

## ***Life Cycle of a Star: Carl Sagan and Circulation of Reputation***

It is a commonplace in science studies that reputations of particular scientists can play important roles in the stories of scientific knowledge. In this paper I place the emphasis on reputation rather than scientific knowledge. I argue that in order to fully understand their role in science we must historicise reputations – consider how these distinctive characterisations form and become known about, and study the factors influencing such processes. My approach is based in re-applying James Secord’s ‘Knowledge in Transit’ proposal; instead of scientific knowledge, I consider how ‘biographical knowledge’ of individuals is constructed through communications and shaped by communicative contexts. I illustrate this using the case-study of Carl Sagan. Sagan was widely discussed – amongst scientists, media professionals, and the public – for his skill as a charismatic populariser of science, perceived arrogance and egotism, political activism, and debated merit as a practising scientist. By showing how these aspects of Sagan’s reputation developed and circulated *alongside* his scientific work – rather than existing as a static ‘context’ for Sagan’s scientific work – I argue that different forms of knowledge (biographical and scientific) influence each other as they circulate. This suggests a complex but essential extension to Secord’s Knowledge in Transit project.

### ***Introduction***

In science, as in celebrity culture, people somehow acquire knowledge of a subject without encountering it themselves. We come to know of people through others’ characterisations of them and the stories swapped about them. Just as the complexity of the natural world is simplified and passed around in the form of scientific knowledge, the complexity of individual lives are simplified and passed around in these recognisable shared accounts. As such, I argue, reputations can be treated by historians of science in a similar fashion to scientific knowledge – as shared accounts, produced by social actions, which bear the marks of particular contextual factors through which they have passed. I do so by following the ‘Knowledge in Transit’ approach of James Secord. Secord has argued that we should see scientific knowledge-making

as an act of communication, influenced not only by local but also communicative contexts.<sup>1</sup> I apply this to the circulation of reputation, seen as ‘biographical knowledge’. I do this through the example of American astronomer and science populariser Carl Sagan (1934-1996), showing how specific features of his reputation emerged from – while also influencing – communicative acts. However the aim here is not biography or a history of popular science. Instead I intend this piece as a methodological reflection on how science studies must consider not only *circulation* of different forms of knowledge but also their *interaction*.

I use Carl Sagan, the ‘glamor boy of astronomy,’ due to both his great fame and his blending of popularisation and research.<sup>2</sup> As such he was (and is) known to a great many audiences, for a variety of activities and characteristics, and through a diverse array of communication channels. All this provides numerous communicative contexts for consideration. Though a professional astronomer and exobiologist, Sagan was mostly recognised for his popularisation.<sup>3</sup> His popular work ranged across astronomy to psychology to human evolution, and also included political activism and science fiction. With his lyrical writing style, countercultural sympathies, and skill as an eloquent conversationalist he was widely portrayed as a welcome departure from the ‘typical’ scientist. Within the scientific community, however, he was criticised for providing speculative suggestions to the public, instead of well-grounded research. His opponents claimed he was a second-rate scientist, monumentally egotistical, and more interested in selling himself than science. This description of Sagan will be familiar to many; however, it conceals a key point – these distinctive aspects of Sagan’s reputation did not always co-exist, but rather all

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<sup>1</sup> James A. Secord ‘Knowledge in Transit’, *Isis* (2004) 95.4, pp.654-67

<sup>2</sup> Quotation from Art Harris ‘Second View: Sagan on Encounters’, *Washington Post (Weekend)*, 16 Dec 1977, pp.1-2, 1

<sup>3</sup> Exobiologists study the possibilities of biological life elsewhere in our solar system, based largely on the physical and chemical conditions of planets.

emerged, were emphasised, were downplayed, or disappeared at different points throughout his life.

I begin with a background section, in which I briefly discuss some approaches to – and potential pitfalls of – using reputations in history of science, with reference to literature on biographical methods. This sets up my use of Knowledge in Transit as a useful tool in biographically-informed history of science. I then move on to four narrative sections. The first two focus on Sagan’s celebrity, tracing the development and circulation of his reputation via two different forms of communication (word-of-mouth and texts).<sup>4</sup> Sections three and four focus on ‘Sagan’s science’. For breadth I consider ‘science’ considered in two separate, purely heuristic, ways. The first, borrowing from Sagan, is to see science as a personal way of thinking. I use the example of Sagan’s TV show *Cosmos* to develop the familiar story of reputation-influencing-science by also illustrating how particular representations of science and representations of people can simultaneously influence one other. I extend this into the final narrative section, in which I treat ‘science’ as a body of specialised knowledge. I use the conclusions of previous sections to re-examine the story of Sagan’s role in nuclear winter debates, by showing how communicative acts were simultaneously contests around scientific and biographical knowledge. In my concluding section I use these observations to reflect on the Knowledge in Transit approach. I argue that we must consider *interactions between* circulating knowledge of numerous forms, not scientific knowledge alone; and that distinctions between ‘circulating knowledge’ and ‘communicative contexts’ could benefit from re-examination.

## ***Background***

*‘What is meant by ‘charisma’ is not easy to say. It seems to refer to some sort of ambrosial body odour.’*

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<sup>4</sup> Note that by ‘texts’ I include audio and visual recordings.

*Erwin Chargaff*<sup>5</sup>

Reputation already has a presence in much STS literature. Canonical sociological works have shown reputation as a key context underlying assessment of scientific claims, acquisition of resources, and available forums for communication.<sup>6</sup> However, too readily applying generalisable insights such as these to specific historical actors risks treating them, in the words of David Aubin and Charlotte Bigg, as ‘ideal types of wider social entities [such as] the invisible technician, the scientist-entrepreneur, the theoretical physicist’.<sup>7</sup> Sagan’s surprisingly scarce appearances in STS literature exemplify this, usually portraying him as an ideal type of the media-savvy but much-criticised populariser (indeed, he is such an archetype of the role that such criticism has become known as ‘the Sagan Effect’).<sup>8</sup> The most extended discussion, and the most widely-cited, appears in media scholar Rae Goodell’s work on ‘Visible Scientists’. This work provides a detailed overview of Sagan’s life and career which illustrates how Sagan achieved ‘visibility’ (extensive media attention). However by grouping Sagan into the ‘visible scientists’ in her analysis Goodell focusses on visibility as a common attribute, a shared end-point, rather than on situating Sagan’s particular and protean reputation within those details of his career trajectory.<sup>9</sup> The work also appeared before the broadcast of *Cosmos* and the nuclear

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<sup>5</sup> Erwin Chargaff ‘A Quick Climb up Mount Olympus, *Science New Series* (1968) 159, pp.1448-1449, 1448

<sup>6</sup> Just two examples include Harry Collins, *Changing Order: Replication and Induction in Scientific Practice*, London: Sage, 1985, esp. pp.84-89; and Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts*, 2nd ed., Princeton: Princeton University Press, 1986, esp. pp.194-206

<sup>7</sup> David Aubin and Charlotte Bigg in Thomas Söderqvist (ed.) *The History and Poetics of Scientific Biography*, Aldershot: Ashgate, 2007, pp.51-70, 55

<sup>8</sup> The term ‘Sagan Effect’ originally comes from from Jim Hartz and Rick Chappell, *Worlds Apart: How the Distance Between Science and Journalism Threatens America’s Future*, Nashville Tennessee: Freedom Forum First Amendment Center, 1997. See Michael B. Shermer, ‘This View of Science: Stephen Jay Gould as Historian of Science and Scientific Historian, Popular Scientist and Scientific Popularizer’, *Social Studies of Science* (2002) 32.4, pp. 489-524 for discussion of the Sagan Effect applied to another celebrity scientist, Stephen Jay Gould. For discussions of Sagan in science studies, as well as the examples I discuss here see William Macauley ‘Inscribing Scientific Knowledge: Interstellar Communication, NASA’s Pioneer Plaque, and Contact with Cultures of the Imagination 1971-1972’ in Alexander C.T Geppert (ed.), *Imagining outer space: European astroculture in the twentieth century*, Basingstoke: Palgrave Macmillan, 2012, p.286; Kim McQuaid ‘Selling the Space Age: NASA and Earth’s Environment, 1958-1990’, *Environment and History* (2006) 12.2 pp. 127-163, 147-148; James E. Strick, ‘Creating a Cosmic Discipline: The Crystallization and Consolidation of Exobiology, 1957-1973’, *Journal of the History of Biology* (2004) 37.1, pp.131-180, 135; Matthias Dörries ‘The Politics of Atmospheric Sciences: “Nuclear Winter” and Global Climate Change’, *Osiris* (2011) 26.1, pp. 198-223

<sup>9</sup> Rae Goodell, *The Visible Scientists*, Boston: Little Brown, 1975 – for chapter on Sagan’s career see pp.163-176, for ‘visibility’ analysis see pp.6-10 and pp.201-207

winter debates, two major events in Sagan's career. *Cosmos* is discussed in Marcel LaFollette's history of science on American television, but again Sagan is mostly portrayed as a 'celebrity machine' acquiring airtime and viewership for the programme; the reciprocal effect of *Cosmos* on Sagan's reputation is not considered.<sup>10</sup> Histories of nuclear winter go beyond other works in considering not only that Sagan was well-known, but also what he was known *for* (especially his political activism). However they only deal with a slim segment of his life and therefore exactly *how* he had become known about is not fully related to his previous work, as I consider further in my fourth section.<sup>11</sup> All this is not simply biographical nitpicking; as I shall illustrate throughout this piece, both Sagan's distinctive features and the means through which they were communicated are essential for understanding the stories of both Sagan and his science.

However, the other extreme – i.e. focussing in detail on the unique life of an individual – brings its own problems. Such biographical work has a complex relationship with history of science, risking 'Great Men' accounts and psychobiography.<sup>12</sup> Most problematically, as one emphasises the distinctiveness of an individual it becomes harder to ask and answer questions with relevance to broader problems in history of science. As historian and biographer Mary Terrall puts it, 'what can an individual life story say about larger trends or broader issues?'<sup>13</sup> Again this problem can be illustrated with reference to literature on Sagan, in this case the non-academic biographies. There are two major biographies of Sagan, the first by science journalist Keay Davidson and the second by popular science writer William Poundstone. Poundstone's is a

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<sup>10</sup> Marcel C. LaFollette, *Science on American Television*, Chicago: Chicago University Press, 2013, pp.156-159

<sup>11</sup> Lawrence Badash, *A Nuclear Winter's Tale: Science and Politics in the 1980s*, Cambridge, Mass.: The MIT Press, 2009; Naomi Oreskes and Erik Conway [2010] *Merchants of Doubt: How a handful of scientists obscured the truth on issues from tobacco smoke to global warming*, New York: Bloomsbury Press, 2010, pp.48-65; Matthias Dörries, 'The Politics of Atmospheric Sciences: 'Nuclear Winter' and Global Climate Change', *Osiris* (2011) 26.1, pp. 198-223

<sup>12</sup> The canonical article on this topic is Thomas L. Hankins, 'In Defence of Biography: The Use of Biography in the History of Science,' *History of Science* (1979) 17, pp.1–16; a more recent resurgence of interest is documented in Söderqvist op. cit. (7). For psychobiography in history of science see Robert J. Paradowski 'The Biographical Quest: Some Personal Reflections of a Pauling Biographer on the Art and Science of Scientific Biography', in Ramesh S. Krishnamurthy (ed.), *The Pauling Symposium: A Discourse on the Art of Biography*, Oregon: Oregon State University Libraries, 1996, pp.31-57

<sup>13</sup> Mary Terrall 'Biography as Cultural History of Science', *Isis* (2006) 97.2, pp.306-313, 307

chronological account, narrating key events in Sagan's life through detailed description; Davidson's is a more thematic account which attempts to get inside Sagan's mind and understand his combination of scepticism and speculation.<sup>14</sup> Both provide extensive details, including interviews with key figures, which have been drawn on by nearly all academic works on Sagan. But neither explicitly speak to historical or science studies literature, and neither attempt to contribute new insights on science or mass media in this period – any references to broader contexts are used to deepen understanding of occurrences in Sagan's life, and not vice-versa.<sup>15</sup> As Robert Hotz's excellent review of both biographies notes, the reader learns much 'about Sagan's failed marriages and his feuds, but much less than we should about his place in a century that more than any other owes its character to the achievements of science'.<sup>16</sup>

There are works in history of science which navigate these opposed concerns in a sophisticated fashion by virtue of being 'biographies in context'.<sup>17</sup> Canonical examples include Mario Biagoli's *Galileo: Courtier* which uses studies of the patronage system in 16<sup>th</sup>-Century Italian courts to illuminate 'Galileo's court-based articulation of [his] new socio-professional identity... by reconstructing the *culture and codes of courtly behaviour* that framed Galileo's everyday practices';<sup>18</sup> Adrian Desmond and James Moore's *Darwin* which sets out 'to portray the scientific expert as a product of his time... in a *society undergoing reform*';<sup>19</sup> and Steven Shapin and Charles Thorpe's study of Oppenheimer, which focusses on his role in the Manhattan Project to argue that 'to understand the social and technical order of one of *the most important technoscientific sites of modern times*, we should get to grips with the role of embodied personal

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<sup>14</sup> William Poundstone, *Carl Sagan: A Life in the Cosmos*, New York: Henry Holt, 1999; Keay Davidson, *Carl Sagan: A Life*, New York: John Wiley, 1999. There is a third introduction to his career aimed at children – *Carl Sagan: A Biography* (Ray Spangenburg, Kit Moser, Westport Connecticut: Greenwood Biographies, 2004) – but this draws most of its material from the other two biographies.

<sup>15</sup> See, for instance, Poundstone's discussions of American counterculture as an influence on Sagan, pp.175-176, or Davidson's description of the 'panspermia' debate in exobiology in which Sagan found himself, pp.159-161

<sup>16</sup> Robert Hotz 'Star Trek', *Los Angeles Times* (16<sup>th</sup> Jan 2000), p.4

<sup>17</sup> Giuliano Pancaldi, quoted in Aubin and Bigg op. cit. (7) p.55

<sup>18</sup> Mario Biagoli *Galileo, Courtier: The Practice of Science in the Age of Absolutism*, Chicago: University of Chicago Press, 1993, p.3

<sup>19</sup> Adrian Desmond and James Moore, *Darwin*, Hammersmith: Penguin, 1991

authority'.<sup>20</sup> I include these programmatic statements to illustrate how, despite their diverse subjects, all share the broad aim of combining historical literature on particular contexts with biographical stories to mutually deepen our understanding of both. However, I have added the emphases to illustrate an important point: even though these biographies go beyond a narrow focus on their biographical subject, the approaches taken and lessons learned are still tied to designated historical periods and particular settings.

Therefore, although there is a potentially interesting social biography in Sagan's life – for example, embedding Sagan's career in a detailed account of the various mass media contexts his career passed through, and drawing out lessons on the relationships between science and the mass media in 20<sup>th</sup> century America – I am not attempting this. Instead I focus on the problem raised by my discussion of social biographies. This problem is symptomatic of a more general question in contemporary history of science – given the rejection of 'Big Picture' narratives in favour of detailed case-studies, how do we produce *any* work which can be reliably extrapolated beyond its original, specific, setting? James Secord suggests that one possible solution to the problem of producing a 'rich array of research that somehow adds up to less than the sum of its parts' is to focus on a practice common to all 'sciences' from all times – communication.<sup>21</sup> He suggests that we should see 'knowledge-making itself as a form of communicative action' by 'eradicating the distinction between the making and the communicating of knowledge'.<sup>22</sup> This 'Knowledge in Transit' approach places new emphasis on such factors as the material media through which people communicate, the availability and non-availability of communication channels, and the imbalance of power within communicative relationships.<sup>23</sup> I refer to such

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<sup>20</sup> Charles Thorpe and Steven Shapin, 'Who Was J. Robert Oppenheimer? Charisma and Complex Organisation', *Social Studies of Science* (2000) 30.4, pp.545-90, 549. I include this article to illustrate that the work of 'biographies in context' can be done by other materials beside full-length books which expressly self-define as 'biography'.

<sup>21</sup> Secord (op. cit. 1) p.660

<sup>22</sup> *ibid.* p.661

<sup>23</sup> *ibid.* pp.657-670

factors as *communicative contexts*.<sup>24</sup> However, where Secord discusses communicative contexts and scientific knowledge, I discuss communicative contexts and reputations. Although specific reputations vary between individuals, all require communicative actions to spread ‘biographical knowledge’ about the individual.<sup>25</sup> As such, I suggest that to fully understand the origins and influences of reputations we must carefully consider the communicative contexts in play. I therefore use Sagan’s life to provide broad methodological reflections on how historians can use specific reputations –and, by extension, other forms of knowledge besides the scientific – across history of science.

### ***Section One: From Specialism to Stardom***

*I don't think one can know Carl intellectually without also knowing him socially.*

- Gerald Soffen<sup>26</sup>

The young Sagan acquired his early professional positions largely as a result of personal communication between himself and more senior scientists. As an undergraduate at Chicago, obsessed with the niche interests of planetary science and exobiology, Sagan studied an eclectic mix of astronomy, biology, and chemistry.<sup>27</sup> This combination proved significant, for these interdisciplinary skills formed the basis of his early reputation. In 1959 the theoretical division of the newly-founded NASA received a letter from Nobel prizewinning biologist Joshua

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<sup>24</sup> These factors are contextual in the sense that they tie ‘specific pieces of work’ to the broader ‘conditions of their production’ – *ibid.* p.657

<sup>25</sup> For clarity, I treat ‘knowledge’ in a sociological sense, i.e. distinguished from ‘belief’ or ‘opinion’ by the fact that they are collectively endorsed to be *the* truth, rather than idiosyncratically put forward as individual truths. So the important distinction is not whether the statement *is* true, but in how it is expressed. Treating reputations as ‘biographical knowledge’ therefore usefully distinguishes these shared characterisations (often expressed as facts) from more personal opinions about an individual. Particular parallels and divergences between scientific and biographical knowledge are explored further in Oliver Marsh, ‘Richard Feynman’s “Cloud of Myth”: Scientific and Biographical Knowledge’, unpublished draft, 2013

<sup>26</sup> Quoted Shirley Thomas, *Men of Space: Profiles of the Leaders in Space Research, Development, and Exploration*, vol. 6, Philadelphia: Chilton Company Book Division, 1963, p.193

<sup>27</sup> Sagan found that most astronomical work at the time focussed on deep-space objects – Ronald E. Doel, *Solar system astronomy in America : communities, patronage and interdisciplinary science, 1920-1960*, Cambridge: Cambridge University Press, 1996, pp.2-3; Poundstone op. cit. (14) p.33.

Lederberg, advocating publication of a 'Handbook of Planetary Biology'. Lederberg feared 'some problem in finding a sufficiently informed enthusiast to do the work,' but suggested Sagan, whom he had encountered as a visiting student to the University of Colorado, as 'well informed and deeply interested in planetary biology'.<sup>28</sup> Similarly, when astronomer Frank Drake asked Sagan to join the first Search for Extraterrestrial Intelligence (SETI) conference at Green Bank, 1961, it was on the basis that 'he knew more about biology than any astronomer I'd ever met'.<sup>29</sup> From these Sagan was soon employed on a wide range of groups and committees – as Sagan put it, "I sort of glided effortlessly from attending late-night bull sessions about exobiology at Lederberg's house to advising the government on the issue" – usually to act as translator between astronomers and biologists.<sup>30</sup> By 1963 this Sagan speciality was well-recognized, as is clear in interviews with Sagan's colleagues taken by journalist Shirley Thomas: Gerald Kuiper and W.W. Kellogg spoke of Sagan's usefulness in discussions comprising different disciplinary experts, while Elie Shneour remarked that 'Carl has created a new field – one bridging the gap between astronomy and biology. He is essentially alone in this field'.<sup>31</sup>

As well as these interdisciplinary skills, Sagan's face-to-face contact with increasing numbers of space scientists in group projects led to increasing discussion of the eloquence for which he would later become widely known. This was a useful resource to space science in the late 1950s, facing a deluge of new data, theories, and questions; as Kellogg remarked, 'he has such an understanding of the scientific problems and is so articulate, that he can organise these complicated thoughts and ideas in an excellent manner'.<sup>32</sup> But this eloquence was of even greater interest to another group who, following the launch of *Sputnik* in 1957 and the

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<sup>28</sup> Both were briefly at the University of Colorado in 1957; they shared an interest in exobiology, but Lederberg knew little astronomy. The twenty-three year old Sagan ended up tutoring him. Poundstone op. cit. (14) pp.36-39.

<sup>29</sup> Frank Drake and Dava Sobel *Is anyone out there? : The Scientific Search for Extraterrestrial Intelligence*, New York and London: Pocket Books, 1994, pp.46-47, emphasis added. Drake knew of Sagan from correspondence over Drake's microwave observations of Venus - Davidson op. cit. (14) pp.88-90

<sup>30</sup> Thomas op. cit. (26) pp.192-195. On general problems of interdisciplinarity in planetary science in this period, see Doel op. cit. (27) pp.138-150. Quotation from Drake and Sobel op. cit. (29) p.52

<sup>31</sup> Thomas op. cit. (26) p.192 (Kuiper and Shneour), p.203 (Kellogg).

<sup>32</sup> *ibid.* pp.203-204. For personal recollection of one such meeting, including Sagan's involvement, see Drake and Sobel op. cit. (29) pp.54-55,

foundation of NASA in 1958, had a growing interest in space exploration: the press. Hunting for good interviewees repeatedly led them to Sagan, and from the late 1960s onwards he became a growing presence in newspaper and TV reports on space science.<sup>33</sup> In particular a 1971 *Time* magazine feature on 'Is There Life On Mars – Or Beyond?' opened with a line from Sagan, quoted him liberally throughout (no other scientist was featured), and referred to him as 'exobiology's most energetic and articulate spokesman'.<sup>34</sup> However, the press were more interested in broad developments in planetary science, particularly the promise of spacefaring craft, and less in the specifics of Sagan's work.<sup>35</sup> After Thomas' 1963 interviews it is hard to locate any discussion of Sagan's interdisciplinarity in the popular press. Indeed, a profile by the journalist Henry S.F. Cooper characterised both Sagan and Lederberg as working within exobiology without any reference to how very different their roles and specialisms were.<sup>36</sup> Instead, as Sagan's personal networks increasingly comprised media and showbusiness professionals, a new set of communications built up a new and much more widespread reputation for Sagan.

Within these new communications eloquence became detached from his specialist interdisciplinary knowledge and instead was related to a different set of characteristics: his wide-ranging literacy, his wit, and his skill for emotive evocation. This was presented as a contrast to other scientists (both those he appeared alongside in NASA's publicity drives and to general stereotypes of scientists) – as one reviewer put it, in his popular books Sagan wrote 'more poetically than scientifically'.<sup>37</sup> Divergence from stereotype is a common theme in histories of popular science – for instance, it is one of the features Goodell suggests as a

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<sup>33</sup> Goodell op. cit. (9) pp.169-174

<sup>34</sup> 'Is There Life On Mars – Or Beyond?', *Time Magazine*, 13 December 1971, quoted Poundstone op. cit. (14) pp.174-175

<sup>35</sup> Howard McCurdy *Space and the American Imagination*, New York and London: Smithsonian Institution Press, 1997, pp.54-56, p.77

<sup>36</sup> Henry S. F. Cooper, 'A Resonance with Something Alive', *The New Yorker*, 21 June 21 1976, p. 39

<sup>37</sup> Edward Edelson, 'Star Struck: The Cosmic Connection, An Extraterrestrial Perspective', *The Washington Post*, 25 Nov 1973, p.BW4; Edward Wakin, 'God and Carl Sagan: Is the Cosmos Big Enough for Both of Them?', *U.S. Catholic*, May 1981; Cooper op. cit. (36); Poundstone p.178, 181-182. For general descriptions of Sagan's writing style see also Samuel Mines, 'Spies in the Sky?: UFO's A Scientific Debate Edited by Carl Sagan and Thornton Page', *The Washington Post*, 28 Jan 1973, p.BW6; Pines op. cit. (40); Edmund Fuller, 'Examining the Mysteries of the Brain', *Wall Street Journal*, 14 Jun 1977, p.24

teleological factor for how some scientists achieve 'visibility'.<sup>38</sup> However, the important point is not that Sagan diverged from stereotype, but rather exactly what these divergences were and how they were tied to certain communicative contexts. For example, simply being interviewed in the magazine *Rolling Stone* – more commonly a forum for figures like the gonzo journalist Hunter S. Thompson or artist and punk musician Patti Smith – or the star-studded *Tonight* show was not just highly unusual for a scientist.<sup>39</sup> It also helped to cement the distinctive image Sagan was cultivating: a public intellectual, equally confident at making jokes or quoting classical literature as discussing astronomy; a fashionable young man with a penchant for turtleneck sweaters, who hobnobbed with film directors (including Francis Ford Coppola and Stanley Kubrick) and sent the music of Chuck Berry into outer space; and a countercultural thinker who allied science with left-wing politics and the effects of recreational drug use.<sup>40</sup> As another example, many of the above aspects were supported by his simultaneous appearance as a popular author *and* a TV personality – something I discuss further in the next section. To paraphrase the oft-quoted words of Marshall McLuhan, the medium was also a message.

Although Sagan's reputation for interdisciplinary expertise failed to make its way outside popular circles, the showbusiness reputation circulated by the press made its way back into his professional life. As Sagan recalls, even by the early 1960s colleagues were making slighting remarks along the lines of 'I've been following your career in the *Time* magazine'.<sup>41</sup> Here was the emergence of the 'Sagan Effect', as Sagan's increasingly well-known media reputation

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<sup>38</sup> Goodell op. cit. (9) pp.29-35. A much-cited work on divergence from stereotype is Marcel C. LaFollette, *Making science our own: Public images of science, 1910-1955*, Chicago: University of Chicago Press, 1990 – for a useful summary see pp.17-23.

<sup>39</sup> Timothy Ferris, 'A Conversation With Carl Sagan', *Rolling Stone*, 7 June 7 1973; For *Tonight* show see Boyce Rensberger, 'Carl Sagan: Obligated to Explain' *New York Times*, May 29, 1977, p.8, and Poundstone op. cit. (14) p.177;

<sup>40</sup> For counterculturalism, see Ferris op. cit. (39) and Poundstone op. cit. (14) pp.174-176; for appearance, see Goodell op. cit. (9) pp.163-166 and Maya Pines, 'Matters of the Mind, The Dragons Of Eden: Speculations on the Evolution of Human Intelligence', *The Washington Post*, 29 May 29 1977, p.119; for connections to film directors, see Harris op cit. (2) and Cooper op. cit. (36); for the *Voyager* music, see Drake and Sobel op. cit. (29) pp.184-190 and Poundstone op. cit. p.303, 345. How much of this image came from deliberate cultivation on Sagan's part is a fraught question, though Poundstone (pp.175-177) suggests that the title of his book *The Cosmic Connection* was a conscious move to increase his countercultural appeal – and to sell more copies amongst *Rolling Stone* readers.

<sup>41</sup> Sagan, quoted in Goodell op. cit. (9) p.173

impacted negatively on his credibility amongst scientists.<sup>42</sup> But these criticisms went beyond the general impression that ‘anyone so smooth on TV must be a [scientific] lightweight’ – more specifically, journalists reported that colleagues found him ‘too freewheeling’, that he was ‘too much of a showman’ with habits of ‘public speculation’ and spreading ‘half-baked ideas’; meanwhile scientists worried about his ‘gee-whiz approach... [and] selective use of experimental evidence’ and that his popularisation activities took him ‘out of his depth’.<sup>43</sup> It was particular aspects like those listed above, and not simply his visibility, that would become important in the stories of *Cosmos* and of nuclear winter. Thus throughout the 1960s and 1970s Sagan’s reputation emerged through communications with both scientists and journalists; however, the reputations produced by these different communications were not identical either in form or in their power to spread further.

## ***Section Two: Mass Media, Continuities, and Cosmos***

*He was always ‘on stage’, perhaps even to himself.*

- Dorion Sagan<sup>44</sup>

Sagan’s fame sky-rocketed – to use an appropriate colloquialism – throughout the 1970s, thanks to both his hugely successful popular writings and increasing appearances in television and radio interviews.<sup>45</sup> An interesting feature in this was the role of his distinctive voice, in the double sense of his authorial voice and his literal speaking voice, which remained recognisably consistent across different media.<sup>46</sup> As noted above, as an author he was known for his lyricism

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<sup>42</sup> See Shermer op. cit. (8)

<sup>43</sup> Joel Achenbach, ‘The Final Frontier’, *Washington Post*, 30 May 1996; Cooper op. cit. (36); P.H. Klopfer ‘The Dragons of Eden. Speculations on the Evolution of Human Intelligence’, *The Quarterly Review of Biology* (1978) 53.4, p. 495; Pines op. cit. (40)

<sup>44</sup> Dorion Sagan, ‘Truth of my Father’ in Lynn Margulis and Dorion Sagan, *Dazzle Gradually: Reflections on the Nature of Nature*, Vermont: Chelsea Green Publishing, 2007, pp.8-15, 8

<sup>45</sup> More details in Goodell op. cit. (9) pp.162-174

<sup>46</sup> This was partly due to Sagan’s personal practices blurring the boundaries between speech and writing: he often wrote by stream-of-consciousness dictation to a tape recorder, usually on long car journeys or after heavy cannabis consumption. Poundstone op. cit. (14) p.104, pp.173-175; Cooper op. cit. (36) p.27

and hyperbole combined with frequent literary allusions and wit.<sup>47</sup> Interviews allowed him to demonstrate this same lyricism in his speech, which his son Dorion has described as exhibiting ‘perfect diction, encyclopaedic memory, um-less speech, and a preternatural (if to me privately aggravating) way of orating reasoned paragraphs,’ while his colleague Richard Berendzen commented of his ‘beautiful poetic statements’ that he ‘whipped them off all the time’.<sup>48</sup> Television and radio interviews even allowed the *sound* of his voice to become distinctive. Sagan became renowned for his enunciation (especially his plosive ‘billions’) which reviewers noted, colleagues and students mocked – a fake interview in a Cornell campus newspaper put every other word in bold or italics, which readers felt ‘captured his speaking style perfectly’ – and Jonny Carson famously mimicked on the *Tonight* show.<sup>49</sup> Besides his voice there were other continuities throughout the 1970s – particularly the personal charisma and physical attractiveness mentioned above – which were reinforced by his increasing appearances on television.<sup>50</sup> Therefore, though there was a diversification of the communicative contexts within which Sagan appeared, Sagan himself was recognisable as a consistent vocal, physical, and authorial presence.

We cannot assume such continuities across media were natural or accidental. This can be seen by considering Sagan’s TV show *Cosmos*, broadcast by the Public Broadcasting Service (PBS) in 1980.<sup>51</sup> This was a new departure for Sagan, the first time his writing had been brought to a full-length television broadcast with a substantial production team. Despite this, the continuities with Sagan’s extant image are strong. The script follows all the recognisable Sagan tropes, the only audible voice is Sagan’s, and Sagan (usually looking relaxed, frequently in a

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<sup>47</sup> See note 37

<sup>48</sup> Dorion Sagan op. cit. (44) p.8; Berendzen quoted Poundstone op. cit. (14) p.72. These recollections may, of course, be biased by the processes of memory; nevertheless, reading transcripts of Sagan’s interviews, it is notable how prose-like they are – see Tom Head, *Conversations with Carl Sagan*, Jackson Mississippi: University Press of Mississippi, 2006.

<sup>49</sup> Poundstone op. cit (14) p.178, 263; Davidson op. cit. (14) pp.332-333.

<sup>50</sup> Harris op. cit. (2) p.47; Cooper op. cit. (36) pp.20-22; Goodell op. cit. (9) pp.163-164. Poundstone op. cit. (14) p.261 relates a story of a New Orleans astronomical society that took to wearing turtle-neck sweaters in honour of Sagan.

<sup>51</sup> For background see LaFollette op. cit. (10) pp.156-159

turtleneck sweater) is visible a great proportion of the time. Even episode titles like ‘Harmony of the Worlds’ or ‘The Edge of Forever’, and the music – a combination of classical and new-age, with the same tendency towards high melodrama as the script – reflected the well-known Sagan image. Enforcing these continuities required deliberate efforts from the production team. Much special effects work was employed to keep Sagan in the frame, showing him walking on alien planets or flying through galaxies as he described them.<sup>52</sup> The distinctively Sagan writing style persisted despite the extensive input of two co-writers (Ann Druyan and Steven Soter), and included ideas recognisable from Sagan’s earlier works.<sup>53</sup> The chief artist of the graphic design team was Jon Lomberg, whose idiosyncratic space-art style – ‘inspired by psychedelic posters and album covers’, he told Poundstone – had appeared in all of Sagan’s popular books.<sup>54</sup> The foregrounding of Sagan as a distinct and recognisable individual therefore emerged from a careful co-ordination of group practices.<sup>55</sup>

The exact motives behind continuing the ‘glamor-boy of astronomy’ image varied between parties. For Sagan and collaborator Gentry Lee, *Cosmos* was to bolster flagging public interest in planetary exploration – a plan they had commenced in 1976 by forming ‘Carl Sagan Productions Incorporated,’ clearly indicating the central role of Sagan’s reputation.<sup>56</sup> Director Adrian Malone wanted to reproduce the success of his earlier documentary *Ascent of Man*, in that he wanted to ‘make a star out of Sagan’ as he had done with Jacob Bronowski (another well-known author turned superstar by television exposure).<sup>57</sup> More prosaically, the production company KCET hoped that Sagan’s popularisation abilities would bring marketing success, as it had with his

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<sup>52</sup> Davidson op. cit. (14) pp.329-330; Poundstone op. cit. (14) pp.257-260

<sup>53</sup> The famous ‘Cosmic Calendar’ in the opening episode first appeared in Sagan’s Pulitzer Prize-winning book *Dragons of Eden: Speculations on the Evolution of Human Intelligence* (New York: Random House, 1977), while the much-cited phrase ‘star-stuff’ and reference to material from space as ‘manna’ both appeared in *The Cosmic Connection*, (New York: Anchor Press, 1973).

<sup>54</sup> Poundstone op. cit. (14) p.177

<sup>55</sup> Such disappearance of communities in favour of an individual subject is given a fascinating slant in Hélène Miallet, *Hawking Incorporated: Stephen Hawking and the Anthropology of the Knowing Subject*, Chicago: University of Chicago Press, 2010

<sup>56</sup> Carl Sagan *Cosmos: A Personal Voyage*, New York: Random House, 1980, p.xi; Poundstone op. cit. (14) p.230, McCurdy op. cit. (35) p.58, p.78

<sup>57</sup> Quotation from Shirley Arden in Spangenburg and Moser op. cit. (14) p.95. Many would claim that Sagan also liked this idea, for reasons of ego – see Lynn Margulis in Poundstone op. cit. (14) p.81

books.<sup>58</sup> And for Sagan himself, *Cosmos* continued the exposition of a personal vision of science from his books, as I shall discuss further in the next section. The important point is that Sagan's reputation was a useful resource for diverse aims, all of which benefitted from emphasising continuities – as we shall see again in the higher-stakes scenario of the nuclear winter debates. However, despite all these efforts, once *Cosmos* left the hands of the production team the effect was a *discontinuity* – a new emphasis in Sagan's representation by the mass media. Although both Sagan's writing and his physical/vocal presence were familiar in the press, the new (and extensive) combination of the two in *Cosmos* produced unprecedented levels of vitriol in the mass media. Reviews focussed more on Sagan than the scientific or educational merit of the program. At the premiere, there were murmurs the show was 'a lot of Carl and a little bit of cosmos'.<sup>59</sup> The *New York Times* suggested '*Cosmos* could be subtitled 'the selling of Carl Sagan'', while *Village Voice* magazine called Sagan 'an unctuous scene-stealer from the stars' – an annoyance that they suggested could be avoided by reading the accompanying book instead of watching the series.<sup>60</sup> So the result of thirteen hours of *Cosmos* broadcasts, with screen and audio dominated by Sagan, was a new media representation of Sagan as an egotist more concerned about himself than science.<sup>61</sup> Sagan was aware of the role played by the televisual context in this new image – asked by a journalist whether he was as arrogant as his reputation made out, he replied that the 'interminable close-ups of me looking awed' had led to such criticisms.<sup>62</sup> In the next section I shall draw out another side to these responses by looking again at *Cosmos*, examining the presentation of *science*, as well as of Sagan. The key point from

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<sup>58</sup> Poundstone op. cit. (14) pp.256-257

<sup>59</sup> Richard Berendzen, quoted Poundstone op. cit. (14) p.260

<sup>60</sup> John J. O'Connor, 'TV View: 'Cosmos- A Trip Into Outer Space'', *New York Times*, 28 Sep 28 1980 p.330; Eliot Fremont-Smith, quoted Davidson op. cit. (14) p.334. For mockery of Sagan's voice see John J. O'Connor 'Putting Cosmos in Perspective', *New York Times*, 14 December 1980, p.36 and recollections from colleagues in Davidson op. cit. (14) pp.333-338

<sup>61</sup> Poundstone op. cit. (14) p.282. It should be noted, this reputation had been circulating amongst the scientific community for decades – even the largely hagiographic *Men of Space* profile noted that 'sometimes, Sagan's air of confidence is provoking. His assurance... has caused rancor', Thomas op. cit. (26) p.186. But responses to *Cosmos* gave this a vast new public audience.

<sup>62</sup> Glenn Collins, 'Sagans Mix Fact and Fiction', *New York Times*, 27 October 1985, p.15E

these two sections is that Sagan's reputation was a dynamic product of specific communicative acts, and was in continual development throughout his life.

### ***Section Three: Science-as-context in Cosmos***

*The first few episodes raise questions as to who will get the most on-camera exposure – the universe or Dr. Sagan.*

*- John O'Connor<sup>63</sup>*

As well as continuing a recognisable presentation of Sagan, *Cosmos* drew on Sagan's existing presentations of science. Due to Sagan's habit of using science as a rhetorical weapon in conflicts – whether justifying his popularisation activities in the face of colleagues' criticism, or using rhetoric of anti-authoritarian critical thinking to attack pseudoscience or political opponents – there are plenty of examples where Sagan explicitly spelled out his views of science, which remained remarkably consistent throughout his life.<sup>64</sup> The most famous was his dictum that 'science is more than a body of knowledge; it is a way of thinking.'<sup>65</sup> But this 'way of thinking' incorporated many elements. Firstly, he claimed scientific curiosity as something innate to humanity, for 'evolution has arranged that we take pleasure in understanding'.<sup>66</sup> As a result, Sagan proposed science as an egalitarian pursuit – natural to *all* humanity, not simply those with a specialized 'body of knowledge'.<sup>67</sup> Sagan's disregard for specialisation can also be seen in his approach to disciplinary boundaries. For instance in discussing his movement from popularising astronomy to psychology he claimed, 'the boundary between space and the Earth is purely arbitrary... Most of the people I deal with are human... [s]o I've had a lot of experience with that', thus qualifying personal experience as an acceptable substitute for specialist

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<sup>63</sup> John J. O'Connor, 'TV Weekend; Marilyn Story, Electronic Evangelists', *New York Times*, 26 September 1980

<sup>64</sup> See the collected interviews in Head op. cit. (48)

<sup>65</sup> Carl Sagan, *Billions and Billions: Thoughts on Life and Death at the Brink of the Millennium*, New York, Ballantine Books, 1997, p.28

<sup>66</sup> Sagan op. cit. (55) pp.xii-xiii

<sup>67</sup> Sagan op. cit. (65) p.28

training.<sup>68</sup> Instead of expertise, Sagan proposed a combination of the innate human curiosity with critical thinking. Science, he claimed, was ‘a tool for baloney detection... unlike many other human endeavours, [science] reserves its highest rewards for those who disprove the contentions of its most revered leaders.’<sup>69</sup> Personal authority was therefore replaced with community, for ‘science is a *collective enterprise*... There is an established framework in which any scientist can prove another wrong and make sure everyone else knows about it.’<sup>70</sup> So despite downplaying the need for specialised expertise, Sagan still presented science as an ‘established framework’ – a collective enterprise in principle open to anyone, but still with an ingroup and an outgroup. Which group you were in depended on you thinking in the right way, a way for which Sagan offered himself as a spokesman.

These explicit pronouncements were reflected in much of Sagan’s popular work. Sagan’s popularisation is notable for lack of direct reference to living individuals, including himself.<sup>71</sup> This was particularly obvious in his interviews: he very rarely named colleagues, and diverted questions about himself into answers about scientific issues.<sup>72</sup> As a result, his popularisation work presented science as disembodied facts without associated names, schools of thought, or debate. He also strayed into fields outside his professional work and combined popularisation with his own speculations, without distinguishing his personal views from scientific consensus.<sup>73</sup> *Cosmos* followed all these recognisable features. Topics covered include astronomy, biology, psychology, ancient history, and a great deal more. The up-to-date portions

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<sup>68</sup> ‘A Slayer of Demons’, *Psychology Today*, January 1996. Sagan’s *Dragons of Eden* was criticised by professional neurologists for siding with the contentious ‘triune brain’ model of human evolutionary psychology – Poundstone op. cit. (14) p.254

<sup>69</sup> *Psychology Today* op. cit. (68)

<sup>70</sup> Carl Sagan, *The Demon-Haunted World: Science as a Candle in the Dark*, New York: Ballantine Books, 1996, pp.242-244, emphases added.

<sup>71</sup> Historical figures, by contrast, are subjects of extensive discussion

<sup>72</sup> Joseph Goodavage, ‘Carl Sagan Interviewed,’ *Analog: Science Fiction and Fact*, August 1976; Collins op. cit. (62). For examples in written work, see the discussion of his own mistakes in Sagan op. cit. (70) pp.242-245 and his essay on living with cancer in Sagan op. cit. (60) pp.219-226

<sup>73</sup> *Dragons of Eden*, op. cit. (53), discusses psychology, his *Shadows of Forgotten Ancestors: A Search for Who We Are*, (with Ann Druyan, New York: Ballantine Books, 1993) discusses human evolution, and *Broca’s Brain* (New York: Random House, 1978) and *Billions and Billions*, op. cit. (65), contain essays on a great variety of topics. Sagan is the only visible scientist in Goodell op. cit. (9) to popularise work outside their professional experience. For criticism see especially D. Holzman, ‘Whose Brain Is It, Anyway?: Why The Politics Of Science Is A Beastly Business’, *The Washington Post*, 2 December 1984, p.SM6 and Pines op. cit. (40)

of the content blended Sagan's own work, the work of colleagues, and work he had encountered in a non-specialist capacity, without distinguishing them.<sup>74</sup> But the new communicative context – broadcasting this message via television, rather than writing – allowed fact and Sagan's speculations to be seamlessly blended in special effects, such as the interchange of actual astronomical images with artistic mock-ups.<sup>75</sup> The new combination of the typically Sagan script with Sagan's continual onscreen visibility and audibility simultaneously transmitted messages about Sagan and science: science is a collection of agreed-upon facts, and Sagan is its oracle.<sup>76</sup> And, of course, *Cosmos* introduced these images of Sagan and his science to a vast new audience.<sup>77</sup>

This co-presentation of a particular image of science with a particular image of Sagan is exemplified by a particular sequence in episode 6 of *Cosmos*, which shows Sagan in NASA's Jet Propulsion Laboratory.<sup>78</sup> The viewer is presented with a large communal space, filled with constant discussion; even when individual scientists are shown, they are in constant communication via headsets. We then move to a meeting room, where new satellite images are being analysed. This analysis takes the form of visual inspection and collaborative discussion. The camera lingers on the images, allowing the viewer to virtually replace a scientist – even make their own speculations, should they so choose. Sagan's membership of this community is implied by showing him using the equipment, or by placing him in the background of group shots, or showing him discussing newly acquired astronomical images – an identical, but no more prominent, role than his colleagues (except, of course, for his ever-present narration). The

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<sup>74</sup> See, for instance, his discussion of the Mars lander in Carl Sagan, *Cosmos: A Spacetime Voyage*, (Episode 5 'Blues for a Red Planet'), PBS, first broadcast 26 October 1980

<sup>75</sup> LaFollette op. cit. (10) p.6, pp.156-157

<sup>76</sup> The *Cosmos* team used to refer to Sagan's 'Delphic oracle mode' – Spangenburg and Moser op. cit. (14) p.98

<sup>77</sup> John O'Connor noted that 'in terms of audience ratings, it is among the most popular television series produced for the Public Broadcasting Service' – see op cit. (60). Davidson op. cit. (14) estimates that by 1999 the show had been watched by over 400 million people, p.318. The accompanying book reportedly sold more copies than any other English-language science book ever published – Poundstone op. cit. (14) p.262

<sup>78</sup> Carl Sagan, *Cosmos: A Spacetime Voyage*, (Episode 6 'Travellers' Tales'), PBS, first broadcast 2 November 1980

sequence suggests that both Sagan and the viewer are welcome within this community – simultaneously presenting a message about science, and about Sagan.<sup>79</sup>

There are currently no specific studies on how *Cosmos* affected public perceptions of science, but we can extend the above discussion on how it affected representations of Sagan. The *Wall Street Journal Review* noted Sagan's 'tendency to mix metaphysics and scientific statements', while a *New York Times* opinion piece on *Cosmos* claimed Sagan 'progressed blithely from his personal assumptions to grand speculations' and 'refused, for the most part, to acknowledge the very existence of... dissenting opinions'.<sup>80</sup> By suggesting that the science in *Cosmos* diverted from how science *should* be presented, and by blaming these diversions on Sagan, such reviews used opposing concepts of science to support their claims of Sagan's egotism. This raises the idea that *science*, as well as factors like particular media or business interests, can act as a context influencing the construction and circulation of reputation. If we are to see both science and reputation as produced by communicative acts, this complicates the familiar notion that extant reputations acts as a prior context for science. In my final section I consider this with reference to the nuclear winter debates. I build on existing historical work by focussing in detail on particular communications, to begin addressing the complications in this two-way science-reputation relationship.

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<sup>79</sup> An interesting comparison is with 1980s media presentations of Richard Feynman, in which both Feynman and Feynman's science are presented through the image of inaccessible and individualistic genius – see Marsh op. cit. (25)

<sup>80</sup> Richard A. Baer, 'TV: Carl Sagan's Narrow View of the Cosmos', *Wall Street Journal*, 24 October 1980, p.35; O'Connor, op. cit. (60). See also David Paul Rebovich 'Sagan's Metaphysical Parable', *Social Science and Modern Society*, July 1981, pp.91-95; Cooper op. cit. (36), Dennis Meredith, 'Carl Sagan's Cosmic Connection and Extraterrestrial Life-Wish', *Science Digest*, June 1979. Sagan's 'innocent scientism' also featured in Percy Walker's famous satirical work *Lost in the Cosmos: The Last Self-Help Book*, Picador, 1983, pp.173 and 201, cited in Davidson op. cit. (14) pp.336-337

#### ***Section Four: Nuclear Winter and Knowledge-in-Interaction***

*They wouldn't even listen to the content of the ideas he had. It was Carl Sagan's idea – yuk, yuk – Stewart Brand.<sup>81</sup>*

As noted in my background section, in contrast to other episodes in Sagan's life the nuclear winter debates of the mid 1980s have received detailed historical attention.<sup>82</sup> In the rest of this section I draw mostly on Lawrence Badash's book *A Nuclear Winter's Tale* and the second chapter of Naomi Oreskes and Erik Conway *Merchants of Doubt*. I use these works as both describe a key role for Sagan, not simply for his actions but also for the influence of his extant reputation. In particular both draw on his well-known penchant for left-wing political grandstanding. He had frequently spoken out against nuclear weapons, and *Cosmos* had acted as not-too-subtle flag-waving for environmentalism, internationalism, and pacifism – which had attracted especial criticism from reviews in the right-wing press.<sup>83</sup> In addition, as noted previously, Sagan's scientific credibility had been further damaged – both in the mass media and, by extension, amongst professional scientists – by the extensive displays of personal speculation and bias in *Cosmos*.<sup>84</sup> Badash, Oreskes, and Conway therefore begin from a similar premise to me: achieving scientific, governmental, and public credibility for nuclear winter required Sagan to push aside these aspects of his reputation, while in turn Sagan's opponents could use these aspects as resources to attack nuclear winter. Both works also make reference to communicative contexts. Oreskes and Conway separate debates into those taking place in professional versus those in public forums, and Badash goes further by noting the influence of editorial practices for the different publications involved.<sup>85</sup> I build on these works in two respects. Firstly, tying the image of Sagan used during these debates to his pre-nuclear winter

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<sup>81</sup> Stewart Brand, quoted Poundstone op. cit. (14) p.263

<sup>82</sup> See note 11

<sup>83</sup> See Badash op. cit. (11) pp.86-87 and Oreskes and Conway op. cit. (110 pp.44-45, 52-53 for summaries of Sagan's influence. For right-wing criticism see Davidson op. cit. (14) p.337. For left-wing political grandstanding see especially Carl Sagan, *Cosmos: A Spacetime Voyage*, (Episode 13 'Travellers' Tales'), PBS, first broadcast 21 December 1980

<sup>84</sup> See note 80, also recollections in Poundstone op. cit. (14) pp.116, 138, 171-173

<sup>85</sup> See the discussions of *Parade* on p.66, of the *Wall Street Journal* on p.91, and of *Nature* on p.143 of Badash op. cit. (14)

work; secondly, taking an even tighter focus on a specific instances of communication to illustrate how Sagan's reputation and the science of nuclear winter were co-presented by the same communicative acts.

The basic facts of the case are these. In 1982-1983, amidst aggressive pro-nuclear rhetoric by the Reagan administration, a group at the NASA Ames Research centre were modelling possible atmospheric effects of nuclear war. Their initial conclusions, published in *Science* in an article christened TTAPS, suggested that a nuclear exchange could reduce Earth's surface temperature to below freezing for many months.<sup>86</sup> Based on the research, Sagan published articles in the popular magazine *Parade* and the policy journal *Foreign Affairs*, which provoked responses and counter-responses across mass media outlets for the next four years.<sup>87</sup> Within the professional sphere the broad conclusions of the TTAPS paper – that a nuclear strike could cause long-term cooling – were swiftly accepted within the scientific community, although the magnitude of the effects was revised down by more detailed atmospheric modelling.<sup>88</sup> But the animosity created in the public sphere continued long after a scientific consensus had been reached, and although the arguments of the TTAPS paper were never fully discredited it was still held up by many influential scientists as poor scientific practice – largely due to way the results were made public before peer review had concluded, a circumstance attributed to Sagan's publications.<sup>89</sup>

I begin my focus on communications by noting that even within the public sphere, Sagan's tactics varied. In *Foreign Affairs*, his task was to persuade politically knowledgeable readers that the TTAPS results were sufficiently credible to form the basis for policy change. To such a readership, his association with hyperbole and showbusiness would risk the article, and by extension the TTAPS results, being dismissed as an extension of *Cosmos* rather than serious policy recommendations. So on the one hand, Sagan adopted his usual voice as spokesperson

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<sup>86</sup> Oreskes and Conway op. cit. (11) p.48. 'TTAPS' was based on the names of the authors: Richard Turco, Owen Toon, Thomas Ackerman, Jim Pollack, and Sagan.

<sup>87</sup> Badash op. cit. (14) p.66,

<sup>88</sup> Oreskes and Conway op. cit. (11) pp.51-54, p.64

<sup>89</sup> *ibid.* (11) pp.49-51, 64; Badash op. cit. (13) pp.81-85

for scientific consensus: he claimed to offer not personal opinions or suggestions, but results which 'have now been endorsed by a large number of scientists.'<sup>90</sup> He also pre-emptively pushed against dismissal of his work as personal propaganda rather than science by opening with a series of quotations to illustrate that 'comparably dire warnings have been made by respectable scientists with diverse political inclinations'.<sup>91</sup> On the other hand, even though *Foreign Affairs* was not intended as a forum for technical discussions, Sagan's article was very jargon-heavy – very much unlike his popularisation work.<sup>92</sup> This included both scientific and military terminology, such as 'modern tactical or theater missiles (e.g., Pershing II, SS-20)... make the distinction between "strategic" and "tactical" or "theatre" weapons increasingly artificial', suggesting his facility in all areas of the debate.<sup>93</sup> Finally, in his (lengthy) author's biography he emphasised his various research and committee roles, while relegating his popularisation work to the single, non-specific sentence 'Dr. Sagan is also a recipient of the Peabody Award and the Pulitzer Prize.'<sup>94</sup>

By contrast, Sagan's *Parade* article was aimed at increasing general public awareness of (and support for) the nuclear winter cause amongst the twenty million strong readership of the magazine.<sup>95</sup> In this situation a continuation of Sagan's recognisable hyperbolic and emotive rhetoric played well with editorial preferences for the new and groundbreaking, particularly given he was a regular contributor to *Parade*.<sup>96</sup> His piece narrated the 'discovery story' of

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<sup>90</sup> Carl Sagan, 'Nuclear War and Climatic Catastrophe: Some Policy Implications', *Foreign Affairs*, (1983) 62.2, pp. 257-292. Note that TTAPS had been subjected to an unconventional workshop-based peer-review process, Oreskes and Conway op. cit. (11) p.49

<sup>91</sup> Sagan op. cit. (90) p.258

<sup>92</sup> The editorial mission of *Foreign Affairs* stated that 'technical articles will be left to more special magazines' – from <http://www.foreignaffairs.com/about-us>, accessed 26.05.13.

<sup>93</sup> For scientific jargon see especially Sagan op. cit. (90) pp.263-267; for military terminology see pp.260-261. Quotation from p.261

<sup>94</sup> *ibid.* p.257

<sup>95</sup> Badash op. cit. (11) p.3, 66

<sup>96</sup> For the discussion of novelty and hyperbole in scientific news stories see Jane Gregory and Steve Miller, *Science in Public: Communication, Culture, and Credibility*, Cambridge Mass.: Perseus Press, 1998, pp.110-113

nuclear winter in extremely personal and emotive terms: how ‘another consequence [of nuclear war] - by far the most dire - has been uncovered’ with new results which ‘astonished us’ and ‘horrifies me’.<sup>97</sup> This emphasis on novelty also catered to a public well-used to Cold War nuclear scare stories, especially from Sagan himself. The point to draw out of these examples is that, even within the public debates, Sagan tried to put two alternative reputations in circulation – the level-headed, scientifically-informed policy advisor and the popular and passionate orator – by choosing to draw on his past work and reputations in different ways.

However, as with responses to *Cosmos*, the rhetorical power of these different reputations could be used against him. Consider his conflict with Pentagon official Richard Perle over a Pentagon Defense Department report which argued that TTAPS *supported* nuclear escalation. At a joint Congress hearing, Sagan claimed that if the report had been submitted at Cornell ‘it would get a D, maybe a C-minus if I was in a friendly mood,’ thus reminding the audience of his position of academic authority within a formal scientific institution.<sup>98</sup> However, this was turned against him by opponents. A *Washington Post* review of the hearing presented this soundbite in isolation while omitting Sagan’s more extensive technical comments, which supported Perle’s riposte (also reported) that Sagan’s comments were ‘shallow and demagogic’.<sup>99</sup> Drawing on these comments, the right-wing public intellectual William Buckley ascribed Sagan’s ‘arrogant’ performance to his tendency to ‘view himself as The World’s Foremost Authority’ and dismissed his warnings as ‘eschatological melodrama’.<sup>100</sup> All these associations with hyperbole and blending of fact with personal opinion were familiar from *Cosmos* reviews. In *The Wall Street Journal* the geophysicist Russell Seitz even explicitly invoked *Cosmos* to discredit Sagan’s ‘pernicious fantasy’:

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and Dorothy Nelkin, *Selling Science: How the Press Covers Science and Technology*, London: W.H. Freeman and Company, pp.112-113; for Sagan’s relationship with *Parade* see Badash op. cit. (11) p.66

<sup>97</sup> Carl Sagan ‘The Nuclear Winter’, *Parade*, 30 Oct 1983, pp.4-7.

<sup>98</sup> James R. Dickenson ‘Sagan, Defense Official Clash on Nuclear Winter’, *The Washington Post* (Mar 15, 1985) p.A30

<sup>99</sup> *ibid.*

<sup>100</sup> William Buckley, ‘The Specter of Nuclear Winter’, *The Washington Post* (April 22 1985) p.A15

An animated version of his obsolete apocalypse has been added to his updated documentary 'Cosmos – A Special Edition' ... the airbrushed edge of nuclear darkness overtakes planet Earth. Marshall McLuhan was right on the mark – with television's advent, advertising has become more important than products.<sup>101</sup>

Nuclear winter, Seitz suggested, was only as factual as Sagan's special effects, and any support was only due to Sagan's televisual appeal. These attacks aimed at discrediting nuclear winter in the public sphere by personally discrediting Sagan – using his recognised televisual style to attack, rather than support, the circulation of his science.

Similar conclusions can be drawn from communications within professional scientific journals. Alongside attacks on the modelling procedures used and conclusions drawn, commentaries on nuclear winter by professional scientists included attacks on the TTAPS team's credibility. Even a generally balanced review by Henning Rodhe in *Ambio* suggested that 'some authors could unintentionally exaggerate in order to gain attention', while Kerry Emmanuel argued in *Nature* that the TTAPS team had shown a 'lack of scientific integrity'.<sup>102</sup> Even the term 'nuclear autumn' proposed as an alternative to 'nuclear winter' by Stephen Schneider and Starley Thompson from the National Centre for Atmospheric Research (and adopted shortly afterwards by the popular press) took on a rhetorical value, connoting not only diminishment of numerical results but also a push against alarmist hype.<sup>103</sup> Sagan's name played a central role in many of these attacks. In particular, John Maddox's attacks of TTAPS in his *Nature* editorials foregrounded Sagan's role in the debates, referring to the TTAPS team as 'Professor Sagan and a group of associates' and the paper as 'Sagan et. al.', even though the lead author was Richard Turco.<sup>104</sup> Similarly, a commentary on nuclear winter published in *Science* combined collation of scientific work with a

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<sup>101</sup> Russell Seitz, 'The Melting of 'Nuclear Winter'', *The Wall Street Journal* (Nov 5 1986) p.36. The *Wall Street Journal* regularly printed contributions from anti-Sagan voices – as Badash notes, the paper 'had long been a venue for arms race hardliners and anti-environmentalists and a locus of right-wing journalistic crusading' Badash op. cit. (11) p.91

<sup>102</sup> Henning Rodhe, 'A nuclear winter,' *Ambio* (1984) 13:1 p.44, Kerry A. Emmanuel 'Towards a Scientific Exercise, *Nature* (1986) 6051 p.259, cited in Lawrence Badash 'Nuclear Winter: Scientists in the Political Arena', *Physics in Perspective* (2001) 3, pp.76–105, 91

<sup>103</sup> Badash op. cit. (11) p. 250, pp.290-294. Badash notes that seeing 'nuclear autumn' as anti-alarmism ignored the fact that Schneider and Thompson were still postulating a 12°C drop in temperatures.

<sup>104</sup> John Maddox 'From Santorini to Armageddon', *Nature*, 12 Jan. 1984, cited in Badash op. cit. (11) p.144

large picture of Sagan captioned ‘celebrity’.<sup>105</sup> In these examples, even the merest mention of Sagan was a resource used by opponents of nuclear winter. Though Sagan’s professional reputation had always been contested by colleagues, this was rarely as open and brutal as when used to discredit nuclear winter. So, as in the preceding section, simply examining the influence of Sagan’s reputation(s) on the science of nuclear winter is not the full story; we must also consider the influence of nuclear winter on Sagan’s post-nuclear winter reputation.

Unsurprisingly, this was not good. Slighting remarks, referencing nuclear winter, against Sagan were still made by scientists and journalists right through the 1990s, and even after his death in 1996; Poundstone points out that ‘it was almost a rule’ that the kinder of Sagan’s obituaries noticeably omitted nuclear winter.<sup>106</sup>

But looking at Sagan’s reputation in ‘before’ and ‘after’ shots misses the important point: during the nuclear winter debates both scientific knowledge *and* biographical knowledge were in contested circulation. Despite the diversity of the communications discussed above, one important question can be asked of them all – were any of them solely imparting scientific knowledge without biographical knowledge, or vice-versa? I argue not. Sagan’s *Foreign Policy* article simultaneously suggested that nuclear winter was scientifically sound enough to form the basis of actionable policy changes *and* that Sagan himself was a more specialised and credible scientist than suggested by previous work; his *Parade* article both confirmed his reputation as an evocative orator *and* introduced the new work of the TTAPS group to a wider audience; the attacks by Perle, Buckley, and Seitz also confirmed this reputation (though with emphasis on the exaggerated hyperbole of Sagan’s oration), *and* introduced counterclaims to the TTAPS arguments; the scientific commentaries on nuclear winter used the purported exaggerated numbers of the TTAPS team and Sagan’s political persona as an unscientific orator

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<sup>105</sup> Eliot Marshall ‘Nuclear Winter Debate Heats Up,’ *Science*, 16 Jan 1987, pp.271-273, 271, cited in Badash op. cit. (11) p.296

<sup>106</sup> Poundstone op. cit. (14) p.346; Oreskes and Conway op. cit. (11) p.64; Achenbach op. cit. (43)

as evidence and explanation for one another. The communications which made up the debates were not just contests to turn assertions about nuclear winter into accepted facts; they were also contests which turned assertions about *Sagan* into accepted facts. The success of one contest depended, at least in part, on the other.

These contests were not happening in isolation; the knowledge imparted by any communication built on the audience's existing knowledge, whether of Sagan or of atmospheric science. In addition, as I argued in section one and two, we should not treat Sagan's reputation as static; and through the various modelling claims and counterclaims of 1982-1984 the science of nuclear winter was not static either. This leaves us with a question for analysts – what do we see as 'an influence' and what as 'being influenced'? In general, the answer seems to be: circulation of scientific knowledge and reputation are influenced by communicative contexts; they also influence communicative contexts; they also influence each other. There is a simpler way to describe all the above: *Reputation acts as a communicative context for scientific knowledge, and vice-versa*. The full implications of this suggest important considerations for the Knowledge in Transit approach, as I shall draw out more fully in my conclusion.

## **Conclusion**

*Today's credible myth maker may well be a scientist who appears on television*

– *William Poundstone*<sup>107</sup>

This piece began by using James Secord's Knowledge in Transit approach to re-examine the use of reputation in history of science. I argued that, to fully understand the influence of reputation on scientific knowledge, historians must pay attention on the specific story of a given

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<sup>107</sup> Poundstone op. cit. (14) p.xvii

individual's reputation. I suggested that historians can do so by seeing reputation as a form of biographical knowledge, which is constructed and circulated by communicative acts. Focussing on communicative contexts, such as media used or power relationships in a given conversation, allows us to see how reputations spread through numerous settings. Following Secord, I argued that the ubiquity of communication in both science and reputation-spreading means that this approach is not limited to particular historical periods or local settings – although the life of Carl Sagan, a celebrity scientist in an age of mass media, is a particularly illuminating example.

By treating Sagan biographically, focussing on his celebrity rather than his science, I showed that focussing on communicative contexts provides insight into crucial continuities and discontinuities in his reputation, such as his shift from interdisciplinary specialist to a mass media spokesman for science, through the involvement of the press or the forging of connections between his authorial and televisual personae. Drawing on these conclusions provided new material to examine the relationship between Sagan's reputation and Sagan's science. Using the cases of *Cosmos* and the nuclear winter debates, I showed that biographical and scientific knowledge were circulated through the same communications, with each form of knowledge mutually influencing the other.

My main conclusion, which goes beyond the specific case of Sagan, is that different forms of knowledge act as communicative contexts. Whether 'Carl Sagan' or 'Richard Feynman' is the name on a work, or whether the work claims to contribute to 'popularisation' or to 'atmospheric science', can have comparable influence on its circulation as whether the article is mass-printed or carved on stone. We need not limit this to scientific and biographical knowledge. Many of the key factors in history of science, from political situations to social instabilities, must become known about to have an influence. Exactly how this 'knowing about' occurs is an important question to ask when considering how these factors cast their influence, and telepathy is not an option. Thus I suggest an extension to the Knowledge in Transit project, to consider not just circulation of knowledge but *interaction* of circulating knowledges.

This conclusion relates to broader arguments in science studies that all social facts are simultaneously influenced by *and* constitutive of contexts, and as such we should move away from 'context' towards terms like 'network' or 'working world'.<sup>108</sup> I suggest that focussing on communicative practices might be one possible way to follow these questions into projects. This piece was an example of one such project: how constantly focussing on reputation and communication both have a valuable role to play in following the stories of knowledge-claims: from particular individuals, through wider contexts, and wider still to the formation of – seemingly – global scientific knowledge. There are questions to be asked about this approach. In particular, the feasibility of closely following the reputations of *non*-celebrity scientists needs to be considered.<sup>109</sup> But I argue it still has overall value in showing how abstract but important ideas of 'interacting knowledge' might be tied to more concrete practices of handing around information.

Even today, Sagan's reputation is still passed around through a great variety of communications. T-shirts, mugs, and pyjamas bearing many of his aphorisms are sold in the store of the popular online community *I Fucking Love Science*, in a dedicated 'Carl Sagan' section (the only other two sections are 'Top Sellers' and 'New Arrivals').<sup>110</sup> The populariser Neil DeGrasse Tyson includes eulogies to Sagan's personal influence on his career in multiple episodes of the recently remade *Cosmos*, alongside multiple excerpts of Sagan's original narration.<sup>111</sup> Such mythologisations provide insights into how and why people circulate science in an age of social media and celebrity, just as myth-making in general reflects essential concerns of groups across a great many times and settings. As Sagan said, 'all myths are worthy of a respectful hearing.'<sup>112</sup>

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<sup>108</sup> For two examples see Jon Agar *Science in the 20th Century and Beyond*, Polity Press, 2012, p.3; Bruno Latour *Aramis, or, the Love of Technology*, Cambridge, MA: Harvard University Press, 1996, p.133

<sup>109</sup> I am grateful to Mat Paskins for this point. A possible start for such a discussion would be the contrasting discussions of celebrity scientist Stephen Hawking with William Montel, famous amongst his professional community but completely unknown outside of it – see Hélène Mialet 'Do Angels Have Bodies? Two Stories About Subjectivity in Science: The Cases of William X and Mister H', *Social Studies of Science* (1999) 29.4, pp.551-581

<sup>110</sup> <http://ilovesciencestore.com/carl-sagan.html?p=3>, accessed 5<sup>th</sup> May 2014

<sup>111</sup> <http://www.space.com/24955-new-cosmos-show-neil-degrasse-tyson.html>, accessed 5<sup>th</sup> May 2014

<sup>112</sup> Sagan op. cit. (70) p.240