Engineering world society? Scientists, internationalism, and the advent of the Space Age

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Abstract In recent years, there has been a growing interest in the English School concept of world society and how it helps to illustrate the role of non-state actors and the promotion of cosmopolitan values. Yet, less attention has been paid to the idea of science and technology as a key feature of solidarist conceptions of justice and as a unifier of humankind, usually expressed in the form of scientific internationalism. The purpose of this article is twofold. First, it suggests that it is important to incorporate the role of scientists and engineers as agents of international society and to assess the significance of scientific internationalism in terms of its impact on facilitating world society. Second, however, it is also necessary to consider how this solidarist conception of science and technology is staged as complementary to a pluralist logic. This is because of the political and social embeddedness of scientists and engineers as actors who also think and act on behalf of the state. I develop this argument by examining two key turning points that paved the way towards the advent of the Space Age: the spaceflight movement of the 1920s and 1930s and the 1957–1958 International Geophysical Year.

Keywords English School World society Scientific internationalism Scientists Space Spaceflight movement International Geophysical Year

Introduction

This article employs an English School approach to examine how the complex interplay between state and non-state actors shaped the push for the expansion of international society in space. A key dimension of this process has been the idea of

science and technology as a unifier of humankind, usually expressed in the form of scientific internationalism and cosmopolitan values. English School scholars have recently drawn attention to the concept of world society and its relevance to the study of non-state actors and cosmopolitan values. Yet, the influence of scientists as actors, scientific internationalism as practice, and the origins of the expansion of international society beyond this world have been thus far neglected in the relevant literature.

This article takes up this task in two main steps. Firstly, it suggests that it is necessary to incorporate the role of scientists as agents of international/world society and to assess the significance of scientific internationalism in terms of its impact on engineering world society. Second, however, it is also important to consider how cosmopolitan and solidarist conceptions of science and technology are complemented by a pluralist logic. This is an important consideration because scientists and engineers also think and act on behalf of the state. In doing so, I examine two key turning points that paved the way towards the advent of the Space Age: the spaceflight movement of the 1920s and 1930s and the 1957–1958 International Geophysical Year (IGY).

The argument of the article is developed in the following ways. The first part provides a snapshot of the key English School concept of world society, and it then moves on to offer an analysis of the specific set of ideas, norms, and practices that have underpinned scientific internationalism. In doing so, the article traces the modern origins of scientific internationalism and universalism back in the ideal of the Republic of Letters and briefly examines its influence in what later would become the idea of an 'international scientific community'. Crucially, however, with the advent of nationalism, scientific internationalism went hand in hand with scientific nationalism.

The second part of the article then turns to the empirical cases, revisiting the early origins of what is usually called the spaceflight movement of the 1920s and 1930s and the 1957–1958 International Geophysical Year (IGY). Standard International Relations (IR) accounts emphasise the importance of national security and prestige considerations as the principal drivers behind the space race between the United States and the Soviet Union during the Cold War, which ushered in the Space Age with the launch of Sputnik. But for some time, space historians have argued that it was a heterogeneous group of space enthusiasts, amateur engineers, and science fiction writers who advocated the idea of spaceflight and made it seem feasible in the early twentieth century. The article then briefly examines the launch of the first artificial satellites, which occurred as part of the IGY. The IGY, of course, was enmeshed in the Cold War rivalry between the two superpowers, but it was also a remarkable international scientific event and a global science endeavour.

The general point that emerges from employing an English School approach to the origins of the expansion of international society in space is not simply that it was partly driven by the ideals of scientific internationalism and scientific cosmopolitanism, but that scientists and engineers were a key force for taking international society's first small step on a world beyond Earth.

The concept of world society

Although much attention has been paid to the concept of international society as the key contribution of the English School to IR theory[1] as well as on the system/society distinction,[2] less attention has been paid to world society and how it relates to international society. Until recently, as Buzan (2004, pp. 44, 62) notes, the concept of world society was underdeveloped. But although in recent years there has been a burgeoning literature on the concept of world society,[3] there is less consensus about what this might mean and what constitutes its normative and analytical quality. World society is usually linked with moral cosmopolitanism, associated with the normative commitment of promoting a universal community of humanity. In this respect, while the idea of international society is largely about an order-focused society of states, the focus of world society is individual human beings and the delivery of justice (Williams 2014, pp. 130–131).

However, in his influential structural revision of the concepts of international society and world society, Buzan (2004, p. 120) has introduced 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' within the English School, (b) a 'transnational society' that refers to non-state collective actors and (c) an 'interhuman society' that refers to individual human beings. In this framework, the concept of world society is redefined to denote the interplay between the interstate, transnational, and interhuman domains whereby no one of the three societies is standing out as dominant (Buzan 2004, pp. 202–3, 269). Drawing on Buzan's structural revision, others argue that the idea of world society still holds analytical purchase as a distinct level of analysis, which focuses exclusively on non-state actors (Pella 2013, 2015, p. 212).

This debate about the distinction between international and world society also blends into the debate about pluralism and solidarism. Pluralists and solidarists disagree about how best international society can reconcile demands for order and justice. For pluralists, the maintenance of interstate order is conditioned on political tolerance and cultural diversity in international society.[4] For solidarists, however, securing order requires the transcendence of the state system to accommodate concerns of justice in international society.[5] Taking this view, solidarists are concerned with issues of justice, such as human rights and humanitarian intervention, which are largely embedded in liberal cosmopolitan perspectives (Buzan 2014, pp. 15–16).

1 Bull and Watson (1984, p. 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 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'. On international society, see, inter alia, Bull (2002); Clark (2005); Bellamy (2005); Linklater and Suganami (2006); Hurrell (2007); and Navari (2009).

2 For an overview of the debates about the system/society distinction, see Dunne and Little (2014).

3 Recent examples include: Williams (2005); Ralph (2007); Pella (2013); Stivachtis (2014); and Pella (2015).

4 Prominent examples of pluralist works include: Jackson (2000) and Mayall (2000).

5 Key solidarist texts are: Vincent (1986) and Wheeler (2000).

Nevertheless, it is worth emphasising that pluralism and solidarism should not be seen as mutually exclusive, but rather as a conversation that highlights the dilemma between order and justice in international society and how to find the proper balance between the two (Buzan 2014, p. 16; Hurrell 2007, p. 9; Weinert 2011). Indeed, given that pluralism and solidarism are often co-implicated (Zhang 2016, p. 101), Buzan (2014, p. 115) has recently put forward the useful distinction between state-centric solidarism and cosmopolitan solidarism, which are 'strong forms of internationalism, but based on different ontologies (states, people)'. Buzan (2014, p. 132) maintains that, although the solidarist literature 'may be motivated by an underlying cosmopolitanism, in practice it is almost all about state-centric solidarism'.[6] Likewise, Clark (2007, p. 8) argues that international and world society should not be seen as oppositional, but rather as dependent on each other. In this view, world society relies on international society to advance specific norms, values, and practices, and international society also benefits from its interaction with world society.[7]

Clark's articulation of the relationship between international and world society is particularly useful here because it helps to capture the spaceflight movement of the 1920s and the 1930s as well as the efforts to launch the world's first satellites as part of the IGY. But Buzan's notion of state-centric solidarism is equally useful for the purposes of this discussion. As we shall see, while at the outset space enthusiasts popularised the idea of spaceflight without the support of the state, it soon became clear to them that the state was indispensable for turning their dream into a reality. By the late 1930s, therefore, many space enthusiasts had already been absorbed by the state. However, despite the fact that the advent of the Cold War initially was a major obstacle to scientific cooperation, by the 1950s, state policies and programmes had incorporated many of the assumptions and views of scientific internationalism. Therefore, scientific internationalism as practice was consolidated in a state-centric international society, reflecting state-centric solidarism in Buzan's terms. Before considering these developments in any detail, however, it is important to say something about the role of scientists in general and scientific internationalism in particular.

Scientific Universalism: Engineering World Society?

Bringing scientists into International Society

It is neither novel nor controversial to claim that one of the striking features of the contemporary structure of international society has been the role of scientific and technical groups. In particular, much of the authority of scientists and engineers has been rooted in the social construction of scientific and technological advancement as an

6 On state-centric solidarism, also see Zhang (2016, pp. 99–100).

7 Clark (2007, p. 6) defines world society as the 'realm of the individual, of the non-official group or movement, and the transnational network of nongovernmental agents'.

expression of civilisation, empire, progress, and reason. These themes and ideas regarding science and technology were so characteristic of the European colonial expansion in the nineteenth century.[8] However, the authority of scientific and engineering expertise was further consolidated amid the Cold War antagonism. It was during this period that the emergence of scientific and technological advancement as a marker of the state's national power, great power status, and modernity led to a dramatic increase of state-funded science and technology research. This process was not only confined to nuclear technology and the space race, but also affected other fields, including computer science, biomedicine, and meteorology.[9]

In light of the above, the concept of epistemic communities captures something important about the influence and shared expertise of this sort of actors in international relations. Haas (1992, p. 3) famously defined an epistemic community as 'a network of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue area'. Focusing on the European epistemic community of diplomats, Cross (2007, p. 225) points out that it is worth bringing epistemic communities into the picture of international society, given that many of its actors can be seen as epistemic communities that have the effect of moderating the realist inclinations underpinning international society.

While there is clearly something in this, this might seem to be a rather limited framework when trying to make sense of the cases under consideration. A number of points are worth making here. First, as sociologist Bainbridge (2002, p. 41) has persuasively argued, the earlier phase of the development of space technology was largely the product of a sort of a social movement 'that transcended ordinary commercial, military, or scientific motives'. The so-called spaceflight movement was consisted of a heterogeneous and definitely not professional small network of space advocates (rocket amateurs, philosophers, technology enthusiasts) coalesced around the composite ideology of spaceflight (Bainbridge 1976). In this regard, the spaceflight movement was not characterised by professionalism and internal cohesion, two of the key criteria that according to Cross (2013) underpin the formation of epistemic communities.

Second, given that the IGY involved scientists from several scientific disciplines related to Earth sciences, it is more helpful to talk about the role of the scientific community in conceptualising and implementing the IGY, instead of utilising the concept of epistemic communities. In fact, it was not until the launch of Sputnik and the beginning of the Space Age that many new issues related to space emerged, which in turn led to the rise of influential epistemic communities in the true sense, including a transnational community of international lawyers focused on space law.[10] In other words, the concept of epistemic communities can offer important

8 On this process, see, inter alia, Headrick (1981); Adas (1989); and Prakash (1999).

9 On the significance of science and technology during the Cold War, see, inter alia, Oreskes and Krige (2014) and Hecht (2011).

10 On the importance of the community of legal experts and policy networks in shaping space law, see Peterson (2005).

insights into key aspects of the relationship between international and world societies and the role of scientists, especially after the advent of the Space Age. But the focus here is primarily about scientific internationalism that operated initially as a rather composite ideology of different visions about engineering world society expressed in the spaceflight movement. Significantly, however, it was in the reconfigured context of the Cold War that spaceflight became a reality partly as a result of scientific internationalism in the form of state-centric solidarism, which led to the gradual expansion of international society in space.

Scientific internationalism: from the Republic of Letters to the international scientific community

The story of scientific universalism or internationalism has been much discussed in the literature that deals with the historiography of science and the history of ideas. While a detailed analysis of its particular dynamics is beyond the scope of this article, a number of points are worth making for the purposes of this discussion. First, one of the most important expressions of scientific universalism has been the ideal of the 'Republic of Letters'. Despite the fact that the idea of a 'Res Publica Litteraria' dates back to antiquity, it was in the late seventeenth and eighteenth centuries that it gained prominence among savants. The main idea was that people of learning thought of themselves as forming an equalitarian Republic based on the values of cosmopoli-tanism and tolerance that transcended religion, family or nation. While there has been a great deal of debate about the extent to which the Republic of Letters was more or less an inconsequential ideal, the impact of its power as a shared value should not be underestimated (Somsen 2008, p. 363). Indeed, despite its immaterial nature in terms of location and administration, it was a 'real realm' that stood above the sovereign states of the Enlightenment (Daston 1991). In other words, it was an imagined community of scholars (Mayhew 2004, pp. 253–254). As the editor of the annual Histoire de la Republique des Lettres en France noted in 1780:

> there exists a certain empire, which holds sway over only the mind, [an empire] that we honor with the name Republic, because it preserves a measure of independence, and because it is almost its essence to be free. It is the empire of talent and of thought. The academies are its tribunals; people distinguished by their talents are its dignitaries. Their reputation is their title…they are, if you will, a kind of orphan, to whom fortune denies those distinctions for which nature intends them. They form a species by their merit, and gain a reputation as brilliant as that of the great powers of the earth (cited in Daston 1991, pp. 367–368).

Nevertheless, even though the Republic of Letters was inclusive, at least in principle, it is more accurate to say that, in practice, it was identified with the 'civilised world' (Somsen 2008, pp. 363–364).

Second, the French Revolution and the ensuing association of knowledge with patriotic values marked the metamorphosis of the cosmopolitan nature of the Republic of Letters. More specifically, by the early nineteenth century scientific accomplishments were increasingly seen as indicators of a nation's prestige and greatness. However, the rise of scientific nationalism did not preclude the representation of science as supranational by scientific universalists. For example,

Saint-Simonians continued to imagine the formation of a universal association 'of the great human family' through industry and mechanisation (Mazower 2012, p. 97). But what was previously thought of as 'a brotherhood of individuals' gradually became 'an association of nations' and the Republic of Letters was eventually replaced by the idea of an 'international scientific community'. A key dimension of this process was the institutionalisation of the international scientific community, which was manifested in the increased number of international conferences and international scientific unions between 1860 and 1899 (Somsen 2008, pp. 364–366, 2014, p. 125).[11] As Mazower (2012, p. 106) points out, the formation of numerous scientific associations as a consequence of the increasing authority of expert specialisation was reflective of 'an idealized vision of science and technical knowledge as a creed without borders'.

Third, it is important to note that the international organisation of science was concomitant with the spread of scientific nationalism (Forman 1973). This might seem at first sight to be a sort of a paradox, but the participation in international scientific institutions provided an environment for assessing and recognising national scientific attainments on the basis of international scientific standards (Somsen 2008, p. 366). Thus, as Forman (1973, p. 153) notes, the tension between competition and cooperation has been an essential feature of any scientific activity.

But what were the key assumptions and beliefs that informed the ideology of scientific internationalism? At the outset it is important to emphasise that there were different versions of scientific internationalism, not the least because of the increasing role of ideologies between the two world wars. For example, socialist internationalism became increasingly prominent in the European discourse on science and world society in the 1930s. One influential writer that epitomised this was H.G. Wells, who hoped that the transformative and progressive nature of science would ultimately lead to a 'World State' (Somsen 2014, pp. 132–3).[12] That said, it is possible to discern some of the principal beliefs and assumptions that informed scientific internationalism. According to Manzione (2000, pp. 23–24), at the heart of the ideology of scientific internationalism were a set of ecumenical traditions and principles associated with the scientific profession: that scientific knowledge is universally beneficial; that the pursuit of knowledge should be impervious to culture or politics; that scientific exchange is essential to the progress of science and human civilisation; and that science itself is a sort of lingua franca, a universal language of humankind that fosters a cosmopolitan perspective, common goals, and a merit-focused order transcending national borders. What should be added is that scientific internationalism did not only coincide with the consolidation of the authority of the scientific profession, but it was also entrenched in the emergence of internationalism in the 1920s, spearheaded by both state and non-state actors.[13] Against this backdrop, space enthusiasts appropriated the language of science, modernity, and progress in their effort to establish themselves as 'space experts' and turn their seemingly utopian dream into reality.

11 Part of this process was the administrative internationalism of the nineteenth century, expressed in the formation of international administrative unions, like the International Telegraph Union and the Universal Postal Union. See, Howland (2015).

12 On Wells's vision of a world government, see, for example, Deudney (2007, pp. 235–239).

13 For a detailed account of internationalism in the 1920s, see Gorman (2012). On internationalism in international relations generally, see, inter alia, Halliday (1988); Navari (2000); and Holbraad (2003).

The Origins of the Space Age: Per Aspera ad Astra

It was in this reconfigured context of scientific internationalism of the 1920s and 1930s that a cosmopolitan network of space enthusiasts, amateur engineers, and science fiction writers advocated their dream of spaceflight, as a key feature of Western modernity and progress, and made it seem feasible in the early twentieth century. As noted earlier, this was a sort of a social movement, enmeshed in the dynamics of social and cultural processes, which flourished in interwar Europe, outside the established scientific community and the purview of the state.

The pioneers of modern rocketry

According to standard narratives (or myths) of the history of the Space Age, three individuals stand out as the prominent pioneers of modern rocketry: Konstantin Tsiolkovskii (1857–1935), Robert Goddard (1882–1945), and Hermann Oberth (1894–1989). Born in Russia, Tsiolkovskii was a provincial physics teacher driven by his vision of placing humans in space.[14] In many ways, his work embodied the intersection of theory, science fiction, and popular science that defined popular fascination with the cosmos in Russian culture during the late nineteenth century (Siddiqi 2010, pp. 21–22). Inspired by science fiction, his theoretical work dealt with the development of rocket flight and orbital mechanics. Notably, he was the first to formulate a detailed mathematical examination of the possibility of space travel based on the use of multi-staged engines powered by a combination of liquid hydrogen and liquid oxygen (Andrews 2009, p. 80; Siddiqi 2010, pp. 26–27). Despite the fact that he never lived to see his rockets achieve orbit, working in parallel with spaceflight advocates he catalysed the popularisation of space travel in Revolutionary Russia (Andrews 2009, pp. 47–63). Tsiolkovskii's ideas also had an influence on the Society for the Study of Interplanetary Communications, which was created in 1924. Based in Moscow, it was the world's first society of amateur space enthusiasts devoted to the cause of spaceflight (Siddiqi 2007).

While Goddard was not acquainted with Tsiolkovskii's work, he shared his dream of space travel and he was also inspired by science fiction (McCurdy 2011, p. 19). In contrast to Tsiolkovskii, who was a self-educated savant, Goddard held three college degrees, including a PhD in physics from Clark University, where he spent most of his career as a professor of physics. Equally, unlike the Russian pioneer, whose work focused on theory, Goddard carried out experimental research (Crouch 1999, p. 32). In 1919, his classic study A Method Reaching Extreme Altitudes was published by the Smithsonian Institution, an engineering piece on the

14 For a comprehensive and insightful account of Tsiolkovskii's work and his legacy, see Andrews (2009).

possibility of rockets carrying instruments in the upper atmosphere. In 1926, Goddard became the first who designed and successfully launched the first liquid-fuelled rocket (McCurdy 2011, p. 20). Notwithstanding that he continued to be a rather minor celebrity in the United States, his groundbreaking work had an effect on the other side of the Atlantic (Crouch 1999, p. 41).

Goddard was not aware of Oberth's work, when the latter wrote a letter to him in 1922 requesting a copy of his Smithsonian study. Born in the Transylvania region of the then Austro-Hungarian empire in 1894, Oberth had in common with Tsiolkovskii and Goddard the dream of space travel instigated by science fiction (Crouch 1999, p. 36). What is noteworthy is that Oberth published his doctoral dissertation on the possibility of spaceflight soon after the University of Heidelberg rejected it. The short book entitled The Rocket into Interplanetary Space played a part in the popularisation of the idea of space travel in Weimar Germany (Bainbridge 1976, p. 30, Bille and Lishock 2004, p. 9). At the same time, public fascination with space exploration in the Weimar Republic was also reflected in the establishment of amateur societies, the most influential of which was the Society for Space Travel (VfR), formed in 1927. In addition to Oberth, other key members of the society were the popular science writer Willy Ley and a young university student called Wernher von Braun, who had volunteered to contribute to rocket experiments (Crouch 1999, pp. 47–58). Significantly, after the end of the Second World War, Ley and von Braun became two of the most influential advocates of the idea of human spaceflight in the United States (McCurdy 2011, pp. 24, 41–54).

The Spaceflight Movement of the 1920s and 1930s

The key point to emphasise at the outset is that public fascination with space travel in the 1920s and 1930s was largely a social and cultural phenomenon evinced in a wide range of activities, including books, pamphlets, films, experimental research, and exhibitions. Therefore, it is necessary to say something more about the social and cultural context within which the spaceflight movement emerged. Indeed, it is no coincidence that the two most vibrant and influential space amateur societies were formed in Soviet Russia and Weimar Germany. As far as Russia is concerned, public fascination with cosmic travel at the turn of the century epitomised the technological utopianism and mysticism that characterised much of Russian society during this transformative period. This curious effort to fuse the mysticism of the past together with the technological utopianism and enthusiasm of the future associated with space travel was prominently featured in the works of the Society for the Study of Interplanetary Communications (Siddiqi 2007). What merits emphasis is that some of the spaceflight enthusiasts called themselves 'cosmopoli-tans', their cause 'cosmopolitanism', and Tsiolkovskii the father of cosmopoli-tanism, as they saw their endeavour 'as part of a big evolutionary leap for all of humanity' (Siddiqi 2008b, p. 275).

In relation to the German space movement, Neufeld (1990) suggests that three particular cultural factors shaped this public fascination with space travel: nationalism, the belief in technological progress, and an emerging modern 'consumer culture', which was defined by a sense of escapism (Neufeld 1990). However, as was the case with aviation (Rieger 2005; Fritzsche 1992), it can be added that spaceflight was also seen as a powerful symbol of national self-assertion, modernity, and prestige in the competitive international environment of that period.

Nevertheless, while it has become something of a cliche´ in the literature that deals with the history of modern rocketry and astronautics to highlight the influence of the three pioneers of modern rocketry in relation to their respective national contexts, it is useful to acknowledge that the nature of the spaceflight movement was largely international and cosmopolitan. This is an important observation when we consider the impact that international interactions and contacts had on the spaceflight movement (Siddiqi 2004; Geppert 2008). In this regard, one of the most noteworthy aspects of the spaceflight movement was the interaction of ideas between Tsiolkovskii, Goddard, Oberth, and the amateur space societies. For example, as mentioned previously, Oberth wrote to Goddard asking for a copy of his Smithsonian study, when he learned that somebody in the United States was working on the development of rockets. Oberth received a copy and, in turn, sent a copy of his book to Goddard. Being aware now of Oberth's work, the American scientist was prompted to establish his authority in rocketry (Crouch 1999, pp. 37–38). Equally, Goddard's work had an important impact on the Soviet space movement (Siddiqi 2004).

Therefore, despite the fact that public fascination with spaceflight in Soviet Russia and the Weimar Republic was distinctive in many respects, by the early 1930s, the spaceflight movement was already quite transnational and cosmopolitan. Geppert (2008, p. 276) even refers to it as the 'space international'. Indeed, this period witnessed the emergence of a vibrant network of transnational contacts among space enthusiasts and engineers, who had a common interest in building spaceships, interplanetary travel, and the colonisation of other planets. Following the formation of the Soviet and German amateur clubs, the American Interplanetary Society was established in 1930 and the British Interplanetary Society (BIS) in 1933.[15] Furthermore, smaller amateur society groups were formed in other countries (Winter 1983, pp. 73–111; Geppert 2008, p. 266). Interestingly, as early as 1931, there were also discussions of forming a supranational organisation that would bring together the numerous national amateur clubs in a single federated group (Geppert 2008, p. 277).

Although the Second World War disrupted completely the activities of the space international, what is striking in retrospect is that the transnational contacts formed during that period were resumed after 1945. This renewed interest led to the establishment of the International Astronautical Federation (IAF) in 1951. Consisting of 14 rocket societies from ten nations, the stated goal of the IAF was the promotion of international cooperation in space activities and dialogue among scientists (Geppert 2008, pp. 280–281).[16]

15 A recent insightful analysis of the British Interplanetary Society is Dunnett (2017).

16 The IAF is today one of the world's most influential space advocacy organisations, consisting of over 300 members, such as societies, space agencies, institutes, companies, from 66 countries. See its official website at http://www.iafastro.com/index.php/about.

The state and the military enter the stage

Given that amateur societies did not have adequate financial resources to support their research on rocketry, it is not surprising that their activities in Soviet Russia and Germany were gradually taken over by the military. More specifically, in discussing the development of rocketry in Soviet Russia in the early 1930s, two points are worth making. First, under the leadership of Fridrikh Tsander (1887–1933), an amateur society called the Group for Studying Reaction Propulsion (GIRD) in Moscow made efforts to develop a liquid-fuel rocket engine. Tsander genuinely hoped that interplanetary flight would be for the benefit of all of humanity and habitation in other planets would provide better living conditions than on Earth (Siddiqi 2007, pp. 516–517). Then, Sergei Korolev, who would become known as the father of the Soviet space programme, joined GIRD and became its leader in 1932. One year later, GIRD members launched successfully Soviet Russia's first liquid-fuel rocket (Winter 1983, pp. 55–61).

Second, during its first year of life GIRD was a civilian and voluntary organisation, but the military soon became interested in the society's activities and offered limited financial support. At the same time, another space enthusiast, Valentin Glushko, was involved with research on liquid and electrical rocket propulsion at the Gas Dynamics Laboratory (GDL) in Leningrad. In 1933, the Moscow GIRD and GDL were folded into a unified organisation, the Reactive Scientific Research Institute (RNII), under the aegis of the military (Siddiqi 2010, pp. 150–152; Winter 1983, pp. 56, 61). In the early 1930s, therefore, interest in rocketry was incrementally shifting from a form of activity conducted by civilian amateur societies to research and development dedicated for 'national defence' under state sponsorship.

In Germany, by the mid-1930s, most of the members of the Society for Space Travel were absorbed by the military. In 1932, the pragmatic von Braun left the society to join Germany's army rocket programme as a civilian employee. Eventually, von Braun was involved with the development of rockets as technical director of a newly established rocket research facility near Peenemunde under the Nazi regime. Under his leadership, research on rocketry led to the development of the infamous 'vengeance weapon' or V-2 in 1942.[17] The V-2 rocket was remarkable for a number of reasons. First, it was the first ballistic missile that reached the fringes of outer space. Second, despite the enormous amount of money spent on building and producing V-2 s during the Second World War, the gains from their use were strategically insignificant rendering their development a massive waste of resources (Neufeld 1995, pp. 273–274).

Moreover, it has been estimated that the V-2 attacks against Britain (London and the Norwich area) and Belgium caused the loss of approximately 8000 people (Chun 2006, pp. 54–55).[18] But what makes the V-2 rocket also remarkable in this respect is

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

18 This would not prevent the BIS Council to make von Braun an Honorary Fellow in 1949, something that he would accept 'despite the grief the work of me and my associates brought to the British people' (cited in Geppert 2008, p. 280).

that the number of people who lost their lives as slave labourers in its production surpassed the number of people killed in the V-2 attacks. It is believed that roughly 60,000 inmates passed through the concentration camps associated with Mittelwerk, the principal V-2 assembly plant. Of these, at least 10,000 prisoners perished (Neufeld 1995, p. 264).

Nonetheless, as the Second World War was nearing its end, von Braun and his team left Peenemunde and surrendered to US forces. Soon after, they were offered contracts to carry out work for the US Army (Bille and Lishock 2004, pp. 21–23). Not only would von Braun make contributions to the advancement of the US missile and space programmes, but, as noted earlier, he would become a key advocate of the idea of human spaceflight in the United States. Meanwhile, Korolev and his aides would also see the superpower rivalry as an opportunity to push for Sputnik.

Scientific internationalism, the IGY and Sputnik

Before considering the impact of the IGY, it is important to note that there was nothing preordained about the Soviet decision to usher in the Space Age. Intuitively, we might expect that the Soviet decision to pursue a space programme would have been influenced by rational strategic calculations in the context of the geopolitical dynamics of the Cold War. However, the reality was more complex: in the early phase of the programme, there was no centralised body governing Soviet space activities as part of a carefully crafted strategy with defined objectives. Rather, it was usually the design bureaux that would seize the initiative to propose the development of projects and the Soviet leadership would respond on an ad hoc basis without a clear space policy agenda (Siddiqi 2003, p. 171, Sheehan 2007, p. 29).

The principal illuminating example of the important role of designers in the course of the Soviet space programme is the case of Sputnik. Even though the successful development of the Soviet intercontinental ballistic missile (ICBM) had paved the way towards accessing space, it was an amalgam of international and contingent factors that shaped the decision to launch the world's first satellite. More concretely, we now know that it was only after the initiatives and proposals of key designers, like Korolev, Mikhail Tikhonravov, and others, that the Soviet leadership was convinced to undertake the Sputnik mission (Siddiqi 2010, pp. 290–331). In 1954, Korolev and Tikhonravov submitted a proposal for a space programme to the Soviet government. Meanwhile, they began a coordinated effort to communicate, both publicly and behind the scenes, the need for a dedicated satellite plan by skilfully exploiting media announcements to promote their cause. This involved orchestrating the publication of an article in a Moscow newspaper in 1955, which alluded to the formation of a Soviet commission dedicated to space technology. Western media interpreted this as a clear indication that Soviets were working on a spaceflight programme. Consequently, the publicity of this announcement convinced leading US officials that the Soviets were engaged in a programme to develop and launch a satellite into orbit (Siddiqi 2008a, pp. 533–535).

These events had the effect of accelerating the US decision to start a civilian satellite project.[19] A key aspect of this process was the classified National Security Council 'Draft Statement of Policy on U.S. Scientific Satellite Program', known as NSC 5520. The policy statement contained a number of recommendations that shaped the main direction of the nascent US space programme, highlighting the potential military, political, and scientific benefits that could derive from the use of a satellite (National Security Council 1955, pp. 2–3). But given that the Eisenhower administration was keen to emphasise the peaceful purposes of the US satellite, the document also suggested that the IGY presented 'an excellent opportunity' for the launch of a scientific satellite (National Security Council 1955, p. 4). As a result, on 29 July 1955, James Hagerty, Eisenhower's press secretary, publicly announced the US decision to launch a scientific satellite as part of the IGY. In turn, on 30 January 1956, the Soviet Union formally approved a plan to launch a satellite during the IGY (Siddiqi 2008a, pp. 537).

The idea of the IGY originates in a proposal for holding a Third Polar Year in April 1950 that was suggested during a social gathering of leading American upper-atmosphere physicists, including James Van Allen. The two previous International Polar Years were organised in 1882–1883 and 1932–1933 to study the polar regions. However, given that 1957–1958 would be a year of intense solar activity, it was seen as a good opportunity to hold another international scientific project focused on Earth sciences, hence the Geophysical Year. The planning and funding of the programme was overseen by the International Council of Scientific Unions (ICSU), a non-governmental organisation of national scientific bodies and international scientific unions, which in 1952 formed a Special Committee for the IGY, known as CSAGI by its French initials, to act as the governing body for IGY activities.[20] Eventually, on 4 October 1957, the Soviet Union launched Sputnik as part of the IGY, the first artificial satellite in orbit around the Earth. Subsequently, on 31 January 1958, the United States launched its first satellite, Explorer 1, as part of the IGY. The satellite was placed on orbit using an upgraded Redstone as a launching vehicle (Juno 1) developed by von Braun and his team (Bille and Lishock 2004, p. 128). The space race had just begun.

Nonetheless, a few aspects of the IGY and its role in paving the way towards the Space Age are worth noting here. First, it is clear that the idea and implementation of the IGY reflected the growing intersection of politics and science during the Cold War. In this respect, the formation of the IGY owned much to the initiative of American scientists most of whom had established contacts with the US government. Not surprisingly, therefore, it was after the recommendations made by the American delegation that the launch of artificial satellites was included in the IGY activities (Bulkeley 1991, pp. 95–6). Shortly after, the US IGY committee approached the Eisenhower administration with a request for the use of military rockets to launch the satellite. Furthermore, members of the American delegation

19 On the initial phase of the US space programme, see, inter alia, McDougall (1997); Divine (1993); Launius (2010); Logsdon (2010); Kalic (2012); and Mieczkowski (2013).

20 The most detailed account of the IGY and Sputnik remains Bulkeley (1991).

attending the IGY were also interested in gathering any information related to Soviet space plans (Bulkeley 1991, pp. 104–5).

Second, however, the IGY, as one of the largest international scientific efforts ever undertaken, was also the product of scientific internationalism (Deudney 1985, p. 285). As Bulkeley (2010, p. 235) points out, 'the founders of the IGY have cited only its scientific merits, perhaps out of an ideological commitment to the purity of basic science'. Therefore, it is not too fanciful to suggest that the conception and implementation of the IGY serves as an illustration of the interaction between international and world society. On the hand, it is clear that scientists were becoming a key national asset in the context of the Cold War. Studies in the upper atmosphere, in particular, were important for a number of civilian and military reasons, including radio communications. On the other hand, scientists were convinced that they had to 'piggyback' on international society as non-state groups in order to push for their particular set of cosmopolitan norms, values, and practices associated with scientific internationalism. As Van Allen recalled: 'Around 1950…there was a very rigid rigorous restriction in support for scientific work. Most of us in this high altitude work got the definite impression that opportunities were waning rather rapidly during that period, about 1950, ^{0} 51' (cited in Bulkeley 1991, p. 90).

Yet, by the mid-1950s, at least as far as the United States is concerned, a major transformation had occurred to the relationship between the state and scientists. According to Manzione (2000, pp. 53–54), not only did the state co-opt the scientific community within the infrastructure of the US government, but also accepted and even appropriated a sort of scientific internationalism entrenched in the ideology of the scientific community. The IGY and the Atoms for Peace programme were indicative of this emerging sense of celebrated international scientific enterprise (Manzione 2000, p. 53). As Krige (2006, p. 180) notes, the Atoms for Peace programme served to illustrate how the openness of scientific internationalism had become increasingly interwoven with the state's practical goals of national security and intelligence-gathering in ways that rendered one 'both a good scientist and a good patriot'.

But given the wider political climate within which the IGY occurred, what is noteworthy is that there was a degree of beneficial scientific cooperation between the United States and the Soviet Union regarding the exchange of data through satellites. This was an even more remarkable development, especially considering the inherent dual-use nature of the technology involved (Bulkeley 2000, p. 152). As one scientist told the US IGY Committee: 'The most important overall conclusion…is not that cooperation was sometimes difficult and incomplete, but on the contrary that there was indeed more cooperation than ever before and that with patience and understanding it may yet be possible to achieve a working relationship among scientists as far apart as the United States and Soviet Union' (cited in Bulkeley 2000, p. 152). The scientist echoed the words of Eisenhower, who remarked in the opening of the IGY: 'the most important result of the International Geophysical Year is the demonstration of the ability of all nations to work together harmoniously for the common good' (Eisenhower 1957). In this light, the most general point to make is that if we want to understand the origins of the Space Age

and the expansion of international society in space, it is also necessary to take into consideration how the launch of the first satellites during the IGY was largely the result of scientific internationalism in the form of state-centric solidarism. This helps to highlight the role of scientists as agents of international society pushing the vision of spaceflight and the pursuit of knowledge.

Conclusions

The purpose of this article has been twofold. First, it suggested that it is necessary to incorporate the role of scientists as agents of international society and to assess the significance of scientific internationalism in terms of its impact on facilitating world society. This is an important consideration, given that scientists as non-state actors have pushed for the idea of science and technology as a unifier of humankind couched in the language of scientific cosmopolitanism and universalism. This idea has been manifested in the ideal of the Republic of Letters as an imagined community of scholars and its influence on what would later be referred to as the 'international scientific community'.

Second, however, while scientific internationalism as a key practice has had a profound impact on engineering world society, with the rise of nationalism, it went hand in hand with scientific nationalism. This process, of course, reflected key developments in the normative context of the structure of international society. As far as the advent of the Space Age is concerned, the co-optation of scientists by the state serves to highlight that solidarist conceptions of science and technology are staged as complementary to a pluralist logic. This is because of the social embeddedness of scientists and engineers as actors who also think and act on behalf of the state. Yet, in the course of this transformation, the state also accommodated and appropriated the logic of scientific internationalism in the form of state-centric solidarism. The complex dynamics of this process have been reflected in the expansion of international society in space, as the cases of the spaceflight movement and the IGY programme indicate.

In doing so, the analysis presented here points to the importance of recognising the many ways in which international society relates to world society. Conse-quently, it calls attention to the need for further research on the role of scientists as principal agents of international society and opens the possibility for conceptual-ising 'techno-science' as a primary institution of international society. Although a discussion of this rethinking is beyond the scope of this article, this conceptual exercise has the merit of highlighting the normative tension between scientific internationalism and scientific nationalism as derivative institutional practices of the primary institution of techno-science. Equally, this move helps to highlight the constitutive impact of techno-science on state and non-state actors in international society.

Acknowledgements I wish to thank Yannis Stivachtis for his very helpful feedback and Carsten Holbraad, Raslan Ibrahim, Thomas Linsenmaier, Aaron McKeil, Cornelia Navari, and Peter Wilson for their valuable comments on earlier drafts of this article. I am also grateful to Christopher R Hughes for the many interesting and insightful discussions, which have influenced some of the arguments of this article. The usual disclaimers apply.

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