of space centred on the principle of self-reliance. This was perhaps nowhere more evident than in the indigenisation of sounding rockets.

First Steps in Rocketry: Sounding Rockets

The launch of the Nike-Apache rocket in 1963 was a defining event in the early history of India's space programme. However, for the purposes of this discussion what is significant about the sounding rocket programme is not the role of international cooperation itself, but how it was part of Sarabhai's broader step-by-step approach to the development of indigenous technology. Indeed, given the benefit of hindsight, it is easy to see that Sarabhai employed a three-pronged approach to space utilisation: gaining experience by regularly launching foreign sounding rockets at TERLS, embarking on the indigenisation of sounding rockets, and promoting the indigenisation of all the branches of rocketry (Gowarikar and Suresh, 2009: 1516). In this regard, a number of points are worth highlighting. First, there is evidence to suggest that Sarabhai envisioned a full-fledged national space programme right from the beginning (Raj, 2000: 18). Kalam (with Tiwari 2003: 26) recounts that 'after the successful launch of Nike-Apache, he [Sarabhai] chose to share with us his dream of an Indian Satellite Launch Vehicle'.

Second, in consequence, international cooperation was bound to have far more than symbolic significance throughout the 1960s. This was because in the early phase of the programme India had little choice other than cooperation with other countries to develop the necessary technological and engineering skills. Yet, the potential problem of dependence on other countries had to be mitigated through a conscious effort to collaborate with different countries at the same time (Sheehan, 2007: 146). After all, such an approach was reflective of India's broader non-alignment policy based on autonomy and choice (Ogden, 2014: 6-7). In the long-term, therefore, international cooperation was largely seen as a means to achieve greater self-reliance in space technology.

One of the most obvious manifestations of this thinking and practice was the *Centaure* indigenisation programme through technology transfer from France. It is estimated that a total of 81 Centaures were launched from TERLS between 1965 and 1988, of which the large majority were manufactured in India (Rao and Radhakrishnan, 2012: 42, 48). The net effect of this period was the development of India's indigenous *Rohini* sounding rockets. On 20 November 1967 the first of these rockets was launched from TERLS named RH-75, a reference to Rohini and the rocket's diameter in millimetres.[147] These sounding rockets would contribute to the more difficult task of building a launch vehicle (Raj, 2000: 41-4).

Building Space Capabilities in the 1960s: Towards Self-Reliance

National Launch Vehicle

Although technology transfer was a key feature of India's early efforts in rocketry, it is important to recognise that the course of India's space programme remained vulnerable to wider political and geopolitical pressures throughout the 1960s and beyond. Plainly, the 1962 border war with China brought India and the United States together and created a momentum for cooperation in setting up TERLS. Yet, since the mid-1960s, the limits of cooperation were becoming increasingly apparent in India's quest for building a launching capability due to the fact, of course, that such a capability also suggested the development of long-range missiles and related expertise.

Soon after the 1964 Chinese nuclear test, Bhabha and Sarabhai explored the possibility of collaborating with NASA in developing the more powerful all-solid four-stage Scout rocket, which could launch satellites weighting roughly 100 pounds

[147] The Rohini rockets were named after the Hindu Goddess.

into low-earth orbit. This possibility was seen as a response to China's remarkable technological feat, which had provided a major boost to India's rival communist neighbour. Maharaj (2013a: 226-7) details how the Indian request triggered an argument between Frutkin and the US State Department about whether the United States should contribute to India's plans through technology transfer. To be sure, the United States saw space cooperation as a way to help India increase its lost prestige after the Chinese test, without resorting to the option of building nuclear weapons. However, it was believed that assisting India with the procurement of the Scout rocket would be highly visible enough both in political and technological terms, so it could not contribute to restoring India's prestige. Thus, no progress was made in these initial discussions (Maharaj 2013a: 226-7).

Nevertheless, by that time, the commitment to the development of indigenous space technology was already consolidated. Besides, the humiliating defeat in the war with China and the strategic implications of China's nuclear capability acted as a catalyst for challenging the main tenets of non-alignment. The death of Nehru in 1964, then, precipitated a more pragmatic foreign policy outlook.[148] More importantly, perhaps, concerns related to the emerging non-proliferation regime served to highlight the need for the establishment of a strong technological base in rocketry. In other words, the possession of an indigenous launch vehicle was seen as a way to keep the nuclear option open without having to alter India's traditional emphasis on the peaceful uses of nuclear technology (Reddy, 2008: 234).

What is of the most significance for this discussion is that these dramatic developments were aligned with Sarabhai's techno-nationalist thinking. As early as 1968, Sarabhai was contemplating the development of the Satellite Launch Vehicle (SLV), which could be able to launch a modest 40 kg satellite into 400 km circular orbit within five years. Although the configuration and design of the first of these launch vehicles, SLV-3, was modelled after Scout, as (Raj 2000: 57) notes, it was 'not a mere copy of the Scout'. At the same time, as these steps towards developing an indigenous launcher were being taken, other major developments were occurring as part of Sarabhai's techno-nationalist strategy, including the establishment of the Space Science and Technology Centre (SSTC) in 1966 on Veli Hill near Thumba and

[148] On the impact of these developments on India's foreign policy, see, inter alia, Cohen (2001); and Ogden (2014).

India's first earth station, the Experimental Satellite Communication Earth Station (ECNES).[149]

Satellite Capabilities and Applications

One of the most important aspects of India's step-to-step approach to the acquisition of complex space capabilities was the concomitant desire to build satellites. As early as 1965, Sarabhai was interested in the use of communication satellites for establishing a nationwide communication and TV networking system to educate the rural population in India (Rao, 2014: 18). To this end, there were already plans for an Indian national satellite, to be called INSAT, by 1968 (Srinivasan, 1997: 223).

Meanwhile, NASA was looking for an opportunity to field-test the direct broadcast of television to receivers from an Application Technology Satellite (ATS). India presented the logical site for the ATS experiment due to its geography and demographics (Srinivasan, 1997: 219). As we saw earlier, Bhabha and Sarabhai explored the possibility of entering into a cooperative agreement with NASA in procuring the technology of the Scout rocket, but US officials were not interested. However, the idea of a broadcast satellite for India became more attractive to US officials soon after the 1964 Chinese nuclear test as part of their efforts to display the US commitment to the 'third-world' and to promote democratic India as an Asian counterweight to communist China (Maharaj, 2013b: 236-7). While the specific origins of the idea remain unclear, the eventual US proposal for satellite broadcasting dovetailed with Sarabhai's vision of space utilisation for development and modernisation (Siddiqi, 2015a: 41). As a consequence, an agreement was signed between NASA and India's DAE in 1969 for the Satellite Instructional Television Experiment (SITE). Designed to broadcast educational television programmes to rural areas, the project would be conducted in 1975-1976, as we shall see later.

Arrangements for the SITE project occurred in parallel with Sarabhai's plans for building indigenous satellite technology for conducting scientific experiments. In 1968, Sarabhai requested from U R Rao to draw up such a plan. However, in April 1971, an offer was made by the Soviet Academy of Science to help India in space

[149] On the SSTC, see Atomic Energy Commission (1970: 27-8); and Raj (2000: 24). For Sarabhai's role in establishing the ECNES, see Rao (2014: 12); and Shah (2007: 178, 180).

exploration. Sarabhai was quick to arrange a meeting with N M Pegov, the Soviet Ambassador in India, to discuss the details of the offer. What is noteworthy is that the Soviet Ambassador informed the Indian side that the Soviet Union was willing to launch India's first satellite regardless of its weight, but he suggested that it must be heavier than the first Chinese satellite. Subsequently, in August 1971, Rao, along with a group of Indian scientists, was delegated to visit the Soviet Academy of Sciences in Moscow to discuss this possibility. The Soviet team tried hard to persuade the Indian delegation that a scientific payload should be flied in one of the Soviet satellites. But the Soviets eventually agreed to offer a free launch for an Indian-built satellite upon Rao's insistence that India needed to develop its own expertise in satellite technology as soon as possible (Rao, 2014: 28).

The Establishment of ISRO and the 'Sarabhai Profile'

As research and development related to space activities continued to expand, Sarabhai engineered the creation of the Indian Space Research Organisation (ISRO) at Ahmedabad in 1969, under DAE. This was followed by the announcement of a ten-year plan for atomic energy and space research by the Atomic Energy Commission in 1970, entitled a *Profile for the Decade.* The profile*,* which is also known as the 'Sarabhai Profile' because it was largely the product of Sarabhai and his acolytes, summarised in many ways Sarabhai's postcolonial techno-nationalist approach to the development of India's nuclear and space programme. In the preface, it noted that 'The progress of science and technology is transforming society in peace and in war. The release of the energy of the atom and the conquest of outer space are two most significant landmarks in this progress… India is amongst the nations of the world advanced in atomic energy, and is striving for a similar position in space technology and research' (Atomic Energy Commission, 1970: iv). It also recognised that several uses of space can make an important contribution to the economic and social advancement of India, without which 'it is difficult to see how we can hold our own in a shrinking world' (Atomic Energy Commission, 1970: v).

Published one month after the launch of the first Chinese satellite, the profile laid out a concrete decade-long plan for the next phase of a 'full-fledged' space programme by stating that:

> The principal objectives of the space programme of the Atomic Energy Commission are to develop indigenous competence for designing and building sophisticated hardware involved in space technology including rockets and satellites for scientific research and practical applications, the use of these systems for providing point-to-point communications and a national TV hook-up through a direct broadcast synchronous satellite; and the applications of satellites for meteorology and for remote sensing of earth resources (Atomic Energy Commission 1970: 35).

It also confirmed the establishment of the Sriharikota Range (SHAR), a new satellite launching site located at the east coast of India at Sriharikota Island, with the aim to offer a suitable range for launching satellites using multi-stage rockets (Atomic Energy Commission, 1970: 35).

The Profile was not without its critics in the scientific community, the Parliament, and the press. Much of the criticism targeted the viability of the development of bigger reactors and the lack of communication between the DAE and BARC in drafting the Profile (Anderson, 2010: 434). But India's space programme was also subject to criticism in light of China's remarkable technological achievement in space. For instance, Thapar (1970: 726), an influential journalist, noted that China's space feat showed 'a massive co-ordination of skills and resources' of a developing economy. But given that India's scientific effort remained entangled in secrecy, corruption, and incompetence, the author warned that it would 'be left far behind junior neighbours, let alone China' (Thapar 1970: 727).[150]

Whatever the merits of these criticisms were, the country was shocked on hearing the untimely demise of Sarabhai in December 1971. But while Sarabhai's sudden death marked the end of the scientific phase of India's space programme, his postcolonial techno-nationalist vision and legacy would continue to exert a powerful influence throughout the operational phase of the programme during the 1970s and 1980s.

India Joins the Space Club: From the Experimental to the Operational Phase of the Space Programme (1970s-1980s)

By the early 1972, Prime Minister Indira Gandhi's faction of the Congress Party had already won an important Parliamentary election and had led India to a decisive

[150] It should be noted that some Indian elites tried to exploit the launch of the Chinese satellite to argue that India should develop nuclear weapons (Perkovich, 1999: 151-2).

victory in the 1971 Indo-Pakistani conflict over Bangladesh. It was in this reconfigured political context that Sarabhai's sudden death did not come only as a shock for the scientific and political elite, but it also offered an unanticipated opportunity for the government to alter, or at least ameliorate, the tensions between the nuclear and space programmes. A key aspect of this process was a new organisational structure with the creation of a Space Commission and the Department of Space (DoS) in 1972, which effectively separated the space programme from DAE by bringing it directly under the prime minister. This marked the further institutionalisation of the space programme with an allocated budget as well as a clear mission that needed to be justified in parliament (Reddy, 2008: 234-5).

Satish Dhawan (1920-2002) was appointed chairman of ISRO and secretary of DoS in 1972. He would remain chairman of ISRO and secretary of DoS until 1984. One of his first decisions was to set up organisational structures that would allow the various space projects to operate without dependence on the individuals involved (Raj, 2000: 63). In many ways, Dhawan built on Sarabhai's postcolonial techno-nationalist vision, something that was reflected in his efforts to move on with the development of a 'full-fledged' indigenous space programme. Where Dhawan's approach differed was in the introduction of project-oriented management and coordination mechanisms that facilitated the achievement of the stated goals based on rigorous assessments of each project (Baskaran, 2005: 163-4; Raj, 2000: 62). In doing so, he managed to establish a sort of a new organisational and managerial culture that combined Sarabhai's horizontal management style with a vertical management approach, which allowed for better coordination and flexibility (Rao, 2014: 109).

As far as the broader strategy of this period is concerned, Dhawan continued to follow a step-by-step approach beginning with the implementation of several experimental projects related to the development and operation of indigenous technological capabilities, such as launch vehicles and satellites, through international cooperation (Reddy, 2008: 235). Yet, by the mid-1980s, more emphasis was placed on the construction of more powerful and mission-oriented technological capabilities (Mistry, 2001: 1026).

One notable exception of this period occurred in 1980, when Prime Minister Gandhi accepted an offer by the Soviet Union for a joint human mission. This political decision resulted in the visible and symbolic flight of the first Indian astronaut. On 3 April 1984, Rakesh Sharma, an Indian Air Force pilot, was blasted off aboard the

Salyut 7 space station. One day later, amid much publicity, when Prime Minister Gandhi asked Sharma how India looks from space, he famously replied 'the most beautiful land in the whole world is our Hindustan' (Rao, 2014: 83).[151] For all the media attention and the national pride that the flight stirred up, other missions of astronauts did not follow. This exception notwithstanding, what merits mention is that both Indira Gandhi and Rajiv Gandhi, as prime ministers, continued to provide unlimited political support to India's space effort throughout this period (Rao, 2014: 111).[152]

Satellites and Experimental Applications

As we saw earlier, a Soviet offer was made to assist India with the launch of its first satellite. This led to an agreement between the Soviet Academy of Sciences and ISRO in May 1972. Under the agreement, India's first satellite, *Aryabhata*, was launched on 19 April 1975. Despite the fact that Aryabhata was launched on a Soviet rocket from the Soviet Union, the experimental spacecraft was indigenously developed under the direction of U R Rao.[153] Interestingly, as far as naming the satellite is concerned, the board of the satellite project decided to recommend three names to Indira Gandhi, who selected the name Aryabhata after India's famous ancient astronomer and mathematician. The Indian government also decided to release stamps to coincide with the day of the launch (Rao, 2014: 41).

As Rao (2014: 42-3) notes, with India's first satellite, India entered into 'the select group of six nations capable of designing, manufacturing and launching sophisticated space satellites'. The main contribution of Aryabhata was that it established a solid base in satellite technology, which served as a test bed for building future operational satellites. Subsequently, the Soviet Union launched India's first experimental earth observation satellite, Bhaskara-1, in 1979, which was followed by the launch of Bhaskara-2 in 1981.

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[151] These are the first lines of a popular patriotic song, known as the 'patriotic song of the people of Hindustan', which has been associated with the opposition against the British rule and it has been adopted by the Indian Armed Forces.

[152] Indira Gandhi was prime minister between 1966 and 1977 and between 1980 and 1984. For an account of her approach to science and technology, see Parthasarathi (2007). After Gandhi's assassination in 1984, her son, Rajiv, served as prime minister between 1984 and 1989.

[153] On the details of India's first satellite, see Rao (2014: 32-43).

Over the next decade, India also moved ahead with the conduct of a series of experimental projects in satellite applications through international cooperation. As was noted earlier, an agreement was signed between NASA and DAE in 1969 for the Satellite Instructional Television Experiment (SITE), which was eventually conducted in 1975-1976. SITE was an enormous experiment in social engineering (Srinivasan, 1997: 220). By the end of the project, the broadcast of educational programmes for the improvement in health, nutrition, family planning, and agriculture had reached over 2,300 villages and demonstrated that space technology could be successfully utilised by India for socio-economic development. One of the most important consequences of the SITE project was that it paved the way for the development of the Indian National Satellite System (INSAT).[154]

Another key experimental project was the Satellite Telecommunication Experimental Project (STEP), which was taken up during 1977-1979 by using the Franco-German Symphonie satellite. As Reddy (2008: 238) observes, the project was to 'the telecommunications sector, what the SITE was to television broadcasting' as it helped India to enhance its capabilities in operating communications satellites. The experimental phase of India's satellite programme also included the launch of the small *Rohini* series of satellites in the early 1980s as well as the launch of the *Ariane Passenger Payload Experiment* (Apple) communications satellite in collaboration with France, which was placed in geostationary orbit in June 1981 (Moltz, 2012: 117).

As the space programme moved forward in the 1980s, the development of satellite capabilities gradually entered into its operational phase in the fields of communications and remote sensing. Built by Ford Aerospace, INSAT-1A was launched on a US rocket from US soil in April 1982.[155] It was the first satellite of the INSAT series that would form part of the INSAT system. Significantly, one year later, U R Rao, who was then director of the ISRO Satellite Centre (ISAC), succeeded Dhawan as the chairman of ISRO. This marked the transition to the operational phase of India's space programme (Rao, 2014: 109; Baskaran, 2005: 167).

In the field of remote sensing, India reached an agreement with the United States to receive data from its LANDAT satellite when an earth station was opened at Hyderabad in 1979. However, following the successful demonstration flights of Bhaskara-1 and Bhaskara-2, India began developing the indigenous Indian Remote

[154] For a detailed account of the SITE project, see Maharaj (2013b); Also, see Siddiqi (2015a).
[155] On India's first communications satellite, see Srinivasan (1997: 222-6).

Sensing (IRS) satellite programme, which became operational in 1988, with the launch of IRS -1A on a Soviet rocket (Burleson, 2005: 139, 144-5).

Launch Vehicles

One of Dhawan's priorities when he took over as chairman of ISRO was the acceleration of the development of the SLV-3 launch vehicle. As part of this effort, Kalam was assigned project director of SLV-3 in 1972. Eventually, SLV-3 was successfully launched in July 1980. Significantly, the successful completion of the SLV -3 project contributed to the establishment of the more advanced Augmented Satellite Launch Vehicle (ASLV) project in the second half of the 1980s. In turn, the ASLV project would contribute to the design and development of more powerful operational launch vehicles like the Polar Satellite Launch Vehicle (PSLV) and the Geosynchronous Satellite Launch Vehicle (GSLV) (Rao and Radhakrishnan, 2012: 84-97; Raj, 2000: 73).

But the SLV-3 did have another noteworthy effect: India's intermediate range *Agni* missile 'technology demonstrator' employed the SLV-3 booster as its first stage (Pant and Gopalaswamy, 2008a: 378). More specifically, although India had been carrying out R&D programmes on missiles since the early 1970s, under DRDO, these had not yielded the expected results. In contrast to the relatively flat, non-hierarchical organisational culture of ISRO, the prevalent culture in the DRDO was more hierarchical, so it was not particularly conductive to creativity and innovation (Perkovich, 1999: 246).[156] Under such circumstances, there was pressure by the government and the DRDO to bring the space and missile programmes closer, but Dhawan was reluctant to jeopardise ISRO's participation in cooperative projects with other countries and risk sanctions and export controls by building missiles. He believed that the world should continue to see India's space programme as an entirely peaceful endeavour focused on space applications (Parthasarathi, 2007: 173).

However, in 1982 Kalam was eventually transferred to DRDO and was put in charge of India's effort to become self-sufficient in missile technology. Many projects

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[156] For incisive insights on the ways in which the organisational structure of the space and nuclear programmes has been different from other establishments of India's security complex, see Abraham (1992).

benefited from Kalam's involvement with the missile programme, including the design of the Agni-1 missile, which was launched in May 1989. In addition to ISRO's expertise, the missile programme was also assisted by the available infrastructure of the space programme during that period, as several ISRO facilities and assets were used by the DRDO for the test flight of missiles. This was a manifestation of the growing relationship between the civilian and missile programmes since the mid-1980s (Reddy, 2008: 241).

Nevertheless, the most general point to make is that, by the end of 1980s, India had emerged as a key member of the evolving international space society. While a detailed analysis of its engagement with international space society will be taken in Chapter 7, it should be noted that India played a constructive role in formulating key principles related to space law and strongly supported the peaceful uses of space (Jayaraj 2004: 105-6; Wolter 2006: 13, 15, 28-9, 61, 67). Equally, as was highlighted above, it was actively involved in many collaborative projects and international forums, including the IGY, TERLS, and COPUOS. These were clearly indications of India's acceptance as a key space participant.

Concluding Remarks

Most IR analyses deal with the strategic, political, and economic drivers of India's space programme, which are clearly significant determinants of a country's decision to pursue a scientific and technological project of such a scale. But given India's growing presence in space, it is easy to dismiss that there was nothing preordained about India's effort to become a space-faring country. In this regard, one of the most important and relevant questions about India's space programme is how India's space project succeeded in joining the space club as a developing country. Thus, although a complex array of external and internal factors shaped India's decision to develop a space programme, a key challenge for Indian elites was to justify and implement it efficiently in the context of a postcolonial and underdeveloped country.

As this chapter has demonstrated, the success of India's space endeavour can be largely explained by the enduring and powerful influence of a composite ideology of postcolonial techno-nationalism. In doing so, the proceeded discussion considered the role of key figures like Nehru, Bhabha and Sarabhai, who shared in common a postcolonial techno-nationalist understanding of technology as an indispensable marker of the state's scientific prowess, great power status, and modernity. Consequently, this helped to turn the widely held perception that India as a developing country should not develop a 'full-fledged' space programme to a perception that India should acquire space capabilities precisely because it was a developing country.

In addition to an emphasis on indigenisation through international cooperation, one of the most important consequences of this postcolonial techno-nationalist thinking was the 'primacy of the experts', which allowed for the creation of strongly professional and flexible institutions of horizontal controls and flattened hierarchy, with unlimited political support and generous funding. As far as the space programme is concerned, this was reflected in the initial placement of space activities under the powerful Department of Atomic Energy and the subsequent creation of a separate Department of Space. However, as this chapter has suggested, the mere formation of this sort of institutions was a necessary but not sufficient cause of India's successful programme. A principal variable underpinning the earlier phases of India's space programme was the construction of a strong professional identity associated with those working for the space programme, which was fused together with a sense of nationalist commitment and mission. As part of his postcolonial techno-nationalist vision, Sarabhai was instrumental in bringing about this combination of professionalism, organisational culture, and motivation in the space programme. Under Dhawan, this process was further consolidated as India's space programme continued to achieve remarkable space feats in the 1970s and 1980s.

Chapter 6. China and International Space Society (1990-2016)

The rise of China as a major space power has been one of the most widely noted features of the current international space order. But while China's growing influence in space has attracted much attention in recent years, most analyses have tended to examine specific military and/or civilian aspects of China's space programme. Less attention has been given to the constitutive impact of the normative and social structure of international space society on its members, including China. Equally important, less attention has been given to the ways in which China has tried to play a role in shaping international space order. Thus, it is one of the central claims of the following discussion that in order to make sense of China's growing profile in space, we need to consider its engagement with the normative and social structure of international space society.

This chapter approaches this task by examining China's engagement with the primary institutions of international space society from 1990 to 2016. It begins with an analysis of the enduring influence of postcolonial techno-nationalism on key Chinese space projects with a particular emphasis on human spaceflight and space exploration programmes. As we shall see, these remarkable achievements in space have gradually granted China the status of a great power and a hand in shaping international space order. A key insight that emerges from this discussion is the nexus between scientists and political power that reflects the legacy of the strategic weapons programme under Mao and Deng.

The chapter then moves on to offer an analysis of China's increasing interest in the military uses of space and the development of anti-satellite (ASAT) weapons. China's ASAT capabilities have rightly attracted much attention in the literature, especially since the international condemnation of the 2007 ASAT test that created potentially dangerous pieces of space debris. But while China continues to develop ASAT capabilities, it has demonstrated restraint from conducting debris-generating ASAT tests. This illustrates the importance of social pressure and socialisation in international space society. Then, the chapter provides a brief account of China's engagement with space diplomacy, before exploring the possibilities and limits of its attempts to balance US space power as well as the balancing behaviour against China by other states. The rest of the chapter considers China's growing engagement with the primary institution of great power management and the nascent institution of space market.

The overall picture that emerges suggests that, so far, the rise of China in space has contained both negative and positive elements as the emerging post-Cold War international space order has presented both opportunities and challenges. On the one hand, the collapse of the Soviet Union brought to end the arms race in space and halted plans for the deployment of space weapons. As a result, from the early to the mid-1990s, international space order was characterised by relative stability that helped a confident China to cement its position as a member of international space society by developing a full-fledged space programme, while remaining committed to the peaceful uses of space.

Yet, in the 2000s, a number of developments, including the institutional deadlock on space arms control and shifts in the US space posture, posed profound challenges to international order in space. As a result, China's intentions became more perplexing and ambiguous. China's 2007 ASAT test only served to further undermine the key normative and institutional aspects of a dynamic, fragmented, and contested international space society. More recently, however, there is evidence to suggest that China is willing, albeit tentatively, to play a more active role in contributing to the maintenance of international space order that is in accordance with the responsibilities of a great space power.[157]

[157] China's contribution to the process of creating and consolidating global nuclear order is one of the main themes in Horsburgh's study of Beijing's engagement with global nuclear politics. As her study explains, there are two distinct periods in China's attitudes towards global nuclear politics since the 1990s: China's involvement in the process of contributing to the consolidation of global nuclear order as a full-fledged member (1990-9); and China's proactive and constructive, albeit at sometimes cautious, participation in maintaining global nuclear order amid several growing challenges from the 2000s onwards. Horsburgh (2015: 38, 153-62) also argues that China's nuclear behaviour has been largely a reflection of its international behaviour embedded within the wider global order. What should be noted is that there are clearly similarities between China's main patterns of interaction with nuclear order and those of its engagement with space order, not the least because of the links between nuclear and space activities. Equally, like China's nuclear behaviour, its space behaviour has been largely determined by the pursuit of its wider interests and its place in international society.

Technonationalism

The Enduring Influence of Postcolonial Techno-nationalism in the Era of Globalisation

China's growing integration into the global economy in the post-Cold War era has generated some debate about the extent to which the forces of globalisation and techno-globalism have led to an important evolution of Chinese techno-nationalist views and associated practices about technological development. Few, however, would dispute that a postcolonial techno-nationalist ideology still exerts a profound influence on the country's science and technology policy and associated practices.[158] This enduring influence of postcolonial techno-nationalism was captured nicely by the words of the then President of China, Jiang Zemin (2000: 2317), in 2000:

> The outgoing century has witnessed a blossoming of science and technology in the world…These scientific breakthroughs form the foundation on which modern civilization builds, and they promise a future replete with material prosperity and intellectual enrichment worldwide. For these reasons, I believe that science and technology should be the driving force for China's rejuvenation and sustainable development… China has a long history of science and civilization. It was the decadent feudal system and the aggression of the imperial powers that plunged China deep into backwardness and humiliation in modern times. Since the founding of the PRC, however, Chinese scientists and engineers have begun to solve the numerous problems that once stunted the development of our society.

In fact, Jiang was one of the key architects of an effort to reinvigorate the spirit of the *Liangdan Yixing* ideology in the late 1990s. In 1999, for instance, he promoted a redefinition of this ideology based on the key principles of nationalism, indigenisation, diffusion, and catching up (Cheung 2009: 239).

But perhaps nowhere has the enduring influence of postcolonial techno-nationalist ideology been more apparent than in the initiation of China's 15-year science and technology plan. Deliberations on the plan formally began in 2003 and involved the input of more than 2,000 scientists, engineers, economists, corporate executives, and foreign scholars. One of the most important issues that emerged during the contentious process of drafting the plan was the relationship between indigenous innovation and technology imports. A number of economists argued

[158] For example, Suttmeier and Yao (2004: 17-8) argue that there has been some effort by Chinese leaders to promote a mix of policies that reconcile the forces of techno-nationalism and techno-globalism, resulting in what is called 'neo-techno-nationalism'.

that China should continue promoting its current model of development based on technology transfers from multinational corporations. On the other hand, some scientists suggested that China should avoid becoming dependent on foreign corporations for the transfer of technologies, especially with regards to sophisticated technologies. The scientific community's advocacy for a science and technology policy focused on indigenous R&D prevailed in the end. A second controversial issue was the selection of national mega-projects and whether their implementation should be planned by the state or a bottom-up approach associated with a market economy was more suitable. Eventually, those who were advocating the pursuit of large-scale projects selected and implemented by the state won out (Cao, Suttmeier, and Simon, 2006: 41-2; Cheung, 2009: 239-40).

The drafting process lasted roughly 3 years and culminated in the 15-year 'Medium- to Long-Term Plan for the Development of Science and Technology' (MLP) in January 2006. Underpinned by techno-nationalist themes, the MLP promulgates a set of science and technology development policies that should be met by 2020, including the goal of increasing the contribution of science and technology to China's economic development to more than 60 percent, while reducing the country's reliance on foreign technology to less than 30 percent (Xinhua, 2006). Reflecting the *Liangdan Yixing* legacy, the MLP also identifies a number of engineering megaprojects in strategic technologies (Cao, Suttmeier, and Simon, 2006: 40). Significantly, space has been given a high priority with the inclusion of five project areas: human spaceflight, lunar exploration, high-resolution earth remote sensing, satellite navigation and positioning, and next generation launch vehicles (Pollpeter et al., 2015: 42). Therefore, space related R&D has gained additional momentum with the introduction of the MLP in the mid-2000s. However, as we shall see, this has been given impetus by a postcolonial techno-nationalist ideology that has remained one of the driving forces shaping the trajectory of key space projects from the early 1990s onwards.

Satellites and Launch Vehicles

Clearly, China has pursued its space programme with a noteworthy consistency in recent years. It has also sustained a comprehensive approach towards the exploitation and exploration of space that encompasses the full spectrum of space activities. While activities related to human spaceflight and space exploration have attracted much attention over the last decades, satellite development has also progressed steadily. More specifically, although China continues to deploy and operate several communication satellites of the *Chinasat* and *Apstar* series, the principal focus has been on building different types of remote sensing satellites with various applications. This has been evident in the introduction of five new series of remote sensing satellites since 2000. In May 2002, China launched the first of the *Haiyang* series of ocean monitoring satellites. Beginning in 2006, China has also deployed more than twenty-five satellites of the *Yaogan* series. Notably, given the limited information available about this programme, there has been speculation that the *Yaogan* satellites are mainly designed for military applications. Since 2008, China has also begun deploying the *Huanjing* series used for environmental and disaster monitoring, which was followed in 2010 by the introduction of the *Tianhui* series that provide three-dimensional images. More recently, China has begun deploying the *Gaofen* series of remote sensing satellites as part of the mega-projects of the MLP. As a result of this vast network of satellites, China has considerably decreased its dependence on remote sensing data provided by foreign satellites (Pollpeter et al., 2015: 62, 62-8).

Meanwhile, China continues to build and launch other types of satellites including the *Ziyuan* remote sensing satellites based on the China-Brazil Earth Resources Satellite programme (CBERS), the *Fengyun* meteorological satellites, and the *Shijian* technology demonstrator satellites. China also carries on with the improvement of its indigenous satellite navigation and positioning system, the Beidou Navigation Satellite System (BDS), which is expected to provide global coverage by 2020 (Pollpeter et al., 2015: 68-73).[159]

Moreover, important progress has been made in the development of launch vehicles. Throughout the 1990s, China encountered several launch difficulties and failures that

[159] For a detailed account of China's decision to develop its own satellite navigation and positioning system, see C. Li (2013).

severely hindered its ambitions in the commercial launch field (Johnson-Freese, 1998: 77-88). However, China now operates four variants of the *Changzheng* (CZ) (Long March) family of rockets that can carry a range of payloads into low earth, medium earth, and high earth orbits (Pollpeter et al., 2015: 78). More recently, China has begun launching its next generation of more reliable rockets, the CZ-6 and CZ-7. It is also developing its more powerful launch vehicle, the CZ-5, which is designed to support its human spaceflight and deep space exploration missions (A. Jones, 2015b, Xinhua, 2016c).

Human Spaceflight: Project 921

As we saw in Chapter 4, even though China's earlier plan for a human spaceflight programme (Project 714) was essentially cancelled by Deng Xiaoping, the reconsolidation of postcolonial techno-nationalism in the mid-1980s, enshrined in the 863 Plan, put human spaceflight on the agenda anew. Consequently, the members of the special committee (Plan 863-2), which was tasked with drafting a detailed plan for the space sector, suggested that the space programme should revolve around the development of a space station operating in low earth orbit as a symbol of a twenty-first-century great power. However, the idea of a human spaceflight programme was once again marked by fundamental differences of opinion about whether China should embark upon such an ambitious project in the first place. Opponents of the programme argued that human spaceflight is a costly endeavour that would divert limited resources from more pressing needs. Besides, for the opponents it was not clear from a political point of view why China should try to repeat a feat that the United States and the Soviet Union achieved some time ago without bringing them major military or scientific benefits. Advocates of the programme, however, argued that human spaceflight would be an important source of China's technological advancement, national power, prestige, and national pride (Kulacki and Lewis, 2009: 24).

Another matter of major debate was the type of spacecraft that China should build. The aerospace community was split over whether it should develop a reusable spacecraft like the US space shuttle or a Soviet type space capsule (Kulacki and Lewis, 2009: 24; Zheng, 2007: 169). After three years of deliberation, in its report to the State Council entitled 'Summary Report of the Exploratory Work of the National

High Technology Plan for Aerospace', the special committee opted for the development of a capsule. Subsequently, in January 1991, the State Council held a meeting to discuss the report, which was attended by Li Qianming, Deng's brother-in-law and deputy commander of the PLA's Second Artillery (Kulacki and Lewis, 2009: 25). During the meeting, Liu Jiyuan, the deputy director of the Ministry of Space Industry, secretly gave Li a draft of his own plan for a piloted space programme, in which he noted:

> Whether or not we go ahead with a human spaceflight program is a political policy, not purely a technical question, not something scientific and technical people can decide by themselves. Our space program is facing the danger of losing the international standing the old generation of proletarian revolutionaries achieved with considerable difficulty. I urge Party Central to decide this issue quickly (cited in Kulacki and Lewis, 2009: 25).

Soon after, contemplating the heated debate about the future of China's space programme, Premier Li Peng reportedly remarked: 'It can't be said that going ahead with a human space flight program is a wise decision, but it is a decision that must be made' (cited in Kulacki and Lewis, 2009: 25). Notably, by that time, while Deng had begun stepping down from his political positions, it seems that he tried to persuade his successors to move on with the human spaceflight plan through his protégé, Admiral Liu Huaqing, who was then advisor to the Central Party Committee and vice chair of the Central Military Commission (CMC). Liu delivered a letter to Premier Li, Party Secretary Jiang Zemin, and President Yang Shangkun suggesting that the programme should be approved. In the letter it was also suggested that funding should not be the main concern because the programme could evolve incrementally over several decades, which would drastically reduce the costs (Kulacki and Lewis 2009: 25).[160]

Consequently, the Standing Committee of the Politburo chaired by Jiang approved the plan for a human spaceflight on 21 September 1992, dubbed Project 921, which later became known as the *Shenzhou* project. Certainly, it was the largest and most complex space project that China had ever decided to accomplish (Zheng, 2007: 170). The plan initially called for the flight of an unmanned spacecraft by 1998, a human spaceflight mission by 2002, a small space station placed in orbit by 2007, and a

[160] In addition to his support for a human spaceflight programme, Admiral Liu is known in China as 'the father of the modern Chinese Navy'. He strongly believed that the PLA Navy should become a 'blue water' force. Part of his 'blue navy' dream was an aircraft carrier programme. On this point, see Kulacki and Lewis (2009: 25-6). Also see Wong (2011).

larger station by 2010 (Harvey, 2013: 264). To this end, the Party Central Committee established the 'Human Spaceflight Project Office' under the Central Special Committee (CSC) tasked with the coordination and implementation of the 921 Project (Kulacki and Lewis, 2009: 26). The CSC is an ad-hoc high-level decision-making committee consisted of senior civilian and military leaders, including the premier, defence minister, and leading scientists, which is responsible for the supervision of the most significant strategic technology projects. The fact that the 921 Project was overseen by the CMC meant that the much-needed political authority existed to help transcend bureaucratic hierarchies and inertia, something that highlights the institutional and organisational legacy of the *Liangdan Yixing* programme (Cheung, 2009: 254). After all, it was no coincidence that the chief designer of the *Shenzhou* programme was Qi Faren, who had previously worked on the *Dongfanghong* satellite project under Marshal Nie's National Defence Science and Technology Commission (NDSTC). According to Feigenbaum (2003: 184), 'Qi came of age in Nie Rongzhen's organizational model' and 'designed Project 921's R&D structures' in ways that mirrored the management style and organisational modes associated with the strategic weapons experience.

As the Chinese were contemplating the best way to move forward with the human spaceflight programme, they turned to Russia for technical assistance. More concretely, with the establishment of a 'constructive partnership' between China and Russia in the early 1990s, which would evolve into a 'strategic partnership' by the mid-1990s, bilateral relations between Beijing and Moscow had significantly improved. This resulted in the gradual increase of diplomatic and military exchanges, including technology transfers (Yu, 2005: 232-3). In this light, the normalisation of Sino-Russian relations provided the Chinese with the opportunity to seek cooperation in the field of space, especially with regards to China's eventual *Shenzhou* programme. In March 1994, a formal space cooperation agreement was signed in Moscow between the Russian Space Agency (RKA) and the Chinese National Space Administration (CNSA),[161] which was followed by a visit by President Jiang to the Russian flight control centre in September of the same year. A second space

[161] In 1993, the CNSA was formed, when the Ministry of Space Industry was split into CNSA and the China Aerospace Corporation (CASC). CNA is the principal Chinese space agency responsible for space cooperation with foreign countries. CASC is the leading organisation of the space industry and plays a prominent role in efforts to foster technological innovation and civil-military integration. On CASC, see Pollpeter (2011).

cooperation agreement was signed in 1996. As part of the burgeoning partnership with Russia, the Chinese bought critical equipment related to the human spaceflight programme, including an entire support life system, a spacesuit, rocket engines, a docking module, and a rendezvous system. They also purchased a complete *Soyuz* capsule, but without its electronics or any of its equipment. Another important aspect of space cooperation with Moscow was astronaut training, medicine, and supervision (Harvey, 2004: 248-51). Yet, the Chinese side felt discontent with what was seen as 'patronizing and opportunistic Russian behavior' (Kulacki and Lewis, 2009: 26).

Be that as it may, although the Chinese would later downplay the impact of Russian equipment and technology transfer on the success of China's human spaceflight endeavour, bilateral cooperation with Russia proved to be crucial in the development of China's spacecraft (Cheung, 2009: 253; Moltz, 2012: 88). Indeed, there has been some debate about the extent to which the Chinese have copied the Russian Soyuz space capsule. In response to comments and comparisons with the Russian spacecraft, Xie Mingbao, the director of the Human Spaceflight Project Office, recognised that Chinese experts 'learned much from their Russian counterparts in spaceship designing', but added that the Chinese spacecraft 'is not a replica' of *Soyuz* 'and it is more comfortable' with 'more functions' (People's Daily, 2003). According to Harvey (2004: 264), while it is clear that the *Shenzhou* spacecraft reflects the influence of the *Soyuz* design, it is also apparent that it is not a mere copy of it.[162]

Launching the First Human Spaceflight Mission *Shenzhou* 5

Delays in meeting the deadline of launching *Shenzhou 1* by 1997 reopened the question of whether China should cancel the project, but it was decided that a modified test capsule should be used for the first launch, which was rescheduled for October 1999. As a consequence, in addition to the fiftieth anniversary of the PRC and the Macao handover, the flight of *Shenzhou 1* became one of the most important priorities of the Party Central Committee in 1999 (Kulacki and Lewis, 2009: 26-7). Eventually, on 20 November 1999, a CZ-2F rocket carried in orbit the first unpiloted precursor flight of China's spaceship, *Shenzhou 1,* which returned to Earth after 14 orbits. President Jiang Zemin is reportedly credited with giving the name *Shenzhou*

[162] For a detailed comparison of the two spacecrafts, see Harvey (2004: 261-6).

(usually translated in English as ‘magic vessel’ or ‘divine craft’) to the Chinese spacecraft and he personally inscribed the calligraphy of the two Chinese characters painted on its cabin (Gittings, 1999). On board *Shenzhou 1* there were also the flags of China, Hong Kong, and Macao. After *Shenzhou 1* returned to Earth, President Jiang personally opened its cabin in the presence of Vice-President Hu Jintao and other senior members of the Chinese leadership (Harvey, 2004: 261). Three other unpiloted test flights of the *Shenzhou* spacecraft followed the launch of *Shenzhou 1*, reflective of the degree of risk aversion of the Chinese leadership regarding human spaceflight. These were: *Shenzhou 2* in January 2001, *Shenzhou 3* in March 2002, and *Shenzhou 4* in December 2002.[163]

Therefore, the stage was set for China’s first human spaceflight mission. On 15 October 2003, *Shenzhou 5* blasted successfully into orbit carrying Yang Liwei, China’s first astronaut. This made China only the third country in the world, after the Soviet Union and the United States, to put a human in space. Before the flight, Yang was quoted as saying ‘I will not disappoint the motherland…And I will gain honor for the People’s Liberation Army and for the Chinese nation’. President Hu, who was present at the launch remarked that the mission ‘is a glory for our great motherland’ and signals ‘another historically significant step forward…toward conquering the summit of world science and technology (Yardley, 2003).

After spending 21 hours in space, Yang returned to Earth to a hero’s welcome, sparking celebrations. ‘I feel proud of my motherland’ China’s first astronaut said when he exited the capsule (Agence France-Presse, 2003b).[164] In the aftermath of the historic spaceflight mission, Yang became instantly a national icon and a symbol of national unity and patriotism. In November of the same year, at a high-profile ceremony organised by the Central Committee of the CCP, the State Council, and the Central Military Commission, Yang was conferred the title of ‘space hero’ (Xinhua, 2003b). Furthermore, soon after his flight, ‘Great Hero Yang’ visited Hong Kong, Macao and other Chinese cities in an apparent bid to bolster Chinese nationalism.[165] The practice of turning Chinese astronauts into ambassadors for the Chinese

[163] For an overview of these missions, see Harvey (2004: 259-82).

[164] However, it later transpired that when Yang emerged from the capsule his face was covered in blood as a result of extreme G-force pressure during re-entering the Earth’s atmosphere. Workers were quick to wipe the blood from his face, fastened him back in the cabin, and closed the door. It was only after that the cameras arrived (Jacobs, 2010).

[165] For a trenchant analysis of these visits in particular and the role of Yang as an icon in general, see Hansen (2007).

government and the nation continued to be a feature of the next *Shenzhou* missions. As Sheehan (2013: 110) points out, whereas the Soviet Union used to send its cosmonauts abroad as symbols of international prestige, China prefers to send them to the mainland and its autonomous administrative regions as a way to promote 'patriotism, scientific awareness and national unity'.

What is noteworthy is that Xie Mingbao was rather straightforward about the political value and techno-nationalist rationale of the mission, stating, 'We believe this outstanding and remarkable achievement would certainly…give rise to more patriotic fervor and national cohesion among the Chinese people'. The Chinese official added, 'we believe China must possess independently the technology to realize space travel…It's also a way for us to boost national esteem and hope for China's future development' (Pomfret, 2003).

Shenzhou Missions 6 – 10 and the Space Station *Tiangong 1*

Since *Shenzhou 5*, China has successfully launched four other human spaceflight missions. In October 2005, *Shenzhou 6* orbited space for five days carrying two astronauts, which was followed by a three-man crew mission, *Shenzhou 7* in September 2008. During the mission, Chinese astronaut Zhai Zhigang performed China's first spacewalk, waving a small Chinese flag (Barboza, 2008). In another milestone for the space programme, in September 2011 China launched its first space laboratory module, *Tiangong 1* (Heavenly Palace), as a test bed for the ultimate goal of placing a larger 60-tonne space station in orbit around 2020. In December of the same year, the unpiloted *Shenzhou 8* successfully docked with *Tiangong 1*, which was the country's first space docking mission (Xinhua, 2011). This was accompanied by the launch of *Shenzhou 9*, a three-person crew, including China's first female astronaut, Liu Yang. *Shenzhou 9* docked with the Chinese space station marking the first crewed space docking mission (Amos, 2012). Like *Shenzhou 9*, China's fifth spaceflight mission, *Shenzhou 10,* which orbited space in June 2013, also carried a crew of three and docked with the space station. This was the most recent human spaceflight mission. It signalled the end of a ‘trial-and-error period’ and the beginning of the operational phase of the human spaceflight programme (Chen, 2013).[166]

What should be added is that the new Chinese leadership under Xi Jinping continues to attach great importance to the Chinese space programme through visits to space facilities and public utterances (A. Jones, 2014). Indeed, President Xi has linked China’s space effort to his slogan of the ‘China Dream’ of rejuvenating the Chinese nation, which he put forth when he took over the top post of the CCP in November 2012.[167] During his talk to the crew members of *Shenzhou 10* onboard the orbiting *Tiangong 1,* the Chinese leader noted that ‘the space dream is part of the dream to make China stronger. With the development of space programs, the Chinese people will take bigger strides to explore further into space’ (Xinhua, 2013c).[168] Briefly stated, political support has been a crucial variable affecting the success of China’s human spaceflight programme and this continues to be the case under the leadership of Xi.

Space Exploration

China’s Lunar Exploration Programme

China’s Lunar Exploration Programme (CLEP) has carried out four lunar missions thus far, as part of a three-step Moon probe project.[169] The programme will be completed with an eventual lunar sample return mission. The first phase of the programme focused on orbiting and taking images of the Moon. It began in October 2007 with the launch of *Chang’e 1* lunar probe, named after the Moon goddess in Chinese mythology. *Chang’e 1* orbited the Moon providing a full map of the lunar surface along with other performances. This was followed by the launch of China’s second lunar probe, *Chang’e 2,* in October 2010, which also orbited the Moon, testing critical technologies and gathering data for future landings. Then, in December 2013,

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[166] Tiangong 2, China’s second space station, is scheduled for launch in September 2016 and *Shenzhou 11* in the following month in order to dock with the space station (China Central Television, 2016b). Recently, the Human Spaceflight Office publicly proposed landing astronauts on the Moon by 2031-36 as a follow-up mission to the space station, however such as a mission has not been formally approved yet (Perret, 2016).

[167] For an insightful analysis of the ‘China dream’ and its multiple meanings, see Callahan (2013).

[168] However, under the leadership of Xi, it seems that there has been a turn towards restricting the amount of information available about China’s space programme (M. Jones, 2014).

[169] For an overview of China’s lunar programme, see, inter alia, Pollpeter et al. (2015: 53-60); and Harvey (2013: 311-40).

the *Chang'e 3* mission was launched with the aim of studying the lunar surface. This mission marked the second phase of the CLEP programme and involved landing a robotic rover named *Yutu* (Jade Rabbit).[170] It was the first soft landing on the Moon after 37 years and made China the third country ever to perform such a mission, after the Soviet Union and the United States. The latest lunar exploration mission to date was the launch of an experimental spacecraft nicknamed 'Xiaofei' (little flyer), which conducted a lunar flyby before returning to Earth in November 2014. It was designed to pave the way for the *Chang'e 5*, which will signal the third phase of the CLEP programme (Xinhua, 2014b).

Like other key Chinese space projects, the CLEM programme traces its origins in the proposals and initiatives of a small group of influential scientists. It was Ouyang Ziyuan, a leading geologist and director of the Institute for Geochemistry of the Chinese Academy of Sciences, who started advocating strongly for a first lunar mission on political grounds in the early 1990s. By and by, Ouyang managed to get the support of other high-profile scientists like Min Guirong. But although Ouyang convinced the central government to consider his proposal, it was eventually turned down because it was driven by political motivations without much scientific value. However, Min, as director of an aerospace group funded by the 863 Plan, suggested the creation of a task force for a lunar mission, which resulted in the continuation of work on Ouyang's proposal. In 1993, the newly founded CNSA, under the leadership of its Administrator Liu Jiyuan and Deputy Administrator Luan Enjie, carried out its own proposal for a lunar mission, which was also rejected by the central government. Undeterred, however, advocates continued to tout their idea for a lunar project (Besha, 2010: 215-7).

Indeed, in 1997, CAS academicians Yang Jiachi, Wang Daheng and Chen Fangyun, the three of the four scientists who had proposed the 863 Plan to Deng, drafted the 'Proposal for Development of Our Nation's Lunar Exploration Technology' under the 863 programme. Consequently, in 1998, a plan for the development of robotic technology for a future lunar mission was approved (He, 2003: 2354). In the same year, as part of major organisational reforms, COSTIND was civilianised and placed under the State Council, while all its previous military functions were transferred to

[170] The name *Yutu* was selected in an online poll of 3.4 million voters and it is a reference to the pet rabbit of goddess *Chang'e* in Chinese mythology (Rincon, 2013).

the newly established General Armament Department (GAD) under the Central Military Commission. This major restructure reduced COSTIND's influence and ties to the military, but COSTIND took control of the CNSA.[171] As a result, Luan Enjie, a strong advocate of a lunar programme, was promoted to administrator of CNSA and deputy director of COSTIND. Luan was keen to exert his new bureaucratic influence in order to establish the development of a long-term lunar programme by advocating the idea to top policy makers. Meanwhile, in 2000, the CAS lunar team with the support of several CAS centres submitted a final report that elaborated on the scientific significance of a lunar programme. Among other things, the report suggested that such a programme could contribute to the recovery of lunar-based Helium-3 fusion fuel. It also suggested a three-phase exploration road map similar to its current form. The net effect of these efforts was that a plan for undertaking a three-pronged lunar exploration programme was formally approved by the Chinese leadership in January 2004 (Besha, 2010: 217-8). In 2011, China also announced its tentative plans for a human lunar landing by 2025 (State Council of the People's Republic of China, 2011).

A number of points are worth making here in order to explain the broader significance of the project. First, several of its drivers are usually identified in the relevant literature, including: international prestige, national pride, scientific research, military spin-offs, access to mineral resources, and geopolitical considerations (Pollpeter et al., 2015: 54; He, 2003: 2353-4; Lele, 2010).[172] Yet, one of the motivating factors behind China's lunar exploration programme that has attracted much attention is access to lunar mineral and energy resources. Indeed, Ouyang, who was appointed chief designer of the CLEM, frequently talks about the significance of exploring the Moon for Helium-3 and other resources.[173] Yet, while the prospect of Moon mining might become a reality, albeit in the quite distant future, as Johnson-Freese (2013a: 63) observes, this justification of lunar exploration can also be seen as an attempt by scientists to address political concerns about the economic value of such missions.[174]

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[171] For the significance of these reforms, see Cheung (2009: 112-8).

[172] It is worth noting here that space is mentioned in popular Chinese political texts that reflect what Hughes (2011b: 605, 606) calls 'geopolitik nationalism', that is, the growing merging of nationalism and geopolitical thinking.

[173] See, for example, China Daily (2006); People's Daily (2007); and Ouyang (2009).

[174] Interestingly, Ouzang has also publicly suggested that China, India, and Japan should cooperate in lunar exploration to 'deepen mankind's understanding of the moon' (Xinhua, 2008a).

Second, it should be noted that the implementation of the lunar programme has also been mirroring the management style and organisational structure associated with the *Liangdan Yixing* legacy. Significantly, in February 2004 the Central Committee of the CCP and the State Council formed a Leading Small Group (LSG) for the Lunar Orbiter Project, as a top-level coordination mechanism. It is also likely that the Central Party Committee created a Lunar Probe Project Office under its auspices, similar to the Human Spaceflight Project Office. This means that the highest echelons of the Chinese leadership undertake the management of the lunar programme in ways that support cross-agency coordination and civilian-military cooperation. Thus, leaders from key ministries and institutions are involved in the implementation of the CLEP. The LSG appointed Luan Enjie as General Manager, Sun Jiadong as Chief Designer, and Ouyang Ziyuan as Chief Scientist of the project (Besha, 2010: 218-9).

Third, and more importantly for the purposes of this discussion, it is necessary to highlight that the political status and function of the CLEP reflects the enduring influence of a postcolonial techno-nationalist ideology. In fact, Chinese officials have emphasised that the CLEP contributes to the country's comprehensive national power (CNP) (Pollpeter et al., 2015: 53).[175] Tellingly enough, in October 2000, expounding on the goals of China's human spaceflight and exploration programmes, Luan Enjie, who was then the director of CNSA, outlined a postcolonial techno-nationalist rationale behind the space programme, which is worth quoting at length:

> Presently the development of space technologies and the level of their applications becomes [sic] an indicator of *a nation's united power and development of its civilization*... The Chinese aerospace program has actively contributed to the global space development and is *an integral part of the world space [community]*...Under the future integrated national planning and unified leadership, and following the strategic guidance of 'strengthening the nation through science and education' and 'sustainable development', and through domestic research and development and international cooperation, ... the Chinese space program will select limited goals to achieve breakthroughs, sustain development, and promote technological innovation. This will enhance research and setting up the infrastructure, achieve breakthroughs in key space technologies, advance technical levels and basic capabilities, and maintain China's position as a space leader internationally (Wei 2000, emphasis added).

[175] 'Comprehensive power' refers to the idea, shared among Chinese strategists, that power is multidimensional, comprehensive and integrative, and thus its pursuit requires the cultivation of power across different domains of social activity, including science and technology (Shambaugh, 2013: 5-6).

Moreover, Ouyang has emphasised that the US Apollo Moon landing programme of the 1960s and 1970s resulted in the advancement of US science and technology and its economic take-off. For this reason, China's Moon probing project is 'the job that has to be done'. Equally remarkably, elaborating on the question of why China should try to 'reach the moon' considering the many economic, social, and environmental issues that the country is still facing, Ouyang said: 'This is precisely because the moon probing suggests a nation's comprehensive national strength and it is of significance to increasing China's international prestige and the cohesive power of the Chinese nation…Furthermore, mineral deposits, energy resources and environment on the moon constitute a crucial sphere for the humankind and, if China fails to make any inquires into this sphere, the country accordingly will not have any right to speak about in this regard' (People's Daily, 2007).[176]

Mars Exploration

Similar political considerations have also underpinned China's Mars exploration ambitions. In 2003, it was reported that China had conducted a planetary exploration study as part of the 863 programme, including Mars. Subsequently, in March 2007, China entered into an agreement with Russia, which would allow a small Chinese Mars satellite, called *Yinghuo 1,* to be launched in tandem with the Russian Phobos-Grunt sample return spacecraft.[177] In November 2011, *Yinghuo 1* was launched piggy-back on the Russian spacecraft, but it failed to leave Earth orbit, putting a premature end to China's first planetary mission (Harvey, 2013: 330-4). However, in 2014, Chinese scientists announced that there are plans for sending a Mars rover around 2020. These plans reflect mounting pressure on China to conduct a high-profile Mars mission after India successfully launched its Mars Orbiter Mission (MOM) in 2013, becoming the first Asian country to reach the Red Planet. This has been evident in recent statements made by Chinese scientists who advocate a Mars exploration mission. For example, Ye Peijian, a leading design adviser for China's lunar probes and a strong supporter for such a mission has been quoted as saying, 'India has gone

[176] A very similar argument has been put forward by Ouzhang in a co-authored article with his CAS colleagues: 'Lunar exploration is a hotspot for spaceflight nowadays in the world, and also an important reflection of a country's comprehensive national strength and science and technology level. It may strengthen China's international influence and national cohesion' (Zheng et al., 2008: 882)
[177] *Yinhuo* means 'firefly' in Chinese and it is an ancient reference to Mars.

ahead of us…We already lag behind (India) in time, so we should do it better' (Yu, 2014). It appears that these efforts to place a Mars programme on the agenda have recently paid off. According to Xu Dazhe, the current director of the CNSA, the Chinese government approved a Mars probe mission in January 2016 (Xinhua, 2016a).

In sum, postcolonial techno-nationalism continues to exert a powerful influence on the pursuit of key Chinese space projects, such as human spaceflight and space exploration programmes, as markers of national strength, great power status, and modernity. Chinese elites believe that the development of such high visibility space projects can enhance China's position and status as a full-fledged member in international space society and give China a seat at the table and possibly a significant role in shaping and maintaining international space order. Crucially, a key aspect of this process remains the intersection between high politics and big science as well as between the political leadership and the scientific community in China.

Space Militarisation

The lack of transparency in China's military policies and the inherent dual-use of space technology make any accurate observation about China's military space capabilities a daunting task. It is clear, however, that the utilisation of space assets is becoming increasingly important to China's current military modernisation efforts. The Gulf War of 1991, which some analysts refer to as the 'first space war', led to a profound reassessment of China's key military concepts of operations and doctrines in tandem with a growing appreciation of the impact of space capabilities on modern warfare (Cheng, 2012: 57-8; Liao, 2005: 206, 208). As part of this reassessment, the new doctrine of 'local wars under modern high-tech conditions' was introduced with priority placed on the R&D of a wide range of more advanced technological capabilities. These included: upgrading ballistic missiles development and precision-guided munitions, acquiring the ability to conduct electronic warfare and electronic countermeasures, developing satellites, early warning and command systems, as well as communication relay stations (Shambaugh, 2004: 70).

The so-called 'Revolution in Military Affairs' (RMA), the transition to information warfare (IW), the 1995-96 Taiwan Strait crisis, the NATO intervention against Serbia in 1999, and the more recent US-led campaigns in Afghanistan and Iraq further precipitated this process.[178] Therefore, in 2002, the phrase 'limited war under high-technology conditions' was changed to 'local wars under modern informationalized conditions' (Finkelstein, 2007: 104). Two years later, Hu Jintao, the then president of China, announced the PLA's 'new historic missions'. One of the most important of these missions called for safeguarding China's national interests that have now expanded to also include access to space and the electromagnetic sphere (Cheng, 2012: 61). This emphasis on the military uses of space has continued under the leadership of Xi. In 2014, the Chinese President urged the air force 'to speed up air and space integration and sharpen their offensive and defensive capabilities' (Blanchard, 2014). Likewise, China's most recent Defence White Paper has identified outer space as a 'commanding height in international strategic competition' (State Council of the People's Republic of China, 2015).

Satellites

In light of the above, there has been a growing interest in the development of dual-use satellites for communications, reconnaissance, navigation, meteorology, electronic intelligence (ELINT), and signals intelligence (SIGINT) collection as a force multiplier. The rapid growth of China's satellites constitutes a crucial component of the PLA's expanding operations, like power-projection, precision-strike and anti-access/area denial (A2/AD) operations, by enhancing command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) capabilities. Of particular significance in this regard has been the effort to build a variety of high-resolution remote sensing satellites that provide critical military reconnaissance and surveillance capabilities (Hagt and Durnin, 2011). China is in the process of deploying a network of reconnaissance-capable and data relay satellites providing real-time images that could support targeting and tactical operations in the future. For example, the *Yaogan* series of remote sensing satellites are equipped with electro-optic sensors and synthetic aperture radar (SAR) that provide high-resolution

[178] For a good overview of the impact of these external pressures on Chinese doctrines and training in the post-Cold War era, see Shambaugh (2004: 74-89). For an account of China's national military strategy, see, for example, Finkelstein (2007).

imaging.[179] It is also believed that some *Yaogan* satellites serve as electronic intelligence (ELINT) platforms (Hagt and Durnin, 2011: 751, 740). As we saw earlier, China has also built the *Haiyang* series of ocean monitoring satellites and the *Huanjing* series of satellites designed for environmental and disaster monitoring. These three types of satellites are suited for the task of maritime surveillance and contribute to the country's targeting capabilities (Erickson, 2011: 15).

More recently, the last of the *Gaofen* satellites, *Gaofen -4,* was put in geostationary orbit in December 2015 and it is reportedly designed for both civilian and military applications, including locating and targeting US carriers (Minnick, 2015; A. Jones, 2015d; Lin and Singer, 2016). China simultaneously is developing the new *Zhongxing* series of military communications satellites (A. Jones, 2015c). In September 2015, China also launched a classified satellite, which could possibly be a test for a missile early warning system (A. Jones, 2015a). As mentioned previously, important progress has also been made in completing the Beidou system. When completed, it will provide global coverage allowing China to reduce its dependency on the US GPS, access to which could be denied to any US adversary during conflict (Pollpeter et al., 2015: 73; Hu 2015; Xinhua 2016b). According to a retired senior Chinese military official, this is what actually happened during the 1995-96 Taiwan Strait crisis, when a sudden disruption of GPS signals led the Chinese military to lose track of its targets.[180] As the official notes, 'It was a great shame for the PLA ...an unforgettable humiliation. That's how we made up our mind to develop our own global [satellite] navigation and positioning system, no matter how huge the cost', adding that 'Beidou is a must for us. We learned it the hard way' (Chan, 2009).

Counterspace Capabilities

China's focus on acquiring a variety of counterspace capabilities has attracted much attention in recent years, especially after its direct-ascent ASAT test in 2007 (Tellis 2007; U.S. China Economic and Security Review Commission 2015: 272-337; Heginbotham et. al. 2015: 245-58). In addition to ASAT capabilities (more on which

[179] The development of satellite-based Synthetic Aperture Radar (SAR) technology was one of the main projects under the 863 Plan. See Feigenbaum (2003: 169, 179-80).

[180] On the 1995-96 Taiwan Strait crisis, among others, see Ross (2000); Whiting (2001); Scobell (2003: 171-91). For an insightful account of the politics of China-Taiwan relations of this period, see Hughes (1997).

below), it is believed that China is developing a multidimensional counterspace programme, including 'jamming, laser, microwave, and cyber weapons' (US Department of Defense, 2012: 9). For instance, a ground-based laser operating from China allegedly 'blinded' one US satellite in 2006. However, shortly after, Donald Kerr, the director of the US National Reconnaissance Office (NRO), confirmed that a Chinese laser might have 'illuminated' one or more US satellites, but 'it did not materially damage the U.S. satellite's ability to collect information', something that 'blinded' usually implies (Space News Editor, 2006; Kessler 2011). Assessing whether China intentionally tried to illuminate US satellites is very difficult due to the lack of available information, but it is important to note that using laser-ranging techniques can also be part of regular non-military space activities like tracking the orbit of a satellite. Besides, many analysts have pointed out that ground-based lasers are not an effective ASAT weapon (Reuters, 2006; Kessler, 2011; Kulacki, 2014: 10).

Moreover, China reportedly conducted unusual rendezvous and proximity operations (RPO) of two Chinese satellites in 2010 (Weeden, 2010). Similar orbital manoeuvres were also carried out in 2013 (Smith, 2013; David 2013), which most likely involved space robotic arm technology (Pollpeter, 2013: 1). Yet, while these operations could possibly indicate the development of co-orbital ASAT technology, it is more likely that they were a demonstration of a non-military capability related to orbital satellite inspection (Weeden, 2010; Kulacki, 2014: 10).[181] But again, not only do such activities serve to highlight how the boundary between civilian and military applications in space is rather blurred, but also point to the difficulty of determining intentions in the absence of trust and transparency. Having said that, what is clear is that China is pursuing a direct-ascent ASAT programme. It is worth considering this in some detail.

[181] Robotic arms also have several non-military applications, such as satellite maintenance and space debris removal (Pollpeter, 2013: 2).

ASAT Capabilities

The 2007 Chinese ASAT Test

On 11 January 2007, the People's Liberation Army (PLA) successfully used a direct-ascent kinetic kill vehicle to destroy a defunct FengYun-1C (FY-1C) Chinese weather satellite.[182] The vehicle crashed into the FY-1C satellite utterly destroying it and breaking it up into an estimated 35,000 orbital debris objects, making the test the 'worst single debris event ever' (Milowicki and Johnson-Freese, 2008: 2; Morring 2007). The test has been subject to much analysis and needs little repetition here.[183] But a few observations are worth making about its intentions and motivations. First, in the absence of any official explanation offered by the Chinese government, several motives have been identified in the relevant literature. For example, from a realist perspective, it has been argued that the test was indicative of China's broader strategy to counterbalance US military space superiority, reflecting Chinese beliefs about the inevitability of conflict in space (Tellis, 2007). Others have suggested that the test was part of China's effort to cajole the United States into negotiating a treaty banning space weapons and space-based missile defence.[184] It has also been postulated that the test was intended to send a 'deterrence message' that the United States cannot fully depend on the use of space-based assets in the event of a conflict with China over Taiwan (Krepon, 2008: 162).[185]

Second, it was after twelve days that a confirmation of the test was provided by the Chinese Ministry of Foreign Affairs, a period during which the Ministry appeared to be unaware of its conduct. This prompted analysts to question whether the PLA proceeded with the test without advising key constituencies of the foreign policy and security apparatus, suggesting signs of emerging factionalism between the Ministry of Foreign Affairs and the PLA (Gill and Kleiber, 2007). But it is most likely that the

[182] It has been reported that China attempted two other times to test the system. On 7 July, 2005, the system was tested without striking a known target. On 6 February, the second test of the system occurred with the missile passing near a satellite target without hitting it. It is not clear whether the intention was to approximate the target or strike it. In both cases Washington remained silent, without issuing a demarche (Gordon and Cloud, 2007).

[183] On China's ASAT test, see, inter alia, Tellis (2007); Saunders and Lutes (2007); Lieggi and Quam (2007); Krepon (2008); and Milowicki and Johnson-Freese (2008).

[184] For a brief overview of these possible explanations, see Hitchens (2007: 15).

[185] On the role of space-based assets during a Taiwan Strait conflict, see, for example, O' Hanlon (2004: 91-104).

highest levels in the government hierarchy had approved the test and were informed about its conduct (Mulvenon, 2007: 5, Gill and Kleiber, 2007: 3, Cheung 2009: 254).

However, while most Western analysts have placed emphasis on the United States as the key driver behind the Chinese ASAT test, based on interviews with Chinese experts, Kulacki and Lewis (2008) have put forward a more plausible explanation. According to Kulacki and Lewis (2008: 337) it seems that all of the key parts of the Chinese bureaucracy were aware of the test, but they did not coordinate well, and the key determinant for the decision to conduct the ASAT test was 'the maturity of the technology'. More specifically, it is likely that the project managers pushed for the test because they were under pressure to demonstrate to the leadership that they had developed a technological capability ready to be used. It is also likely that the decision to conduct an ASAT test, instead of a missile intercept, was taken on the basis that targeting a satellite was easier than intercepting a missile (Kulacki and Lewis, 2008: 337). In some ways, therefore, this would be in line with the influence of techno-nationalists in the history of the Chinese missile and space programme. Equally importantly, Kulacki and Lewis (2008: 336) suggest that the ASAT test was part of an R&D programme, which began in the mid-1980s, without a specific military mission or objective. It is possible that it was the product of the broader reconfiguration of defence planning that occurred during that period, under Deng' leadership, with a focus on building dual-use science and technology research like the 863 Plan (Feigenbaum, 2003: 153-88; Kulacki and Lewis, 2008: 336, 343).

Other Suspected or Known ASAT Tests

On 11 January 2010, in a three-sentence statement, China announced that it had conducted a test of what was described as a 'ground-based midcourse missile interception technology' (Xinhua, 2010a). This came at a time when Beijing had expressed its fierce criticism over the prospect of arms sales by the United States to Taiwan, including advanced Patriot Pac-3 air defence missiles (Branigan, 2010). The next day, the Foreign Ministry spokeswoman Jiang Yu confirmed the test of missile interception technology by stating that it was in line with China's defensive military strategy and that it 'was defensive in nature and targeted at no country'. Significantly, it was also stressed that 'the test would neither produce space debris in orbit nor pose a threat to the safety of orbiting spacecraft' (Xinhua, 2010b).[186]

What is noteworthy is that China managed the 2010 test quite differently from the way it had handled the January 2007 ASAT test (Mulvenon, 2010). First, in contrast to the January 2007 test, China immediately issued an announcement and the Foreign Ministry spokesperson was prepared to confirm the conduct of the interception. Second, despite the fact that the test was ostensibly part of China's ASAT programme, this time it was careful to carry out the test in low orbit without creating long-lived orbital debris and calling it a missile defence test. Indeed, as indicated above, China was keen to stress that the test did not generate space debris. In doing so, Beijing was able to avoid the sort of political condemnation that accompanied the January 2007 test (Lewis, 2010; Mulvenon 2010: 1-2).[187] Then, on 27 January 2013, China conducted a second 'land-based mid-course missile interception test' similar to the one carried out in January 2010 (Xinhua, 2013a).

However, one of the most important developments in China's ASAT programme was the launch of a rocket from the Xichang Satellite Launch Centre on 13 May 2013 (Weeden, 2014: 1). China announced that the launch was a scientific 'experiment in the high-altitude atmosphere and near-Earth space' aimed at studying the space environment (Xinhua, 2013b). Yet, several US officials believe that this was the first test of a new direct ascent ASAT system (Shalal-Esa, 2013; Gertz, 2013; Gruss 2015). A Pentagon spokesperson stated that the launch 'appeared to be on a ballistic trajectory nearly to geosynchronous Earth orbit', that is roughly 30,000 km (Schanz, 2013). According to Weeden (2014: 1-19), there is evidence to suggest that the launch could have reached an apogee of around 30,000 km using a new missile, which could attack targets in medium or high earth orbits, including satellites in geostationary earth orbit (GEO).

Subsequently, on 25 July 2014, the US State Department issued a statement claiming that China had carried out 'a non-destructive' test of an ASAT system on 23 July (Gruss, 2014a; Weeden, 2015: 1). The Chinese Ministry of National Defence called the launch an 'anti-missile experiment' (Xinhua, 2014a), but Frank Rose, U.S. deputy assistant secretary of state for space and defence policy, said that 'Despite

[186] According to a 2011 February cable of the US Department of State, the US intelligence community believed that China had launched a SC-19 missile for the interception, which was used previously for the 11 January 2007 ASAT test. The United States assessed that the 2010 January test had contributed to the improvement of both Chinese ASAT and ballistic missile defence (BMD) systems (United States Department of State, 2010).

[187] For an insightful analysis of the January 2010 test and its implications, see Mulvenon (2010).

China's claims that this was not an ASAT test; let me assure you the United States has high confidence in its assessment, that the event was indeed an ASAT test' (Gruss, 2014b). On 30 October 2015, China conducted what was again claimed to be a missile defence interceptor flight test, but there have been reports suggesting that this was possibly a test of a new direct-ascent missile capable of destroying satellites (Axe, 2015, Gertz, 2015).

Be that as it may, it not clear that developing such a capability would provide China with a significant strategic advantage in the context of a conflict with the United States. For instance, the distribution and redundancy of the more than 30 US GPS satellites in medium earth orbit (MEO) means that any attempt to degrade GPS satellites would require the preparation and execution of numerous back-to-back launches of Chinese missiles hitting successfully their targets over several hours without suffering a counterattack (Weeden, 2014: 18; Sankaran, 2014: 25). As Sankaran (2014: 23-30) argues, this would be a merely impossible task, given the resilience of the US GPS constellation and the current missile and launching capabilities of China. Moreover, in the event that some US satellites are lost after an attack, terrestrial and airborne systems can perform the functions of key US military space assets, such as intelligence, surveillance, and reconnaissance (ISR) and communication satellites. Besides, any ASAT test would almost certainly risk escalating the conflict (Sankaran, 2014: 33, 30-4).

Learning How to Shoot Satellites

Notwithstanding the strategic rationale for deploying ASAT weapons, it is not surprising that these developments have raised legitimate concerns about China's intentions in space. But what merits emphasis is that the change in how China has handled and framed the tests since 2007 can be seen as evidence of a process of social learning (Mulvenon, 2010; Johnson-Freese, 2013b). It appears that China has come to recognise that any ASAT weapon risks jeopardising even its own space assets. Equally importantly, this change also points to the importance of collective pressure exerted by other key members of the international space society and China's socialisation into the emergence of a new sort of normative convergence premised on the norm of 'space sustainability'.

It is interesting and revealing that the US China Economic and Security Review Commission and US diplomats have acknowledged this social dynamic. For example, in its 2015 Report to Congress, the US China Economic and Security Review Commission notes that 'The non-debris-generating nature of the tests suggests China may have gained a better appreciation of the diplomatic costs of debris-generating antisatellite tests as well as the long-term consequences of such tests for China's own space assets' (US China Economic and Security Review Commission, 2015: 293). More recently, Mallory Stewart, the US State Department's deputy assistant secretary for emerging security challenges and defence policy, remarked that 'there have been subsequent tests by China, but none of them have been debris generating', which the State Department likes to credit to 'the huge international outcry' that followed the January 2007 test (Gruss, 2016). At the same time, however, the continuation of the ASAT programme also reflects the dark side of this socialisation process, given the general trend towards the militarisation of space in international space society. Finally, the quest for possessing ASAT capabilities as an indicator of great power status and modernity should not be underestimated, especially considering their limited strategic rationale.

Space Diplomacy

One of the most important aspects of China's space diplomacy has been a focus on multilateral approaches to space arms control within the UN.[188] In February 2000, the Chinese delegation issued a working paper to the Conference on Disarmament (CD), entitled 'China's Position on and Suggestions for Ways to Address the Issue of Prevention of an Arms Race in Outer Space at the Conference on Disarmament'. In the paper, China tacitly acknowledged that space has been militarised, albeit 'to some extent', through the use of military satellites, but it suggested that 'their role should be all together negated' (Hu, 2000: 5). It also called for the prevention of the weaponisation of an arms race in space based on the 'basic obligations' of 'not to test, deploy or use weapons, weapon systems or components' (Hu, 2000: 5).

[188] On why the UN is generally favoured by China, see Foot (2014). For excellent overviews of China's opposition against the weaponisation of space at the CD, albeit somewhat outdated, see Lewis (2007: 171-92); and Zhang (2008).

In June 2001, the Chinese delegation issued another working paper that elaborated on its 2000 paper and put forward a possible 'Treaty on the Prevention of the Weaponization of Outer Space'. Then, in 2002, China submitted a joint proposal with Russia to the CD on 'Possible Elements of the Future International Legal Instrument on the Prevention of Deployment of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects'. Combining elements from the Chinese treaty proposal and a previous Russian treaty proposal from 1983, this was essentially a new space arms control initiative after several years. It urged states 'not to place in orbit or around the Earth any object carrying any kinds of weapons' and 'not to resort to the threat or use of force against outer space object' (Hu and Skotnikov, 2002: 3). Yet, in addition to the lack of specific verification measures, the treaty did not include a definition of 'weapons'. Also, unlike China's 2001 proposal, it did not suggest the prohibition of testing space-to-space, ground-to-space, or sea-to-space weapons (Moltz, 2012: 92-3).

As we saw in chapter 2, in 2008 China and Russia also submitted at the CD a draft for a legally binding 'Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force Against Outer Space Objects' (PPWT), but the proposal received mix reactions, especially given that it followed China's 2007 ASAT test. The 2014 updated draft PPWT by China and Russia remains controversial because it addresses weapons in space, but it allows for the use of kinetic energy ASATs of the type that China used in 2007.

Nevertheless, it is important to note that China has played a constructive role in the formation of the 2007 Space Debris Mitigation Guidelines as one of the thirteen members of the Inter-Agency Space Debris Coordination Committee (IADC) (United Nations Office for Outer Space Affairs, 2010). It is also a member of the UNCOPUOS Working Group on the Long-term Sustainability of Outer Space Activities (C. Johnson, 2014b). Furthermore, China has participated in the UN Group of Governmental Experts (GGE) on Transparency and Confidence-building Measures in Outer Space Activities (TCBMs), a key space sustainability and space security initiative within the UN framework (C. Johnson, 2014a).

In terms of bilateral space cooperation, China has increased space contacts with a number of countries and organisations, including Russia, Brazil, ESA, France, UK, Germany, Nigeria, Venezuela, Argentina, Ukraine and Belarus.[189] What is more, China has been active in the promotion of regionalism with the establishment of the Asia-Pacific Space Cooperation Organization (APSCO) that started officially operating in 2008. With its headquarters in Beijing, APSCO consists of eight member states: China, Bangladesh, Iran, Mongolia, Pakistan, Peru, Thailand and Turkey. APSCO's aims include the promotion of 'multilateral cooperation in space science and technology' with an emphasis on 'development and research, space technology application and training of space experts' (Xinhua, 2008b).[190] The creation of APSCO clearly indicates China's desire to establish itself as a space leader in the Asia-Pacific (Pollpeter, 2008: 32; Moltz, 2012: 94).

Balance of Power

There is evidence to suggest that a sort of adversarial balancing has been taking place in recent years in the context of the US-China rivalry and the ASAT tests. A detailed analysis of China's balancing behaviour or balancing Chinese space power is beyond the scope of this study, but it is worth highlighting some aspects of what form this has taken thus far and what this can tell us about balance of power as a primary institution of international space society. First, while much attention has been paid, and rightly so, to the relations between the United States and China as a possible expression of adversarial balancing behaviour, there is also some evidence that balancing may have a regional dimension. As we shall see in the next chapter, the 2007 Chinese ASAT test has had the effect of prompting India to accelerate the development of its military space capabilities, which has been exacerbated by the increasing space cooperation between China and Pakistan. The notion of an Asian space race, especially between China and India, is also suggestive of some 'soft' balancing. Another key example here is Japan's increasing interest in the military uses of space, which is partly a response to China.[191] In 2008, Japan entered into force the Basic Space Law that allows for the first time the military uses of space, shifting its decades old normative

[189] For a more detailed overview of most of these cooperative activities, see Pollpeter et al. (2015: 25-35). For a good overview of Sino-Russian space relations, see Perfilyev (2010). On Sino-Latin American space cooperation, see Delgado-López (2012).

[190] More information on APSCO's activities and programmes can be found at the organisation's site: http://www.apsco.int/.

[191] For a detailed account of Japan's space programme, see Pekkanen and Kallernder-Umezu (2010).

emphasis on 'peaceful purposes' under its pacifist restraints.[192] Based on the Basic Space Law, Japan formulated the Basic Space Plan in 2009, which includes explicit references to the utilisation of space for national security purposes (Secretariat of Strategic Headquarters for Space Policy, 2009).

Second, this regional dimension is compounded by the series of bilateral security relationships that the United States has formed with its close allies in the Asia-Pacific, known as the 'hub-and-spokes' system. Crucially, a space component has become more prominent in the US alliance relationships as part of the US 'pivot' or 'rebalancing' to Asia under the Obama administration.[193] For example, in recent years, the United States and Japan have taken key steps towards expanding their military cooperation in the domain of space as part of their 'comprehensive dialogue on space' and the 2015 revised US-Japan Defence Guidelines. Several areas of military space cooperation have been identified, including space situational awareness (SSA) and maritime surveillance from space (Pekkanen, 2015, Kyodo News, 2015). At the same time, the United States has also extended its space cooperation with Australia and South Korea with an initiative on tackling space debris (McGuirk, 2012; Kim, 2015).

However, one of the most widely noted attempts at balancing in space has been China's initial participation in the EU's Galileo navigation satellite system. Indeed, several authors have argued that Sino-European space cooperation represented a form of balancing in response to the US quest for space hegemony and growing unilateralism under the Bush administration. For example, Johnson-Freese and Erickson (2006) have called the space partnership between the EU and China 'a geotechnical balancer', while Casarini (2009: 108; 89) has described it as 'a soft balancing initiative' aimed at establishing EU independence from the United States. In a rather similar vein, according to Wang (2009: 456), the Galileo case constituted a 'pragmatic and flexible balance of geopolitical interests'. Bolton (2009) has even suggested that Galileo has been an attempt to balance against the power of the United States, as neorealists would typically expect.

Therefore, with the benefit of hindsight, it is worth saying something more about this interesting case as it helps to illuminate the possibilities and limits of adversarial balancing in space. In October 2003, China signed an agreement with the EU

[192] On the Basic Space Law, see, inter alia, Suzuki (2008); Aoki (2009); and Maeda (2009).
[193] For an insightful account of the US 'pivot' to Asia, see Silove (2016).

concerning the joint development of the Galileo global navigation satellite system, which was envisaged as an alternative to the US GPS. Under the agreement, China pledged to contribute approximately €200 million to the programme. Clearly, this has been one of the most important and high profile agreements ever reached between China and the EU and marked the beginning of what was described then as a 'comprehensive strategic partnership'. Despite the fact that Europeans had free access to the GPS system, the decision to build Galileo was largely driven by a growing concern about the possibility that the United States could deny the use of the GPS system to others. In the early 2000s, this concern was reinforced by the unilateralist impulses of the Bush administration and the growing emphasis on 'space control' and 'space power' in Pentagon documents. As a result, the Galileo system was seen to be necessary in order to reduce the EU's reliance on the GPS and to secure its strategic and technological independence from the United States. Further, the Galileo system was intended to enhance European competiveness by ensuring that Europe could take a share of the lucrative global market for navigation satellite services (European Commission, 1999; Johnson-Freese, 2007: 13-5; Casarini, 2009: 106-11).

Consequently, these strategic and commercial considerations have had a significant impact on the EU's decision to invite China to collaborate in the Galileo system. In particular, Europe saw Chinese participation in the Galileo programme as a way to access the potentially lucrative Chinese space market. For China, participating in the programme offered an opportunity to access strategic technology and know-how (Casarini, 2009: 105).

Not surprisingly, however, at a time when a zero-sum approach in space had become prevalent in Washington, the development of Galileo was perceived as a possible challenge to US dominance in satellite navigation. The United States was also concerned about the potential of the Galileo's commercial signals to overlap with the GPS signals used by the US military. Eventually, in 2004, an agreement signed between the two sides ended this dispute. However, one of the main US objections to the European plans for Galileo was centred on the potential of technology transfer raised by Chinese participation (Johnson-Freese, 2007: 190-4, 14-5).

Nonetheless, Sino-European cooperation on the Galileo system was short-lived due to a confluence of several factors that led the Europeans to exclude China from the second phase of the programme in July 2008. Given that the programme had changed from a public-private partnership to one funded by European governments, the

Europeans decided to introduce national security restrictions. Security considerations were compounded by China's decision to build its own Beidou system that could compete with the Galileo and the related dispute over the overlap of signals of the two satellite navigation systems. Other important considerations that influenced the EU decision included: growing European concerns about technology transfer and the enforcement of Intellectual Property Rights (IPR), strong US objections to Chinese participation, especially after China conducted its 2007 ASAT test, and the gradual improvement of US-European relations (Casarini, 2009: 177-88; Moltz, 2012: 100; Aliberti, 2015: 267-9).

To be sure, it is difficult to draw too many conclusions from the aforementioned examples, not the least because the inherent dual use nature of space technology further complicates matters. Yet, a few observations flow from this discussion. First, it appears that there is some form of balancing behaviour against the rise of China in space, but this is rather tentative and incomplete. To the extent that it involves the traditional allies of the US plus India, it points to aspects of US hegemony that are widely regarded as legitimate. At best, these dynamics suggest a US led strategy of hedging against China, which is also premised on liberal values held in common between the United States and its allies in the Asia-Pacific. The eventual exclusion of China from the Galileo project also helps to illustrate the role of common shared values in the context of what is usually called the 'transatlantic security community'. But this also highlights the limits of Chinese efforts to balance against the United States in space, at least for now. Third, although, as many have noted, US-China relations are characterised by a form of adversarial balancing of the sort that realists and power transition theorists would expect, this is accompanied by elements of associational balancing, which is more closely linked to great power management.

Great Power Management

Certainly, one of the key drivers of China's space programme is the quest for great power status.[194] But the key demand here is for social recognition by other great powers. Given that certain space capabilities signify different levels of space

[194] On China's quest for great power status in general, see, inter alia, Deng (2008); Suzuki (2008); Ross (2009); Larson and Shevchenko (2010); and Suzuki (2014).

participation and possibly entrance to the club of great space powers, it is helpful to briefly say something about how human spaceflight capabilities have conferred on China the status of great power.[195] An important indication of this process of social recognition in space was a series of messages from foreign leaders congratulating China on its first successful human spaceflight mission in 2003.[196] More importantly, shortly after China's historical achievement in space, the first deputy of the Russian Space Agency, Nikolai Moiseyev stated: 'We welcome this development and congratulate China for joining the club of space powers that have their own manned space programs' (Agence France-Presse, 2003a). Equally, as NASA administrator, Michael Griffin (2006: 2), said during a 2006 visit to China, 'one of the points I tried to annunciate…was to welcome China to the rank of space faring nations by virtue of their ability to put people into orbit entirely on their own resources'. While visiting China, Griffin also noted, 'we welcome China to the fraternity of space-faring nations' (NASA Office of Public Affairs, 2006: 14). What is remarkable about these statements is not only that they illustrate the social recognition of China's entry into the club of great powers by the established space powers based on the acquisition of human spaceflight capabilities, but also that this recognition is grounded on a notion of an international space society as a point of reference.[197]

Nevertheless, China's exclusion from the International Space Station (ISS) serves as a reminder of how attaining the status of a great power is a complex and non-linear process. In this regard, it is necessary to highlight that ESA officials have openly supported China's participation in the ISS. As far as the United States is concerned, in 2010, it was announced that Charles Bolden, then NASA's administrator, would discuss the possibility of Sino-American cooperation on human spaceflight during his visit to China, but this was not well perceived by certain members of the US Congress (Moltz, 2012: 95). Perhaps, therefore, China's exclusion from the ISS says something more about the role of the US Congress in shaping US space policy and the

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[195] This is also significant because, unlike, for example, the Non-Proliferation Treaty (NPT) distinction between recognised nuclear haves and have-nots, the Outer Space Treaty embodies 'a material understanding of the principle of state equality' (Wolter 2006: 96).

[196] For instance, see Xinhua (2003a). A full list of the foreign leaders that sent congratulatory messages can be found on the Xinhua website following this link: http://www.xinhuanet.com/english/space/04.htm.

[197] Although far from insignificant, this is different from recognising China simply as a great power at the global level due to the attainment of human spaceflight capabilities. For instance, Australian Foreign Minister Alexander Downer was quoted as saying that 'China's manned entry into space…is one more sign of that country's historic emergence as a leading Asia-Pacific nation and a force in world affairs' (Xinhua, 2003a).

perception of China as a threat among its members. In fact, under legislation initiated by Republican Congressman Frank Wolf, the US Congress passed a law in 2011 that effectively bans NASA and the White House Office of Science and Technology Policy (OSTP) from bilaterally working with China on national security grounds (Rosenberg, 2013; Johnson-Freese, 2015). Yet, as we shall see below, the Obama administration has looked for establishing avenues of cooperation on key areas with China.

As for special responsibilities and rights, it is clear that China's 2007 ASAT test lessened its credentials as a responsible great power by undermining two key norms of international space order, that is, the peaceful uses of space and space sustainability. However, it would be wrong to assume that Beijing has not sought legitimacy in international space society or that it has not engaged with the process of maintaining international space order. As noted previously, it has tried to take a leading role in advocating a legally binding treaty on the prevention of a space arms race and the placement of weapons in space. It has also participated in all the major space sustainability initiatives, including the UNCOPUOS Working Group on the Long-term Sustainability of Outer Space Activities and the UN GGE on TCBMs.

As a developing country, China has also emphasised the promotion of a more representative space order, including support for the needs of developing countries. For example, under a recent agreement, China and the United Nations Office for Outer Space Affairs (UNOOSA) will cooperate on enabling developing countries to use China's space station for space experiments and offering flight opportunities (UN Information Service, 2016). Indeed, Chinese officials recognise that the provision of public goods in this regard is a key responsibility of great powers in space. At a recent joint *ad hoc* meeting on space security at the UN General Assembly, Chinese Ambassador Fu Cong (2015) highlighted this important dimension:

> Spacefaring nations should take up the responsibility of providing public goods, and help nations with limited or no space capabilities to enjoy the benefits of space exploration. China has done a lot of work in this regard. China has entered into 97 bilateral space cooperation agreements with 30 countries, provided satellite launching service to more than 10 countries and made great efforts for the international application of the Beidou Navigation Satellite system. China has also played an active role in regional space cooperation under the framework of APSCO, effectively enhancing satellite remote sensing applications by APSCO and its members, and contributing to natural disasters reduction and relief in the Asia pacific region. China is willing to expand and deepen cooperation and exchanges in

peaceful uses of outer space with interested countries, and continue to work with the international society for a more equal and equitable environment for utilization, based on win win cooperation.

Another significant development in the context of the institution of great power management is cooperation between the United States and China. Despite the US Congress law banning NASA from collaborating with China, the current US administration under Obama and the US State Department have taken important, albeit tentative, steps towards cooperation with China on the management of common challenges to international space order, such as space debris and space sustainability. Washington and Beijing held their first 'Meeting of the U.S.-China Space Dialogue' in September 2015 aimed at enhancing cooperation between the two countries on a range of space related issues with a particular emphasis on space debris and space sustainability (US Department of State, 2015). Washington and Beijing have also set up an emergency 'space hotline' to avoid misunderstandings and manage a future crisis in space (S. Jones, 2015).

This focus on managing international space order was given further impetus in September 2016 during the meeting between Obama and Xi at the margins of the G20 Leaders Summit in China. The two leaders identified space debris as one of the key areas of global challenges on which Washington and Beijing should manage their differences and work together. According to a statement issued by the White House, the United States and China, as permanent members of the UN Security Council 'with major space programs', committed themselves to strengthening cooperation on addressing the creation of space debris and 'to promote cooperation on this issue in the international community' (the White House, 2016). What form this cooperation will take remains to be seen, but it serves to illustrate the growing importance of great power management as a primary institution of international space society as well as China's growing acceptance as a great power that it should have a hand in the management and enhancement of international space order.

The Space Market

Since the mid-1980s, one of the most important aspects of China's commercial space activities has been its effort to establish itself as key player in the commercial launch field. In 1990, a CZ-3B rocket successfully launched AsiaSat-1, which made China one of the few countries and organisations offering commercial launches for foreign customers. However, during the 1990s, China encountered a series of launch failures and accidents that damaged its reputation as a provider of reliable commercial launch services. One of these launch failures occurred in February 1996, when a Chinese rocket carrying an Intelsat satellite built by Space System/Loral exploded seconds after its flight. Then, in August 1996, a CZ-3 rocket failed to put a US Hughes satellite in high orbit. These two failures prompted investigations by the US firms Loral and Hughes, which involved sharing information with Chinese space officials (Johnson-Freese, 1998: 77-88; Moltz, 2012: 89-91).

This sharing of information soon emerged a major issue, when it became the subject of investigation on suspected Chinese nuclear espionage and satellite technology transfer by a US Congress bipartisan committee, known as the Cox Committee. In its report, 'the Cox report', the committee argued that the exchange of information regarding the launch failures between Loral and Hughes involved the transfer of technology to China that did not comply with US export control regulations. While the extent to which the investigation process resulted in the exchange of sensitive information remains controversial, the Cox report had the effect of hindering Sino-US space cooperation as well as China's commercial launch business (Johnson-Freese, 2007: 153-8; Moltz, 2012: 90-1; Erickson, 2014: 155-6). This case also served to highlight how commercial space activities remain largely enmeshed in techno-nationalist ideas and perceptions. To be sure, this is compounded by the inherent dual-use of space technology.

Nevertheless, China has managed to gain a foothold in commercial launch services. Since the mid-2000s, it has launched satellites for a number of countries, including Nigeria, Venezuela, Pakistan, Turkey, Argentina, and Ecuador. The stated goal is to seize 15 percent share of the satellite-launching market by 2020, which is illustrative of its ambition to expand its commercial activities in the global market of space products and services (X. Li, 2013). At the same time, China continues to focus on satellite exports. China has manufactured communication satellites for Nigeria, Venezuela, Pakistan, and Bolivia. It has also built a remote sensing satellite for Venezuela. Moreover, China has signed agreements to build satellites for Belarus, Laos, Sri Lanka and Venezuela (Pollpeter et al., 2015: 22-3).

What this list of countries suggests is that China's commercial space interests cannot be easily separated from its broader foreign policy and diplomatic goals, including developing its role as a leading member of the 'Global South' and securing access to energy resources (Pollpeter et al., 2015: 22). In sum, it is still difficult to disentangle China's commercial space activities, like those of other countries, from broader techno-nationalist approaches and practices. It is clear, however, that China's integration into the global space economy provides it with significant resources for claiming a leading role in shaping the emerging space order, which spills over into more traditional forms of international politics.

Concluding Remarks

A number of observations can be made regarding China's engagement with the primary institutions of international space society. First, of all, an analysis of China's engagement with the key institutional elements of international space society provides a more comprehensive and insightful account of China's complex, multifaceted, and often contradictory, interaction with international space order. Although most analyses about China tend to focus on its specific civilian and/or military space programmes, especially in the context of a possible Sino-US conflict in space and the Asian space race, relating space to international society sheds a revealing light on the constitutive impact of the institutions of international space society on the identity of China as a space-faring participant. In doing so, it also helps to illuminate the impact of history and nationalism on the formation of China's space policies and projects.

Second, framing space as international society helps to illustrate the ways in which China has tried, albeit with different degrees of success, to contribute to the process of consolidating and shaping order in space over the last decades. This is an important consideration, given that little work has been done on Chinese contributions to the normative and social structure of international space society. And yet, to understand the ongoing complex dynamics of the international politics of space it is necessary to acknowledge that international space society is a two-way street that not only shapes its members, but is also shaped by them.

Third, a key insight that emerges from this discussion is that China's rise as a great space power has had both negative and positive effects on international space order to date. On the one hand, for example, China's 2007 ASAT test undermined key normative features of international space order, such as the peaceful uses of space and space sustainability. On the other hand, throughout the period covered in this chapter, China remained committed to engaging with the principal institutional facets of international space society, including an emphasis on multilateral approaches to space arms control. In part, these contradictions in Chinese space behaviour can be seen as a response to what Beijing saw as a shift towards an international space society based on US space hegemony aimed at containing China. But they are also indicative of the tensions and contradictions embedded in the politics of China's national identity, as Chinese elites remain indecisive about what kind of great power they want China to be, including what kind of a space power.[198]

However, the tendency in recent years appears to be that China is willing to play a more constructive role in shaping order in space by accepting key responsibilities that are more commensurate with its increasing power and influence in international space society. It remains to be seen how successful China will be in assuming this role. It is relatively safe to say, however, that its willingness to become more involved with the process of shaping international space order and its desire for recognition by other space-faring members that it should have a stake in the maintenance of that order, already mark China as a major power and a full-fledged member in international space society.

[198] On the importance of China's multiple and often contradictory identities and their impact on its engagement with international order, see, inter alia, Breslin (2013); and Shambaugh (2013: 13-44).

Chapter 7. India and International Space Society (1990-2016)

One of the most distinctive developments in the current state of India's space programme is a new emphasis on highly visible space projects, such as space exploration missions, which seems to be at odds with its traditional conceptualisation of space utilisation as a way of promoting socio-economic development. At the same time, despite the fact that India's official policy continues to place importance on the peaceful uses of space, a growing number of Indian officials and policy-makers advocate the militarisation and even weaponisation of India's space programme and it is clear that India has become more interested in enhancing its military space capabilities. It is not surprising, therefore, that these recent developments have attracted much scholarly attention, especially in the context of discussing India's rising power in space and the purported Asian space race. However, less attention has been paid to the constitutive impact of the social and normative structure of international space society on India's space behaviour. Less attention has also been given to the ways in which India has contributed to the maintenance of international space order.

Consequently, this chapter focuses on India's engagement with the primary institutions of international space society from 1990 to 2016. It begins with an examination of the enduring influence of postcolonial techno-nationalism on key Indian space projects. Although some observers have suggested that India's shifting outlook in space indicates a significant departure from its longstanding position of denouncing high visibility space projects, I shall argue that there is more continuity than change in Indian space policies, which is illustrative of the plasticity and resilience of postcolonial techno-nationalism. The chapter then moves on to consider the growing militarisation of India's space programme, which is partly a response to the external security environment and the broader trend towards space militarisation in international space society. Despite external and internal pressures, what is striking, perhaps, in this regard is how reluctant New Delhi has been in increasing its military space capabilities. The chapter then moves on to offer an analysis of India's space diplomacy, before considering its engagement with the institutions of the balance of power, great power management and the space market. It will be suggested that China's growing influence in space has prompted Indian policy-makers to formulate a response that encompasses elements of balancing behaviour. Deepening space cooperation with Washington can partly be seen in this light. Yet, given its continuing emphasis on strategic autonomy, New Delhi has resisted being too closely associated with the United States. Generally, so far, India's response has been somewhat cautious and incomplete.

The chapter will argue that, although India is a rising space power, it is not an established great space power yet. While it can be seen as a responsible member of international space society that has participated in the process of contributing to key aspects of international space order, India has been less willing to assume great power responsibilities that are commensurate with its growing influence in space, at least for now.

Techno-nationalism

India and Postcolonial Techno-nationalism

India has made great strides in integrating into the global economy over the last decades as a result of the liberalisation of its economy in the early 1990s. This has had an important impact on India's science and technology policy as it marked a shift from technological self-reliance to an emphasis on cutting-edge R&D that is market-oriented and suitable for the needs of its industry. Unlike China, India has not promoted ambitious R&D plans and the progress of reforming its R&D system remains somewhat slow. But like China, the Indian government remains the major source of R&D funding, the largest portion of which is dedicated to strategic technologies, such as space, atomic energy and defence (Kennedy, 2016: 75-6).

Therefore, the point to emphasise at the outset is that the pursuit of the space programme is still underpinned by the influence of postcolonial techno-nationalism. For even the most cursory glance at how India's science and technology policies and programmes have been justified suggests the enduring relevance of postcolonial techno-nationalism to the understanding of the relationship between the state, technology, and modernity in contemporary India. For example, APJ Abdul Kalam, the eminent and influential scientist whom we encountered in Chapter 5 as project director of India's first indigenous Satellite Launch Vehicle (SLV-III) before moving to DRDO to become the 'father' of the missile programme, and who later served as the eleventh President of India (2002-2007), has cast a revealing light on his postcolonial techno-nationalist thinking in his bestselling autobiography. Kalam (with Tiwari 2003: 103) ends the epilogue of his book by referring to two key plans for India's science and technology policy – the 'Self Reliance Mission in Defence System 1995-2005' and the 'Technology Vision 2000' –with the following words: 'A nation needs both economic prosperity and strong security for growth and development…I earnestly hope and pray that development resulting from these two plans…will eventually make our country strong and prosperous and take our rightful place among the ranks of the "developed" nations'. More recently, delivering the Prem Bhatia Memorial lecture, the then National Security Advisor Shivshankar Menon noted that 'talk of strategic autonomy has little meaning unless our defence production or innovation capabilities undergo a quantum improvement…a country that doesn't develop and produce its own major weapon platforms…cannot claim true strategic autonomy' (Press Trust of India 2011).

Similar postcolonial techno-nationalist rationales have also been provided with regards to the space programme. For example, after witnessing the Polar Satellite Launch Vehicle's (PSLV) 100th space mission in 2012 that launched two foreign satellites (France's Spot 6 satellite and the Japanese micro-satellite), the former Prime Minister Manmohan Singh (2012, emphasis added) stated:

> Questions are sometimes asked about whether a poor country like India can afford a space programme and whether the funds spent on space exploration, albeit modest, could be better utilized elsewhere. This misses the point that *a nation's state of development is finally a product of its technological prowess*. The founding fathers of our space programme faced a similar dilemma, but they persevered in pursuing their vision. When we look at the enormous societal and national benefits that have been generated in diverse fields, there can be no doubt that they were right. Equally, I have no doubt that ISRO will build on these glorious traditions and scale still greater heights.

As we shall see, this postcolonial techno-nationalism premised on space technology as a marker of the state's power, status, and modernity in international society has shaped, and continues to shape, the pursuit of most of India's key space projects and activities in the post-Cold War era, to which I now turn.

India's Space Programme: Key Developments and Projects (1990-2016)

Satellites and Launch Vehicles

As we saw in chapter 5, Sarabhai's postcolonial techno-nationalist vision for the indigenous development of satellites and launch vehicles continued to guide the course of India's space programme during the 1970s and 1980s. Despite the fact that India's growing interest in space exploration missions has added a new highly visible component in its space programme (more on which below), since the early 1990s, the principal focus has remained on space-based applications, such as communications and remote sensing, and satellite launch vehicles.

In the field of communications satellites, the 1990s saw India building fully operational multipurpose communications satellites as part of the Indian National Satellite (INSAT) system, which provides services in the areas of telecommunications, television broadcasting, weather forecasting, and search and rescue missions. While the INSAT-1 series was built by Ford Aerospace, the launch of INSAT-2A in 1992 marked the operation of the second generation of INSAT satellites (INSAT-2 series), which was indigenously designed and developed by ISRO. Since then, India has launched several state-of-the-art satellites of the INSAT-3 and INSAT-4 series, and the INSAT system is now one of the largest constellations of communication satellites in the Asia-Pacific. From the early 2000s onwards, India also began launching the GSAT series of smaller communications satellites.[199]

In relation to remote sensing or earth observation, since it became operational in 1988, the Indian Remote Sensing (IRS) satellite programme has made significant progress in building and operating indigenous remote sensing satellites that provide images of multiple resolutions used for various applications, such as management of earth, water, ocean resources, and disaster monitoring. As a result, today India operates one of the largest networks of remote sensing satellites. Key remote satellite series include: the IRS-1, IRS-P, Cartosat, Resourcesat, Radar Imaging Satellite (Risat) and Oceansat.[200]

To reduce its dependence on foreign navigation satellite systems and to support various applications, India has also completed the deployment of its own regional navigation system, known as the Indian Regional Navigation Satellite System

[199] On the development of the INSAT programme, see Rao (2014: 145-58); and Sankar (2007: 36-46).
[200] For an overview of the IRS programme, see Rao (2014: 123-44); and Sankar 2007: 179-239).

(IRNSS), consisting of seven satellites. When it is operational, the IRNSS will offer a positional accuracy of better than 20m and two types of services – an open service for civilian use and a restricted one with encrypted signals.[201] ISRO launched the first satellite of the series, IRNSS-1A in July 2013 and the seventh satellite, IRNSS-1G in April 2016. The point to make here is that the IRNSS can also be seen as a reflection of India's postcolonial techno-nationalist project. As Prime Minister Narendra Modi proudly noted after the launch of the seventh IRNSS satellite 'We are now one of five countries with our own navigational system. Today we are free of dependence on other countries for navigation' (Bhat, 2016).

Meanwhile, in its quest for self-reliance, India has made great strides in building a series of operational satellite launch vehicles since the successful launch of the Satellite Launch Vehicle -3 (SLV-3) in 1980 and the first developmental flight of the Augmented Satellite Launch Vehicle (ASLV) in 1987. The ASLV programme proved to be a 'technological bridge', as it paved the way towards the design and development of the more powerful operational launch vehicles, the Polar Satellite Launch Vehicle (PSLV) and the Geosynchronous Satellite Launch Vehicle (GSLV) (Raj, 2000: 73; Rao and Radhakrishnan, 2012: 84-97).[202]

The first PSLV was successfully launched in October 1994 and provided India with the capability to put its remote sensing satellites (a 1,000 kg payload) to a 800-900 km altitude orbit. As Raj (2000: 231) notes, this breakthrough brought to reality Sarabhai's dream of building satellites indigenously and having the capacity to launch them. The PSLV has four stages using both liquid and solid propulsion stages, with the second stage being based on the *Viking* liquid engine, acquired from France (Raj, 2000: 191-8; Baskaran, 2001: 159). Thanks to its reliability, the PSLV has been in service for more than twenty years.[203]

The GSLV was intended to launch communications satellites to the geostationary orbit. To this end, the two stages of the PSLV could be replaced with a cryogenic engine. Although the first steps in cryogenics were taken in the 1970s under Sarabhai, ISRO began considering more systematically how to develop a cryogenic engine one decade later. As part of this effort, ISRO opted for purchasing this technology from

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[201] ISRO, IRNSS Programme, http://www.isro.gov.in/irnss-programme.
[202] On the development and technical details of India's satellite launch vehicles, see, for example, Raj (2000: 125-272); Rao and Radhakrishnan (2012); Suresh (2008); and Suresh (2015).
[203] On this point, see ISRO, Polar Satellite Launch Vehicle, http://www.isro.gov.in/launchers/pslv.

abroad. In exploring this possibility, there were negotiations with the United States, France and Japan, but these did not yield results largely because of considerations relating to restrictions imposed by the Missile Technology Control Regime (MTCR), which had been established in 1987. Consequently, ISRO turned to Glavkosmos for help and in 1991 the two sides reached a deal for the supply of two cryogenic stages as well as technology transfer for the GSLV (Raj, 2000: 234-43; Rao 2014: 179-82).

However, given that the *Agni* missile, which was launched in 1989, had used the first stage of the SLV-3, the United States was concerned that the supply of Russian cryogenic technology could be used to build a long-range ballistic missile for delivering nuclear weapons. Therefore, in 1992, the United States imposed sanctions against the Indian and the Russian space agencies over the deal. This placed enormous pressure on the Russian side to cancel the agreement and led to the renegotiation of the contract in 1993. Under the new agreement, Russia would now provide to India only completed cryogenic engines in order to withhold the further transfer of cryogenic technology (Moltz, 2012: 121-2; Raj, 2000: 243-9; Rao, 2014: 182-8). In turn, ISRO was forced to develop the technology indigenously. According to UR Rao (2014: 185), this was 'truly a blessing in disguise', as it propelled ISRO towards self-reliance in all critical areas of space technology. The controversy over the cryogenic engine deal also made the Indian public aware of the difficulties involved in building strategic technologies and galvanised further support for the space and missile programmes (Baskaran, 2001: 162). In the end, in May 2003, the first GSLV was successfully launched using the Russian engine and, after overcoming several technical hurdles, in January 2014, the first GSLV D5 (Mark 2 version), powered by an indigenously built cryogenic engine, successfully put a communications satellite in orbit (T.S. Subramanian, 2014; Suresh, 2015: 923).

Space Exploration

Indian's First Lunar Mission: *Chandrayaan -1*

Like China, India's first lunar mission owes much to the initiative of scientists, who began discussing this possibility in the late 1990s (Chakravarty, 2000). On 11 May 1999, Krishnaswamy Kasturirangan, the then chairman of ISRO, announced for the first time the idea of an Indian lunar mission during a lecture he gave, entitled 'India's

Space Odyssey', on the occasion of celebrating the first National Technology Day. The day had assumed symbolic importance as it was marking the first anniversary of Pockhran II, a reference to the five nuclear bomb test explosions that India had conducted at the Pockhran Test Range one year before (Bagla and Menon, 2008: 5-6, 82-3; Kasturirangan, 2008: xii).

The announcement attracted much attention in the media and became a subject of heated debate about the merits of an Indian lunar mission. Opponents questioned why India should pursue a lunar mission more than thirty decades after the Apollo 11 mission. According to HS Mukunda, professor at the Indian Institute of Science (IISc), a lunar mission would be 'the stupidest thing to do. What others did 30 years ago, we are trying to do now. It won't bring the country any technical benefit' (Chengappa, 2000). Yet, most of the critics argued that a lunar mission would mark a significant departure from India's traditional emphasis on space applications without bringing any tangible socio-economic benefits (Chakravarty, 2000). For example, Manoj Joshi, the political editor of the Times of India, argued that India as a poor country with high illiteracy rates would be better off leaving lunar missions to the Americans and the Europeans. Instead the focus should be on the use of space technology for development or national security (Joshi, 2001). In a rather similar fashion, V Rajamani, professor at the School of Environmental Sciences, Jawaharlal Nehru University, suggested that funds for the lunar mission ought to be spent on a project for socio-economic development, like water utilisation (Srikanth, 2003). In other words, the bulk of criticisms echoed the familiar question of why India as a developing country should harbour ambitions in space.

To offset these criticisms, the ISRO leadership embarked upon a process of consultation and engagement with the political leadership, the scientific community, academia, and the public. To this end, the first step was a symposium organised at the sixty-fifth annual meeting of the Indian Academy of Sciences entitled 'An Indian Case for Going to the Moon' in October 1999. Then, in February 2000, the Astronautical Society of India (ASI) held a meeting to discuss the lunar mission proposal in order to elicit recommendations from the scientific community. In September 2001, ISRO created a National Lunar Mission Task Force, which prepared a report that provided an assessment of the feasibility of the mission and defined its objectives. In 2003, a national committee headed by MGK Menon and consisting of a hundred leading scientists from various fields related to space exploration met in

Bangalore to review the report of the Task Force (Bagla and Menon, 2008: 86-9; Kasturirangan, 2008: xiv-xvi; Kasturirangan, 2006: 197). The committee unanimously recommended that India should pursue the mission, especially given the renewed international interest in lunar exploration since the early 2000s (Datta and Chakravarty, 2008: 19-20). Subsequently, in May 2003, the Parliamentary Review Committee gave its green light to the lunar mission, which was approved by the cabinet in November 2003 (Bagla and Menon, 2008: 89).[204] On 15 August 2003, India's Independence Day, Prime Minister Atal Behari Vajpayee formally announced the country's plan for a lunar mission.[205]

Three aspects of ISRO's successful push for the lunar project were especially noteworthy. First, it appears that the resurgence of international interest in lunar missions of the early 2000s has had an important impact on the national committee's final recommendations (Bagla and Menon, 2008: 89, 84). By that time, all of the key space powers had announced plans for lunar missions (United States, Russia, China, ESA, and Japan). Second, unlike China, India's lunar mission was opened to international cooperation. As a result, apart from indigenous payloads, *Chandrayaan -1* carried payloads from NASA, British, German and Swedish research institutes (through ESA), and Bulgaria (Datta and Chakravarty, 2008: 22-3). As Moltz (2012: 132) points out, this move contributed to establishing ties with leading international space programmes and highlighted further the scientific value of the mission. Thus, it helped to dispel most of the criticisms within the scientific community and generated further public support for *Chandrayaan -1*.

Third, in many ways, the justification for the mission also reflected the enduring influence of a composite postcolonial techno-nationalist ideology. As was the case with earlier efforts, this involved embracing a justification for the programme based on the belief that India has little chance other than pursuing a lunar mission precisely because it is a developing country. In response to the opponents of the lunar mission who argued that a country mired in poverty should first focus on dealing with its many terrestrial problems, Kasturirangan said 'it is not a question of whether we can

[204] It was also decided that the following institutions would be involved with the mission: the Physical Research Laboratory, the National Physical Laboratory, the Tata Institute of Fundamental Research and the Indian Institute of Astrophysics (Bagla and Menon, 2008: 89).

[205] Notably, according to Kasturirangan (2008: xvii), while ISRO had initially identified the mission as *Chandrayaan*, which means 'Moon vehicle' in Sanskrit, the prime minister decided to announce it as *Chandrayaan -1* because he believed that India's lunar endeavour should not be confined to a 'single-shot' mission.

afford it, it's whether we can afford to ignore it.' Referring to the relatively low budget for the lunar mission (roughly $80 million), he added that 'the returns, in terms of the science…the technology, inspiration, stature, prospects for international cooperation…are immense' (Singh, 2008). Indeed, a repeating theme underlining Kasturirangan's justification for a lunar mission was the many benefits that India could accrue from such a high-prestige programme, including national pride and international prestige. In his words: 'as a motivator, it will electrify the nation… If we go ahead, it will demonstrate to the world that India is capable of taking up a complex mission that is at the cutting edge of space. The spin-offs for us are going to be many' (Chengappa, 2000).

Elsewhere, Kasturirangan (2008: xix, emphasis added) noted that 'cost-effective missions like *Chandrayaan-1* could create the necessary credentials both in terms of technology capability and the ability to play a unique scientific role, that in turn *will enable India to play its rightful role in the Comity of Nations* in the most exciting area of human exploration. Not surprisingly, the political leadership also shared this postcolonial techno-nationalist rationale. In 2006, the then Prime Minister Manmohan Singh defended the lunar mission by saying:

> We have to walk on two legs, to deal with the fundamental problems of development and at the same time set our sights sufficiently high so we can operate on the frontiers of science and technology…In the increasingly globalised world we live in, a base of scientific and technical knowledge has emerged as a critical determinant of the wealth and status of nations and it is that which drives us to programmes of this type' (Johnson, 2006).

It was in this context that India's first lunar mission picked up steam. Eventually, on 22 October 2008, India launched its first lunar probe, *Chandrayaan -1*, designed to map the lunar surface. Given that the mission was launched roughly one year after Japan (*Selene*) and China (*Chang'e 1)* had deployed their lunar probes, the mission attracted considerable worldwide attention and contributed further to the notion of an Asian space race.[206] Despite the fact that *Chandrayaan-1* encountered technical difficulties and had to be terminated ten months after it was launched, it was described by ISRO as a complete success (Bagla, 2009). Shortly after, data received from instruments carried on the *Chandrayaan-1* mission confirmed evidence of water

[206] For example, see Singh (2008); Ramesh (2008); and Page (2008).

on the Moon (Pidd, 2009). ISRO is currently working on a follow-up lunar mission, Chandrayaan-2 (Nair, 2015).

The Mars Orbiter Mission (MOM)

The success of India's first lunar mission increased ISRO's confidence in space exploration and provided a crucial impetus for other missions of this type. Therefore, after the lunar mission, ISRO saw a mission to Mars as the next logical step, like most of the space-faring countries had opted for it in the past (Laxman, 2014: 72). More specifically, in 2007, soon after China and Russia had signed an agreement for their joint mission to Mars, G Madhavan Nair, the then ISRO chairman, announced that ISRO was studying a proposal on a mission to the Red Planet, but he rejected the view that this was part of an attempt not to be left behind in the 'race for Mars' (Press Trust of India, 2007a).

The idea of a Mars mission resurfaced after the launch of *Chandrayaan-1*. In 2010, Koppillil Radhakrishnan, who had succeeded Nair as chairman of ISRO in 2009, revitalised the plan for India's first interplanetary mission to the Red Planet by taking a series of initiatives. These included engaging in dialogue with the scientific community, authorising feasibility studies, and increasing interactions with the political leadership (Bagla and Menon, 2014: 49). As part of this effort, in 2010, ISRO formed a group of scientists, called the Indian Mars Mission Study Team, to conduct a feasibility study of such a mission. In its report, the team pointed to the growing number of space-faring countries participating in the exploration of Mars and recommended that a Mars mission would help India to 'have a strong say globally in the scientific, technological, and strategic circles'. Considering that Mars and the Earth come closer to each other about every 26 months, the report also suggested that there would be three windows of opportunity for a Mars mission, the first of which would be in November 2013 (Laxman, 2014: 70-1).

Nevertheless, what is noteworthy is that India's plan for a mission to the Red Planet was given added momentum as a consequence of the unsuccessful Russian-Chinese Phobos-Grunt Mars mission in November 2011. We do know now that a few weeks later the Space Commission convened a meeting in New Delhi and decided to go ahead with the mission during the November 2013 launch window opportunity. This would offer India a chance to reach the Red Planet ahead of China. According to

Bagla and Menon (2014: 47-9), this 'race mentality' is also illustrated by the fact that the Indian government never received the *Chandrayaan* team in a formal ceremony. Given that these ceremonies are usually held for less important satellite launches, this is seen as an indication that former Prime Minister Singh and other members of the government felt irritated because India was beaten by China in the Asian Moon race. Hence, it appears that these political and geopolitical considerations placed additional pressure on ISRO to undertake a Mars mission within a remarkably short time frame (Bagla and Menon 2014: 47-9).

That said, the decision was also influenced by other factors. First, while the loss of the Chinese Mars orbiter boosted India's own Mars effort, the failure of the Russian component had the effect of delaying Russia's participation in India's second lunar mission, Chandrayaan-2.[207] As a result, India had little option but to move forward with a different mission. Meanwhile, ISRO was facing one of the most serious crises in its history due to a corruption scandal that involved Antrix, the commercial arm of ISRO, and an Indian private company, Devas Multimedia, created by former ISRO employees.[208] In this regard, going to Mars could also help to restore the reputation of ISRO, which was severely damaged by the controversial deal (Bagla and Menon, 2014: 40, 48). Moreover, a high-visibility mission could generate national pride and more interest in ISRO's commercial space services and contribute to the perception of India as an emerging great power (Lele, 2014: 18; The Economist, 2014; S. Subramanian, 2014).

On 15 August 2012, during his address to the nation on the occasion of India's sixty-sixth Independence Day, Prime Minister Singh formally announced that India would launch a $100 million spacecraft to Mars to collect scientific information, possibly in November 2013 (Laxman, 2014: 38-9). Thus, the spacecraft had to be developed and completed in a record time of 15 months, which meant that, unlike *Chandrayaan-1*, there was no time to establish collaborative projects with foreign partners (Bagla and Menon, 2014: 53). The Mars Orbiter Mission (MOM), also called Mangalyaan (meaning 'Mars craft' in Hindi), eventually lifted off on 5 November 2013, with the aim to study the surface and mineral composition of the planet and search for methane. It was successfully put into orbit around Mars on 24 September

[207] The agreement between Russia and India was signed in 2007. Since the failure of the Phobos-Grunt Mars mission, India has decided to undertake its second lunar mission on its own in 2018.

[208] Madhavan Nair, who was chairman of ISRO when the deal between the two companies was finalised, was banned from holding any government post due to his alleged involvement.

2014. This made India the first country to reach Mars in its maiden attempt and only the third country to do so after Russia and the United States. Budgeted at $74 million, MOM was also the cheapest Mars mission ever, costing a tenth of NASA's Maven orbiter and less than the Hollywood film 'Gravity', as Indian Prime Minister Narendra Modi famously noted (Amos, 2014).

Consequently, MOM attracted worldwide attention and was seen as a victory for India in the unfolding Asian space race.[209] But, as we might expect, there were mixed views about the merits of the mission (Joseph, 2013). Once again, there were critics who argued that such a mission was a luxury that a poor and developing country, like India, could not afford. For instance, according to Jean Drèze, a development economist, the Mars mission did not make sense given the large number of people affected by malnutrition and inadequate access to sanitation. 'It seems to be part of the Indian elite's delusional quest for superpower status' he noted (Mallet, 2012). Priyamvada Gopal (2014), a professor at Cambridge University and expert in postcolonial literature, argued that space exploration as a source of knowledge should not be 'the preserve of the rich west', but she also questioned the value of the mission on the grounds that it was embedded in the language of 'national "heroism"' and 'technological "might"'. Gopal (2014) also suggested that MOM should serve as a touchtone for a national debate in India about the ways in which science and technology can be best utilised to accommodate the 'widest interests of its people'.

To be sure, the scientific value of MOM was questionable, given that it hosted only five payloads and would last only six months (S. Subramanian, 2014; Wall 2014). In this regard, one of the most notable oppositions to the mission came from Nair, the former ISRO chairman, who questioned the scientific objective of the mission as well as its national and international impact. Paradoxically, though, his criticism was based on the view that ISRO should participate in the space race with a human spaceflight mission. In his words, 'That's where the big gap is. The United States space shuttle has failed and they don't have a launch vehicle…China went to the extent of creating a mini (space) station. So, in that race India is lagging behind and unless we give a major thrust to an Indian manned mission, I think we will be left behind' (Press Trust of India, 2012a). In a sense, Nair's view is not surprising considering that a human spaceflight programme was his pet project. Indeed, it was during his chairmanship

[209] See, inter alia, Hume (2013); Agence France-Presse (2014); and Wall (2014).

that ISRO proposed a plan for a human spaceflight programme in 2006. One year later, ISRO announced its plans to launch its first human spaceflight mission in 2016 and to send an astronaut to the moon by 2020 (Press Trust of India, 2007b).[210]

Nevertheless, it is important to highlight that the scientific and political elites have largely justified the mission along techno-nationalist lines. In this vein, a few months after the successful launch of India's Mars mission, Shashi Tharoor, the Minister of State for Human Resource Development, described the Indian Space Research Organisation (ISRO) as the new temple of modern India 'like Nehru said dams are the temples of modern India' (Press Trust of India, 2014a). This captures nicely the continuing legacy of Nehruvian postcolonial techno-nationalism that signifies techno-social and techno-political 'big projects' as celebrations of India's modernity.

As far as the scientific merit of the mission is concerned, Radhakrishnan acknowledged that the principal objective of MOM was to demonstrate that India possesses the technology to reach Mars, but he also noted that its successful implementation 'established our ability to collaborate with any country (on such missions) as equals' (T. A. Johnson, 2014b). The then chairman of ISRO also pointed out that, 'Certainly the Mars mission is going to create a great sense of pride and achievement and it also going to improve our position in the international community' (Radhakrishnan, 2014: xi). Another revealing example of postcolonial techno-nationalist thinking was the justification provided by Ambassador Shivshankar Menon, a former National Security Advisor, who was involved in the reviewing process of the mission. According to the ambassador, 'We have heard these arguments since the 1960s, about India being a poor country not needing or affording a space programme. If we can't dare to dream big it would leave us as "hewers of wood and drawers of water!". India is today too big to be just living on the fringes of high technology' (Bagla and Menon, 2014: 57-8; Bagla, 2012).

Equally importantly, in his address on the successful insertion of India's Mars Orbiter Mission into the Red Planet's orbit, the current Prime Minister of India, Narendra Modi (2014), highlighted some of the key themes associated with postcolonial techno-nationalism. The elated prime minister noted that with this 'spectacular success, ISRO joins an elite group of only three other agencies

[210] In 2014, ISRO launched an experiment test vehicle, the Crew Module Atmospheric Re-entry Experiment (CARE) as a first step towards developing critical spaceflight capabilities, but the government has not formally approved a human spaceflight programme yet (Bagla 2016).

worldwide, to have successfully reached the red planet', and hailed the fact that the spacecraft was built indigenously 'in a pan-Indian effort'. He also congratulated the Indian scientists for having developed 'self-reliance across critical domains' and described the space programme as 'a shining example of what we are capable of as a nation'.[211] Notably, underpinning his speech was also a sense of 'civilisational exceptionalism'. Referring to how India has contributed to the world's knowledge of the cosmos in the past, he urged modern India to continue its leading role as the 'Guru of the world' (Jagad-guru Bharat) (Modi, 2014).

In the context of examining the developments highlighted above, it is useful to make a number of interlinked observations. First, it is clear that one of the most important features of India's space programme is its shifting focus on highly visible space projects, like the lunar and Mars missions, which seems to be at odds with its traditional conceptualisation of space utilisation for the promotion of socio-economic development. However, as the preceding discussion suggests, these high-prestige projects can be seen as an embedded practice of India's postcolonial identity that signifies national techno-social and techno-political projects as markers of power, status, and modernity in international society. In other words, there is more continuity than change in Indian space policy that reflects the resilience and plasticity of the Indian variant of postcolonial techno-nationalism.

A second, but related, observation is that India has never been shy about its desire to acquire the status of a great power and, thus, these recent plans are partly a response to its growing capabilities. What has changed since the early phases of the Indian space programme is that India now has the necessary economic and technical means to negotiate the meaning of its space effort and, thus, to appropriate the political and cultural significance attributed to space technology by other members of the international space society. In their account of India's moon programme, Indian journalists Bagla and Menon (2008: 13) capture this important dimension nicely when they note that 'India's entry into the elite lunar club of the world is a triumph; keeping the membership will be the real trial by fire'. This can also be said about India's other space activities and programmes.

[211] It is worth noting that the crucial support that NASA'S deep space tracking system provided to MOM was usually downplayed in Indian media reports and official statements.

Third, and consequently, this new emphasis on high-prestige space missions should be seen more as a continuity of the postcolonial project in the sense that the lunar and Mars missions can always be signified as indicators of India's ethical modernity as well as an expression of its 'civilisational exceptionalism'. In other words, every technological achievement in space by India, even if it has been achieved before by another space-faring country, can be constructed and represented as an expression of the unique qualities of its postcolonial identity. Put differently, achieving postcolonial modernity never goes away and thus its quest can always be activated to signify more ambitious space projects as part of the state's postcolonial project of modernity. Again, this points to the importance of postcolonial techno-nationalism as a complex and composite ideology that now allows India to associate its space programme with the shared practices and understandings of leading members of international space society.

Space Militarisation

Indian strategists have been well aware of the increasing role of space-based assets as force multipliers that enhance the effectiveness of terrestrial combat forces since the first Gulf War, but the main focus of India's space programme has been on the civilian applications of space technology (Gopalaswamy and Kampani, 2014: 40). Yet, although India's official policy continues to place importance on the peaceful uses of space and the principle of non-weaponisation, a number of recent developments suggest that it has become more interested in the military uses of space, including ASAT weapons.[212] This reorientation has become especially relevant following China's successful anti-satellite test (ASAT) in 2007, which appears to have prompted a reconsideration of India's traditional approach towards the militarisation and weaponisation of space (Pant and Gopalaswamy, 2008b: 69; Rajagopalalan, 2011; Sachdeva, 2013: 315).

This change in Indian strategic thinking has been evident in a series of statements by senior military and DRDO officials, following the 2007 Chinese test and the 2008 US satellite interception, which indicated the intention of using India's missile

[212] On India's increasing interest in the military uses of space, see, for example Gopalaswamy and Wang (2010); Rajagopalan (2011); and Paracha (2013).

defence system to develop an ASAT capability (Samson, 2011: 427). For example, in February 2008, APJ Abdul Kalam told reporters on the sidelines of a conference sponsored by DRDO that India has the ability 'to intercept and destroy any spatial object or debris in a radius of 200 km. We will definitely do that if it endangers Indian territory'. On the same occasion, VK Saraswat, the then Chief Controller, R&D (Missiles and Strategic Systems) at the DRDO, agreed with Kalam, albeit with somewhat less certainty: 'It is just a matter of time before we could place the necessary wherewithal to meet such requirements' (Brown 2010). In January 2010, Saraswat, who had now become the director general of DRDO and the scientific advisor to the President, announced during the 97th Indian Science Congress that India had begun working on an ASAT capability (Brown 2010). A few days later, Air Chief Marshal PV Naik pointed to China as the key driver behind India's effort in an ASAT weapons system, when he highlighted the increasing vulnerability of India's satellites 'because our neighbourhood possesses one' (Kerur, 2010). Since then, Saraswat has made several statements that suggest India's continuing interest in an ASAT capability. For instance, in April 2012, shortly after the successful test of a long-range intercontinental ballistic (ICBM), *Agni-V*, the senior official stated that the test 'ushered in fantastic opportunities in, say, building ASAT weapons'. However, he was quick to stress that the DRDO is 'only talking about having the capability', as India does not seek the weaponisation of space and the government has not approved an ASAT programme yet (Pandit, 2012).

Certainly, India's intention to acquire an ASAT capability has been clearly exacerbated by concerns about China's growing power in space. But this does not mean that there is a compelling strategic rationale for India to develop and deploy kinetic energy ASAT weapons of the type China conducted in 2007 as a means of deterrence against space weapons. As Gopalaswamy and Kampani (2014) show, this is because, among other reasons, India lacks the necessary Space Situational Awareness (SSA) capabilities to identify with confidence whether interference with its space assets was intentional or unintentional. Equally importantly, deploying ASAT weapons would increase the risk of generating space debris, which, in turn, would pose a threat to its own space assets and to those of third parties, making India an international pariah. Rather, a focus on means of interference that have temporary or reversible effects, such as spoofing, jamming, and blinding of satellites with lasers, would form a more effective and credible Indian strategy of deterrence in space (Gopalaswamy and Kampani 2014).

Given the limited strategic value of an ASAT system, additional factors help to explain India's growing interest in exploring ASAT capabilities. More specifically, some analysts have pointed out that these ASAT plans reflect India's bitter experience with the 1968 Nuclear Nonproliferation Treaty (NPT), which established an unequal nuclear order based on the distinction between nuclear 'haves' and 'have-nots'. Because India conducted its first nuclear test after the treaty came into force, it was not recognised as a nuclear weapons state and remained outside the exclusive 'nuclear club'. Therefore, some Indian strategists believe that India should test ASAT weapons now in order to avoid possible restrains imposed by any future international agreement banning ASATs (Samson, 2010; Gopalaswamy and Wang, 2010: 232). It has also been argued that this interest in ASAT systems is partly driven by DRDO's bureaucratic interests and an effort to restore its image, especially given that, in sharp contrast to ISRO, DRDO has a poor reputation for developing good quality and reliable weapons (Gopalaswamy and Wang, 2010: 232).

There are two other plausible interrelated explanations. It is likely that Indian national security planners have assumed the inevitability of the weaponisation of space, so they have moved on with acquiring ASAT capabilities to provide the Indian government with the future option to deploy ASAT weapons if deemed necessary. This is not dissimilar to the way in which India pursued its nuclear policy before its decision to go nuclear (Gopalaswamy and Kampani, 2014: 54). Equally importantly, it is also plausible to argue that India's military-industrial establishment, the 'strategic enclave', is pursuing the development of an ASAT capability without explicit political authorisation in the hope of putting pressure on the political leadership to approve the programme. In other words, this may constitute another case of 'the technological tail wagging the political dog' (Gopalaswamy and Kampani, 2014: 55).

Nevertheless, it is important to emphasise that there is no evidence to suggest that India has crossed the threshold of developing operational ASAT weapons and it is not likely that this would happen in the near future. In fact, the political leadership and ISRO have stressed India's policy stance against the weaponisation of space. Shortly after the Chinese ASAT test, the Minister of External Affairs Pranab Muckherjee stated in the upper house of the Indian parliament that the Indian government 'will continue to be closely engaged with the multilateral efforts towards keeping outer space free of weapons' (cited in Rajagopalalan, 2011: 367).

In a somewhat similar fashion, soon after the Chinese test, the then ISRO chairman, G Madhavan Nair, noted that although India has 'a number of rockets which can achieve the same results', the use of outer space for peaceful purposes remains the philosophy that underpins its space endeavour (Singh, 2007). What the ISRO leadership believes does matter, especially given that it has historically exercised more influence on the development and implementation of India's space programme than DRDO. But whether the pressure from military and DRDO officials will translate into a genuine change in India's space policy stance against the weaponisation of space remains to be seen.

Current Military Capabilities

Despite the fact that the intention to build ASAT capabilities is still controversial and debatable, it is clear that India has recently become more interested in the military uses of space. This has been evident in the establishment of the Integrated Space Cell, which was announced in June 2010. The 'Space Cell' functions under the command of the Integrated Defence Services (IDS) Headquarters of the Ministry of Defence as a unified body that integrates the three services of the Indian Armed Forces (army, navy, and air force), the Department of Space, and ISRO. It is aimed to provide a more efficient use of India's space assets for military space activities by improving cross-agency coordination between all key agencies concerned with space operations and applications (Rajagopalan and John, 2014: 15-6).

Another obvious manifestation of India's growing emphasis on military space capabilities is the shift from utilising dual-use satellites to dedicated military satellites (Lele, 2011: 383). This transition was marked with the launch of India's first military communications satellite under the command of the Indian Navy, the GSAT-7/INSAT-4F, in August 2013. The satellite is a key step in enhancing India's maritime security and intelligence gathering in the Indian Ocean region (Pandit, 2013).

However, India still depends on dual-use satellites for its military activities. For instance, in 2001, ISRO launched the Technology Experiment Satellite (TES) that offers a one-meter resolution. According to the then ISRO chairman, K. Kasturirangan, the satellite was intended for 'civilian use consistent with our security concerns' (quoted in Pant and Lele, 2010: 50). Since then, India has launched a series of high resolution satellites with military applications, such as the CARTOSAT and RISAT satellite series (Lele, 2011: 384; Moltz, 2012: 128; Rajagopalan and John 2014: 20-1).[213] The recent deployment of the IRNSS navigation satellite system is also expected to be an important force multiplier for the Indian military.

In lieu of a conclusion, three additional points are worth making here. First, while India's shifting focus on the use of space for security and military purposes can be seen as a response to China's increasing military space power, other traditional and non-traditional security challenges have been important in shaping the militarisation of India's space programme, including Pakistan, border surveillance, anti-terrorism activities, and human security considerations.

Second, this militarisation trend can also be seen as a response to the policies and practices of other space-faring participants that see space as a force multiplier. On the one hand, Indian strategists feel that India should invest in developing certain military capabilities now, otherwise it risks lagging far behind in the military uses of space. On the other hand, as indicated above, India's restraint from deploying ASAT capabilities can partly be attributed to its willingness to comply with emerging norms and practices related to the peaceful uses of space and space sustainability. That these tensions are currently at the centre of India's space programme is no coincidence, given the wider normative tensions between the militarisation and weaponisation of space enmeshed in the ever evolving normative and social structure of international space society. As Chandrashekar (2011: 448) observes, it is unlikely that India will attempt to deploy ASAT systems in the near future, as this would signify a significant departure from the current normative regime of using space for peaceful purposes. Still, much will depend on the policies and actions of Beijing and Washington (Chandrashekar, 2011: 450).

Third, and related to the previous point, it is useful to remember that military space capabilities are also seen as part of what constitutes a modern state that aspires to be recognised as a great power in international space society. What is remarkable,

[213] Notably, in 2009 India launched the first satellite of the RISAT series that carried an all-weather synthetic aperture radar (SAR) acquired from Israel Aerospace Industries (IAI), whereas the second RISAT satellite, which was launched in 2012, uses indigenously built SAR technology (Rajagopalan and John, 2014: 20-1).

perhaps, in this regard, is how reluctant the Indian decision-makers have been in enhancing the military and security uses of space, when compared to the capabilities already developed by other space powers, and despite ongoing calls from strategists and policy-makers to do so. The very fact that India has not articulated a military space policy also serves to illustrate how the normative discourse within India about its unique path to space utilisation still resonates well among decision-makers.

Space Diplomacy

As noted in chapter 5, India was an early and active participant in the establishment of the legal principles that underpin the current space regime. The two key pillars of its space diplomacy have been an emphasis on the peaceful uses of space and multilateral approaches to arms control in space. These continue to shape its space diplomacy today. Therefore, the United Nations and affiliated forums, such as the Committee on the Peaceful Uses of Outer Space (COPUOS) and the Conference on Disarmament (CD), have been favoured by India. In this regard, India has supported several initiatives related to space arms control within the UN system strongly opposing the weaponisation of space. For instance, in 1998, India, together with Brazil, called for re-starting the Ad Hoc Committee on the Prevention of an Arms Race in Outer Space (PAROS) with the principal goal of negotiating a ban on ASAT weapons and 'rules of the road' for the use of satellites (Wolter, 2006: 67).

More broadly, in the 1990s, India remained adhered to its tradition policy stance against the weaponisation of space and voiced its concerns about the US plans for missile defence, which Indian policy-makers saw as a first step in this direction. In 1997, during a debate on the upper house of the Indian Parliament on US space technology, the then Minister of State for External Affairs, Salim Iqbal Sherwani, noted that, although the Indian government was cognisant that US space activities involve the use of laser-based systems, 'India's stand against use of anti-satellite (ASAT) weapons for prevention of arms race in outer space has been articulated in the relevant fora such as the Conference on Disarmament in Geneva. India has also proposed negotiations for an international treaty to ban anti-satellite (ASAT) weapons' (cited in Rajagopalan, 2011: 360). Then, in 2000, commenting on the US missile defence, the then Minister for External Affairs, Jaswant Singh, stated: 'We have consistently held a view that opposes the militarization of outer space…We cannot support this development' (cited in Tellis, 2006 125).

Nonetheless, by the early 2000s, it was evident that there was a somewhat tentative shift in the thinking of Indian policy-makers from a traditional strong opposition to missile defence systems and the weaponisation of space to an ambivalent stance towards the George W Bush administration's deployment of a national missile defence (NMD). This change was partly because of India's interest in ballistic missile defence (BMD) as a response to national security threats emanating from China and Pakistan and partly as a consequence of a growing recognition in New Delhi that the time was ripe for improving relations with the United States as the sole superpower (Tellis, 2006: 126).

Yet, given that this shift attracted considerable domestic criticism, the Indian government soon backtracked to its position against the militarisation of space. Despite recent pressure from key military and defence constituencies on its traditional position against the weaponisation of space, especially after the 2007 Chinese ASAT test, India's formal position on the issue of space weaponisation and militarisation has not changed (Rajagopalan, 2011: 362, 367). Crucially, however, India has not articulated an official national space policy to date (Rajagopalan, 2015).

Beyond its support for multilateral approaches to space arms control within the UN system, India continues to play an active role in a number of international organisations and forums, including the Committee on Space Research (COSPAR), the International Astronautical Federation (IAF), the Space Frequency Coordination Group (SFCG), the Committee on Earth Observation Satellites (CEOS), the intergovernmental Group on Earth Observations (GEO), the International Charter on 'Space and Major Disasters', the UN Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), and the International Space Exploration Coordination Group (ISECG). India has also been a member of the Inter Agency Debris Coordination Committee (IADC) (Department of Space, 2015: 128-9, Jayaraj, 2004: 105).

As for bilateral space cooperation, India has entered into cooperative arrangements with more than 30 countries, including key space-faring countries, such as Russia, France, the United States, Brazil, the United Kingdom, Germany, Canada, and several developing countries (Department of Space, 2015: 126, Press Trust of India, 2014c). In terms of regional cooperation, since 1995, India is hosting the UN affiliated Centre for Space and Science Technology Education in Asia and Pacific (CSSTEAP), which supports education programmes focused on the use of space technology for social and economic development.[214] India is also participating in the Sentinel Asia initiative of the Asia-Pacific Regional Space Agency Forum (APRSAF) that supports disaster management in the Asia-Pacific region (Department of Space, 2015: 128).[215]

What should be added is that there is now increasing recognition in New Delhi, under the Modi leadership, that space diplomacy can play a vital role in promoting India's broader foreign policy, national security, and commercial objectives. In this light, in 2015, for the first time a foreign secretary was made a member of the Space Commission, which remains the highest policy-making body in the country responsible for issues related to space.[216] Given India's growing presence on the high frontier, it is believed that this reconstitution of the Space Commission will help to outline a space policy that is more attentive to India's commercial and national security needs (Rajagopalan, 2015). This move is also indicative of India's unease with China's growing ties with South Asian countries and points to the close ties between space diplomacy and the balance of power. It is to India's engagement with the latter institution of the international space society that I now turn.

Balance of Power

India's growing emphasis on the military uses of space can be seen as a sort of limited adversarial balancing driven principally by China. But New Delhi is also concerned about the impact of China's growing profile in space on broader regional security dynamics. For example, India is paying close attention to China's increasing space cooperation with Pakistan and its security implications.[217] Beyond Pakistan, New Delhi is also worried about recent developments with regards to space that are indicative of Beijing's gaining foothold in India's neighbourhood. More concretely, in

[214] Centre for Space and Science Technology Education in Asia and Pacific (CSSTEAP), Background, http://www.cssteap.org/background.

[215] For more information on the initiative, see Asia-Pacific Regional Space Agency Forum, Sentinel-Asia: Disaster Management Support System in the Asia-Pacific Region, https://www.aprsaf.org/initiatives/sentinel_asia/.

[216] The 10-member Space Commission is consisted of the Secretary of the Department of Space, who is also the Chairman of ISRO, the Principal Secretary to the Prime Minister, the Cabinet Secretary, the National Security Advisor, the Expenditure Secretary and prominent space scientists and experts. See, Department of Space, Space Commission, http://dos.gov.in/space-commission.

[217] On space cooperation between China and Pakistan, see Ali (2011).

2012 Sri Lanka launched its first communications satellite from China, which was carried out through a partnership between the Sri Lankan SupremeSAT (Pvt) and the China Great Wall Industry Corp. According to analyst Brahma Chellaney, growing space ties between China and Sri Lanka strengthen the impression that Colombo is moving closer to Beijing and this 'sends a message to India that a country in its own backyard is cozying up with China' (Reuters, 2012). Meanwhile, China has entered into a cooperative agreement with Myanmar on remote sensing satellite data sharing, has shared satellite images with Bangladesh, and is exploring the possibility of launching satellites for Nepal and the Maldives (Kasturi, 2013).

Against this backdrop, there is a growing perception in New Delhi that a more active space strategy is needed. A series of reports issued by the principal foreign intelligence agency of India, the Research and Analysis Wing (RAW), have highlighted that India ought to have been more interested in helping Sri Lanka and the Maldives to launch their first satellites, instead of allowing China to augment its interests and image (Dikshit and Joshi, 2013). Consequently, the Prime Minister's Office has also urged ISRO to formulate a proactive strategy to counter China's influence. But as one ISRO official lamented 'quite simply, we just don't have the kind of resources and budget the Chinese do' (Kasturi, 2013). However, in 2014, Prime Minister Modi asked ISRO to develop a satellite to be used by the member countries of the South Asian Association for Regional Cooperation (SAARC) (Press Trust of India, 2014b). Clearly, this can partly be seen as a response to China's growing space ties with India's South Asian neighbours.

As we saw in Chapter 6, there is also an important interplay between regional and global security dynamics shaped principally by the role of the United States in East Asia and the Sino-US relationship. India's strategic posture in general and its space policy in particular are increasingly determined by this ever evolving strategic environment. This has been evident in the remarkable improvement of Indo-US relations over the past fifteen years, after years of alienation. It is not necessary to embrace the so-called 'democratic peace theory' to recognise that shared democratic values have brought the two countries closer. But as many have noted, this growing strategic partnership has also been influenced by balance of power considerations, as the United States aspires to help India emerge as a regional great power and as a counterweight to China (Twining, 2014: 19-20, 22-3). Of course, the most noteworthy aspect of this process has been the United States-India civil nuclear agreement that provided India with *de facto* recognition as a nuclear weapons state (NWS) (Narlikar, 2011: 1615).[218]

In addition to the US-India nuclear deal, another important development in this regard was the announcement of the Next Steps in Strategic Partnership (NSSP) in 2004 in which the United States and India committed to enhance cooperation in key areas of high technology, including civilian nuclear energy and civilian space activities. To facilitate this process, the United States eased its restrictions on the export of dual use high technology to India (Vadlamudi, 2005; Correll, 2006). This paved the way for the subsequent collaboration between NASA and ISRO in the *Chandrayaan-1* lunar mission (Moltz, 2012: 123).

Another important indication of the redefinition of their relationship has been the first Indo-US Space Security Dialogue in March 2015, which is driven by mutual concerns about China's growing military space capabilities (Press Trust of India, 2015). As part of this bilateral dialogue, there are discussions about extending cooperation on SSA and collision avoidance and the use of space for maritime awareness (Rose, 2015; the White House, 2014). Meanwhile, since 2010, the United States and India have been holding the annual India-USA Civil Space Joint Working Group, which reviews bilateral space cooperation, and, more recently, in 2014, they established the ISRO-NASA Mars Working Group. Cooperation also includes the microwave remote sensing satellite 'NASA-ISRO Synthetic Aperture Radar' (NISAR) and sharing earth observation data (Department of Space, 2015: 126-7; the White House 2014).

In parallel with the deepening of space cooperation between New Delhi and Washington, space ties have been established between India and key US allies in the Asia-Pacific. In 2008, ISRO and the Japan Aerospace Exploration Agency (JAXA) signed an agreement to extend their cooperation in the field of disaster monitoring (Brown, 2008) and, in 2012 India signed a memorandum of understanding with Australia on civil space cooperation (Press Trust of India, 2012b). Then, in 2015 India and South Korea identified several areas of bilateral space cooperation, including lunar exploration, satellite navigation, and space science and application as part of their 'special strategic partnership' (Press Information Bureau, 2015).

[218] On the politics of the US-India nuclear deal, see Mistry (2014).

But despite the closer bilateral ties highlighted above, India has not formed an alliance with the United States yet and it is more likely that it will remain unwilling to do so in the near future. So far, it seems that India’s traditional emphasis on preserving its strategic autonomy has dictated a cautious approach to its engagement with the United States and its Asia-Pacific allies. Thus, for now, New Delhi is hesitant to be closely associated with Washington in what might be seen as an overt attempt to constrain Beijing.

Indeed, in 2014, during President Xi Jinping’s visit to New Delhi, a memorandum of understanding was signed between ISRO and the China National Space Administration (CNSA) that encourages bilateral space cooperation, including ‘research and development of scientific experiment satellites, remote sensing satellites and communications satellites’. Clearly, it is too early to say what form this cooperation might take. But we need to be careful not to overestimate the impact of this agreement on Sino-Indian space relations, especially given that, although a ‘framework agreement’ was signed between Beijing and New Delhi in 2006, no significant steps were taken towards bilateral cooperation (Jayaraman, 2014). But while the recent Sino-Indian agreement points to a mutual recognition that both countries have a vested interest in fostering space cooperation, the most general point to make is that India feels increasingly compelled to respond to China’s rise in space by pursuing a space policy that encompasses elements of balancing behaviour.

Great Power Management

Certainly, India’s pursuit of high-prestige space exploration missions has been part of its quest for great power status. In October 2015, reflecting on India’s recent accomplishments in space, including its lunar and Mars missions, the Permanent Representative of India to the Conference on Disarmament, Ambassador DB Venkastesh Varma (2015) noted that ‘India is a major space faring nation’. True, high visibility space achievements have highlighted India’s rise as a space power. For example, a report issued recently by the Beijing Institute of Space Science and Technology Information, which is affiliated to the China Academy of Space Technology (CAST), assessed that India is one of the five major space powers, mentioning its Mars mission as a key breakthrough in its space capabilities (Xinhua, 2015).[219]

Be that as it may, the process of being recognised as a great space power is often complex and multifaceted. In what follows, it will be argued that, although India is a full-fledged member of international space society as well as an emerging space power, it makes more sense to see India as a great space power in the making rather than as an established one.[220] More specifically, it is clear that India has engaged with the process of maintaining and consolidating international space order as a responsible member of international space society. As indicated above, India is party to all key international treaties governing space and it has been supportive of efforts to prevent an arms race in race. As a participant in the Inter-Agency Space Debris Coordination Committee (IADC), it has also played a constructive role in drafting the 2007 Space Debris Mitigation Guidelines. Further, India has backed all of the key UN initiatives with regards to space sustainability, including the UNCOPUOS Working Group on the Long-term Sustainability of Outer Space Activities and the UN Group of Governmental Experts (GGE) on Transparency and Confidence-building Measures in Outer Space Activities (TCBMs) (Varma, 2015).

In terms of responsibilities, as a developing country, India has taken significant steps in addressing the needs of developing countries and promoting a more equitable order in space. A key contribution is this regard has been hosting the UN affiliated CSSTEAP. It is also worth noting that the development of the 'SAARC satellite' has been framed along these lines. In his announcement of the project, Prime Minister Modi emphasised that the 'SAARC satellite' is 'a gift from India' in order to benefit the 'development of all the countries in the region' (Press Trust of India, 2014b). In his words, 'India is rooted in the age old ethos of Vasudhaiva Kutumbakam (the world is one family). India's space programme is driven by the vision of service to humankind and not by the desire for power. We must therefore share the fruits of our technological advancement with those who do not have the expertise, and our neighbours in particular' (T.A. Johnson, 2014a). Equally, under the regional

[219] According to the report (Xinhua, 2015), the ranking order is as follows: United States, Russia, Japan, China, and India. It is striking, perhaps, that a Chinese report considers that China's space power follows behind Japan. But it is likely that the CAST's report is primarily aimed at a domestic audience and is intended to garner further public support for the Chinese space programme by playing the 'Japan card'.

[220] On the general point that India is a great power in the making rather than an established great power, see Narlikar (2011).

cooperative mechanism of the UN Economic and Social Commission for Asia and the Pacific (UNESCAP), India has provided satellite-based technical support to Sri Lanka related to drought monitoring. Likewise, India participates in the COSPAS-SARSAT international system through which it offers search and rescue support to India's neighbouring countries (Department of Space, 2015: 128).

In light of the developments highlighted above, a number of points are worth emphasising here. First, India has not sought to challenge the current international space order. Instead, it has taken part in maintaining it. In fact, India has come a long way from its 'third worldism' and its emphasis on state sovereignty on issues concerning the governance of space in the 1970s and the 1980s (Mohan, 2010: 137-8). By way of illustration, it is useful to remember that India, along with other developing countries, initially opposed the use of direct broadcasting from satellites to other countries on the grounds that it constituted a violation of territorial sovereignty (Mohan, 2013: 31). In contrast, today it seems that Indian thinking about global governance issues is shifting from a focus 'on equity and justice to order and stability' (Mohan 2010: 141-2). As Mohan (2010: 141) points out, this shift reflects India's adaption to 'the logic of major power status'.

Second, and related to the previous point, there is a growing recognition that India, as an emerging space power, should have a hand in shaping and maintaining international space order. As Frank A. Rose (2015), the Assistant Secretary of the Bureau of Arms Control, Verification and Compliance at the US State Department has noted: 'As established space-faring nations, India and the United States should work together to clearly and publicly define what behavior the international community should find both acceptable and unacceptable'. In doing so, Rose (2015) also called India to take a leadership role in multilateral fora in order to shape, together with the United States, norms of responsible behaviour in space. However, implicit in this statement is that India has not taken that role yet. Crucially, in addition to external pressure, especially from the United States, that encourages India to contribute to international space order, there is also a growing recognition within the country that India should be more proactive in engaging with the process of shaping norms and rules in space.[221]

[221] For example, this was one of the underling themes that emerged during the ORF Kalpana Chawla Annual Space Policy Dialogue (Asian News International, 2016).

This leads to the third point to make. For all the debates about its rise as a great space power, it appears that India has been somewhat punching below its weight. Despite external and domestic pressure to assume a leadership role in its engagement with institutional elements of international space order that is commensurate with its rising profile in space, India has generally been reluctant to get involved in efforts to shape rules pertaining to space governance.[222] Indeed, while India has been careful not to undermine key norms that underpin order in space, unlike China, in recent years it has not taken any initiatives concerning arms control in space. It should also be noted that, much to its disappointment, India was not invited to participate in the UN GGE on TCBMs. According to Ambassador Varma (2015) 'it is unfortunate that a major space faring country like India was not included in the GGE on TCBMS…This is one example of how a decision to keep India out was actually a loss to the GGE'. But although it is plain that India's participation in the GGE would provide further legitimacy to its mandate, perhaps, India's exclusion serves to highlight that it is still somewhat early to describe it as a great space power.

Fourth, another important issue here concerns India's limited approach to what the provision of goods involves. In examining India's rise as a responsible great power, Narlikar (2011) makes a helpful distinction between global public goods and club goods. With the risk of oversimplification, whereas public goods are usually associated with great powers and their willingness to set the agenda and preserve order, club goods are usually associated with rising (and regional) powers that are more inclined to supply certain goods targeted to a smaller contingency (Narlikar 2011: 1608-9). So far, India has been more willing to provide specific club goods rather than global public goods. What follows from this is that India is clearly a rising power, but it remains largely hesitant about assuming great power responsibilities that would signify its status as an established great power (Narlikar 2011, Narlikar 2013). This important insight is also relevant to the question of whether India is a great space power. As far as international space order is concerned, it is possible to say that the provision of goods to developing countries is a key aspect of what great power responsibilities involve, but a mere focus on supporting developing countries through the supply of club goods is not enough to render India a great space power.

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[222] On this point, see, inter alia, Gopalaswamy and Kampani (2011); and Moltz (2012: 134).

Therefore, the most general point to make is that, although India is willing to supply certain goods, which are largely confined to developing countries, it has generally been reluctant to take a leadership role in shaping and reinforcing international space order that would be in accordance with an established great power. It remains to be seen whether it will assume a more proactive engagement with influencing international space order, but, among other factors, the quest for strategic autonomy embedded in its postcolonial identity suggests that this will be a slow process.

The Space Market

In 1991, the Indian government under PV Narasimha Rao introduced a series of major reforms aimed at fostering India's integration with the global economy. As part of this effort, the Department of Space established the Antrix Corporation Limited in 1992, ISRO's commercial wing, and since then India has expanded its commercial activities in the global market of space products and services (Moltz, 2012: 120-1). The launch of ISRO's 100th space mission of putting two satellites in orbit has been illustrative of Indian's effort to commercialise its space programme in that none of the satellites onboard the flight was Indian (one was the French SPOT-6 satellite and the other one the micro satellite PROITERES developed by the Osaka Institute of Technology) (the Indian Express, 2012).

In 1999, the successful launch of South Korea's *Kitsat-3* and Germany's *Tubsat* on a PSLV-C2 rocket marked the beginning of India's involvement in the commercial launch business. From 1999 onwards, ISRO has launched 74 international customer satellites from 20 countries using the PSLV launch vehicle.[223] Only between 2013 and 2015, India launched 28 foreign satellites carried on the PSLV that generated $101 million in revenues (de Selding, 2016). What should be noted is that, although most of the flights carried small satellites into orbit due to the limitations of the PSLV, it is expected that the recent successful flights of the more powerful GSLV launcher will help India to capture a bigger share of the global space market. As part of the 'make in India' initiative, ISRO has also called for a bigger role of the private space sector in the space programme that could push India's further integration into the global space market (Press Trust of India, 2016).

[223] Antrix, Launch Services, http://www.antrix.gov.in/business/launch-services.

Concluding Remarks

This chapter has shown the ways in which the ever evolving and dynamic structure of international space society has had a constitutive impact on India from 1990 to 2016. It has also assessed India's contribution to the maintenance of international space order. A couple of points flow from this discussion. First, certainly, one of the key features of India's space programme has been its new emphasis on highly visible space projects, such as the lunar and Mars missions, which seems to be at odds with its traditional focus on the use of space for socio-economic benefits. However, as this chapter has demonstrated, there is more continuity than change in India's space endeavour, which has been manifested in the continuing and powerful influence of postcolonial techno-nationalism on key Indian space projects. Seen in this light, India's recent interest in high visibility space projects constitutes an embedded practice of its postcolonial identity that still signifies highly visible technological projects as markers of power, status, and modernity. Therefore, the analytical framework put forward in this study is attentive to the salience of history in a postcolonial context and how this still influences the nexus between the state, modernity, and technology.

Second, it is clear that India's decision to accelerate the militarisation of its space programme has been a reaction to the emergence of new security challenges, the most important of which is China. Yet, this shift in India's space outlook is also indicative of the 'socialising' effects of the wider militarisation trend in international space society. But it is also useful to recognise that the militarisation of India's space programme can also be seen as an expression of postcolonial techno-nationalism in the sense that military space capabilities assume symbolic importance as markers of the state's great power status and modernity. At the same time, however, it appears that Indian policy-makers are still imbued with a sense of civilisational exceptionalism that emphasises India's normative commitment to the peaceful uses of space for civilian and socio-economic purposes. So far, this has constrained an overt and systemic militarisation, not to mention weaponisation, of the space programme.

Third, it is plain that India has emerged as a major space actor in a number of areas, including space exploration, military space capabilities, and commercial activities. But while India is an emerging space power as well as responsible member in international space society, it is not a great space power yet. As we saw, since 1990, India has been engaged with the process of maintaining and consolidating international space order by supporting the prevention of an arms race in space and opposing the weaponisation of space. It has also played a constructive role in engaging with the norm of space sustainability. Moreover, it has made important contributions to international space order by providing goods to developing countries. Consequently, there is also increasing recognition among established great powers that India today should have a say in managing international space society. Nevertheless, India appears rather reluctant to assume the burden of sharing great power responsibilities that are in accordance with its growing profile in space, at least for now.

Whatever we may think about the efficacy and the goals of India’s space programme, an analysis of India’s engagement with the primary institutions of international space society offers a useful way of trying to capture a wider array of forces and pressures that shape India as an important space actor. Equally important, it also helps to highlight how India takes part in the process of facilitating the construction and maintenance of international space order.

Conclusions

The main aim of this thesis is to investigate what, if anything, can the English School theory tell us about the international politics of space generally and about the cases of China and India as rising space actors in particular. In addressing this question, the central argument of thesis has been twofold. First, using the English School theory as an analytical lens through which to look at space, this thesis pays attention to the existence of international order in space, which is established by rules, norms, and practices shared among space-faring states. This argument is developed by illustrating the ways in which there is an international society at the sectoral level represented by space with a distinct international social structure. This is manifested in how its primary institutions are differentiated from such institutions at the global level (war, law, sovereignty, diplomacy, balance of power, great power management, market, environmental stewardship) in a historical and comparative perspective. This thesis also suggests that there are good reasons for including techno-nationalism as a distinctive primary institution of international space society. A focus on the distinct institutions of international space society helps to highlight their constitutive impact on China and India as space actors and what is accepted as legitimate patterns of space activity.

Second, the thesis argues that the space programmes of China and India have been informed by a certain variant of techno-nationalism in a postcolonial context, what I call 'postcolonial techno-nationalism', which is based on the development of space technology as a normative marker of the state's power, status, and modernity. Building on the English School concept of the standard of civilisation and drawing on key ideas from historical and sociological studies on science and technology, this thesis highlights how this enduring influence of postcolonial techno-nationalism reflects the operation of technological advancement as an informal standard of civilisation during the expansion of the European international society of states in the nineteenth century. Therefore, the concept of techno-nationalism elucidates how historically embedded conceptions and practices associated with the role of technology in international society continue to inform contemporary ideas, meanings, practices, and norms in international space society. Consequently, by highlighting the importance of history, this thesis offers an alternative and valuable approach to the study of the international politics of space that emphasises historical depth.

Main Findings and Contributions

By way of summary, it is useful to restate the main findings of this thesis and to assess its contributions to our understanding of the international politics of space. The most important contribution of this thesis is the conceptualisation of space as international society that offers a number of possible insights. First, relating space to international society helps to highlight the complex and dynamic social constitution of international space order with an emphasis on institutional practices and historical depth. In this regard, a focus on the distinct primary institutions of international space society offers a wide range of analytical tools to examine how international space order is produced, maintained, negotiated, and contested in a historical and comparative context. Thus, by defining space in a societal perspective an international society approach also illustrates the importance of shared norms, institutions, rules, and identities among space-faring participants. Consequently, this thesis makes a timely contribution to debates about the growing militarisation of space by stressing that there is nothing inevitable about space weaponisation, given that space activities and practices are what the members of international space society make of them.

Second, using the cases of China and India, the framework of international space society suggests that it is necessary to recognise how China and India as space actors are social constructs within international space order. Therefore, focusing only on China or India and their specific military and civilian space activities is not enough in order to make sense of the plethora of structural, institutional, and historical factors that shape their behaviour in space. In other words, their rise as space powers is contingent on their interaction with a dynamic, complex, and evolving international space order. In this light, framing space as international society also sheds a revealing light on how China and India have engaged with the process of maintaining and shaping order over the last decades. This is a valuable insight, not the least because it emphasises that international space society is a two-way street that not only shapes its members, but is also shaped by them.

Third, and consequently, by defining space power in societal terms, the framework of international space society sets an innovative and alternative benchmark against which to assess China and India as rising space powers. More specifically, focusing on what the role and responsibilities of great space powers involve, this thesis has argued that China's rise as a great space power has had both negative and positive implications so far. Yet, as was discussed in Chapter 6, recently, there is evidence to suggest that it is more willing to play a more active role in contributing to the maintenance of space order by assuming the burden of sharing great power responsibilities, which are in accordance with its growing power in international space society. At the same time, China is increasingly recognised as a great space power. Equally, this thesis shows how India has emerged as a key space power in a number of areas of space activities. But given its reluctance to accept great power responsibilities, it is not an established great power yet, at least for now. In this light, this thesis also makes an important contribution to wider debates about how to conceptualise and understand space power.

Fourth, while acknowledging the role of technology and the physical qualities of the space environment as material-context factors that influence the primary institutions of international space society, by defining space in a societal perspective, this thesis problematises the very idea of outer space and its demarcation from terrestrial politics. As was discussed in Chapter 2, a sectoral approach that pays attention to the distinct social structure of space activities as a 'social whole' offers valuable insights into the concept of space security by transcending the existing three dimensional framework (outer space for security, security in outer space, security from outer space). This opens up the possibility of bringing both terrestrial and non-terrestrial dimensions of space activities together in a more holistic and finely tuned understanding of space security.

Fifth, one of the most important findings of this thesis is that history matters and the particular interest of China and India in developing highly visible space projects can be explained largely in light of their earlier encounters and formative experiences. As we saw, the enduring influence of postcolonial techno-nationalism that has informed the pursuit of China and India's space programmes as symbols of the state's power, status, and modernity can be largely understood as a reflection of how technological advancement was constituted as an informal standard of civilisation during the expansion of the European international society in the nineteenth century. Based on technological advancement as a key measure of the level of a given civilisation, China and India were usually seen as 'uncivilised' by the 'civilised' and technologically advanced European powers. Significantly, despite the fact that the discourse of racial and civilisational hierarchies became less prominent in the aftermath of the Second World War, technological advancement continues to establish distinctions between outsiders and insiders. Thus, it is necessary to recognise the relationship between being space-faring and being modern and how the advent of the Space Age signified a new condition of demarcating insiders and outsiders and how this compelled Chinese and Indian elites to pursue space programmes from early on. This point has become more relevant today, given China and India's rise in international society and their quest for great power status.

While the main focus of this thesis is empirical rather than theoretical, it also offers pay-offs for English School scholars and science and technology specialists. More specifically, for English School scholars, this thesis provides the straightforward concept of sectoral international societies by extending the English School theory to the study of international society at the sectoral level. As was noted in the Introduction, by bringing technology and the English School theory, a sectoral approach adds a third dimension to the study of international society that transcends the global and regional levels. Equally, a sectoral approach opens up new avenues for bridging the English School with International Security Studies as the example of space security illustrates. It also offers a new way of relating the English School with global governance, including space governance.

In relation to science and technology specialists, this thesis offers the more refined concept of postcolonial techno-nationalism that highlights how history and identity still inform highly visible technological projects as markers of the state's power, status, and modernity. Indeed, one of the key questions is how China's space programme made significant progress and produced remarkable achievements amid a period of political and social turmoil and limited financial resources. Most analyses tend to focus on the reasons why China decided to develop certain space capabilities and how it used them once they were available. But what has happened in the meantime rarely attracts scholarly attention. However, postcolonial techno-nationalism, as a composite, but influential ideology, helps to illustrate how the Chinese space programme was justified and implemented successfully. Likewise, the case of India sheds a revealing light on how a postcolonial techno-nationalist understanding of space technology has informed the pursuit of the Indian space programme since its inception.

Moreover, as we have seen, key works on the history and politics of China's strategic weapons programme have highlighted techno-nationalism as a useful concept. But most of these analyses have rather downplayed how China's techno-nationalism has been influenced by its formative encounter and experience with the expanding European society of states. On the other hand, while important works on the history and politics of India's nuclear programme have emphasised the enduring influence of its colonial experience, it is striking, perhaps, that techno-nationalism has been largely neglected in the relevant literature. Equally, most analyses of China and India's space programmes remain somewhat descriptive and ahistorical. In this light, the concept of postcolonial techno-nationalism can be used to tell the story of other highly visible technological projects by elucidating the crucial relationship between civilisation, modernity, and technology in a postcolonial context.

Concluding Remarks

It is important to recognise here that, in many ways, the conceptual framework of international space society remains underdeveloped. This is not surprising, given that this thesis has attempted to move English School theory into terra incognita. As Chapters 6 and 7 have shown, the concept works well, but much work remains to be done. Therefore, it is useful to say briefly something about some key issues that need attention and further elaboration. First, as was discussed in Chapter 2, my intention is not to offer a comprehensive and definite account of what may be included as a primary institution in international space society, but there is scope for examining other candidates for status as primary institutions, beginning with hegemony. This also involves a more detailed analysis of how the primary institutions of international space society relate to each other and how international space society interacts with international society at the global level. Second, it is clear that the cases of other space actors can help to enrich the concept of international space society, including transnational space actors. Despite the fact that my analysis calls attention to the pivotal role of scientists and engineers as agents of international space society, arguably, more needs to be done in terms of highlighting the interplay between the interstate, transnational, and interhuman domains in international space society. Third, while my focus here is on using international society as an analytical central idea, this thesis hints at the question of whether international space society exists in ontological terms. This is definitely an important question that is worth exploring elsewhere. More broadly, it is also worth considering other sectoral international societies, including the nuclear and cyber international societies, and what can international societies at the sectoral level tell us about international society at the global and regional levels.

All in all, although the conceptual framework provided in this thesis remains incomplete, conceptualising an international space society offers a new way of thinking about the complex dynamics of the international politics of space. Focusing on China and India's engagement with international space order, this thesis also offers valuable insights about China and India as emerging space powers and members in international space society.

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