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States of secrecy: an introduction

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Abstract. This introductory article provides an overview of the historiography of scientific secrecy from J.D. Bernal and Robert Merton to this day. It reviews how historians and sociologists of science have explored the role of secrets in commercial and government-sponsored scientific research through the ages. Whether focusing on the medieval, early modern or modern periods, much of this historiography has conceptualized scientific secrets as valuable intellectual property that helps entrepreneurs and autocratic governments gain economic or military advantage over competitors. Following Georg Simmel and Max Weber, this article offers an alternative interpretation of secrecy as a tool to organize and to hierarchically order society. In this view, the knowledge content of secrecy is less important than its social-psychological effects. The authors argue that, in many instances, entrepreneurial researchers and governments use scientific secrets as an effective tool to manipulate the beliefs of their competitors and the larger public, and not necessarily to protect the knowledge that they hold.

There's not a city in the world without its Loyal and Ancient and Justified and Hermetic Order of little men who think they can reap the secrets of the ancients for a couple of hours every Thursday night and don't realize what prats they look in a robe.[1]

A science without secrets

The study of scientific secrecy began with the statement that it did not exist. In 1942, Robert Merton published a short note in the anti-fascist *Journal of Legal and Political Sociology*, in which he laid down his famous four norms of the scientific ethos: communism, universalism, disinterestedness and organized scepticism.[2] Writing in a politically charged moment, Merton claimed that, like democracy, science was by definition 'communal'. Scientific discoveries were communicated freely, and 'secrecy was

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1 Terry Pratchett, *Going Postal*, New York: HarperCollins, 2004, p. 128.

2 David Hollinger, 'The defense of democracy and Robert K. Merton's formulation of the scientific ethos', *Knowledge and Society* (1983) 4, pp. 1–15.

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an antithesis of this norm'. As Merton approvingly quoted J.D. Bernal, 'the growth of modern science coincided with a definite rejection of the ideal of secrecy'.[3] This idea was also reinforced by the founding myths of science or of the Scientific Revolution, in which the ancient Greeks, or alternatively Francis Bacon and the Royal Society, figured as the heralds of openness.[4]

Merton expressed a sentiment shared by many scientists and policy-makers of the age. While military secrecy might have been necessary for developing the bomb and winning the Second World War, scientific research was supposed to become open again with the advent of peace. In 1945 Vannevar Bush, head of the Office of Scientific Research and Development, famously argued for publishing previously classified military information, and, as Alex Wellerstein has shown, these feelings were shared by many makers of science policy, if only for a few years.[5] At the level of policy-making, the American enthusiasm for openness was soon supplanted by the security concerns of the McCarthy era. Yet, among sociologists, the views of Merton remained highly influential.[6] Edward Shils emphasized the necessary openness of science in 1956 to argue against McCarthyist obsessions with government secrecy. Knowledge had to be exchanged openly. 'Without it science could not exist'.[7]

By 1982, Sissela Bok came to differentiate between the ritualistic denunciation of secrecy and the practical need for maintaining some commercial and state secrets in scientific work. Yet, despite some qualifications, she concluded her work with a call for responsibility by the scientists, lest new practices of secrecy 'gain such a strong foothold that they affect the momentum, the quality, and the direction of scientific research in ways difficult to reverse'.[8] In emphasizing the role of commercial secrets, Bok echoed Merton, who already argued that 'the commercialism of wider society' had a more pernicious effect on science than issues of national security. As he wrote, 'the communism of the scientific ethos [was] abstractly incompatible with the definition of technology as "private property" in a capitalistic economy'. Guided by this norm, scientific inventors followed the ethos of openness when patenting 'their work to ensure

3 Robert Merton, 'Science and technology in a democratic order', *Journal of Legal and Political Sociology* (1942) 1, pp. 115–126. The quote is from J.D. Bernal, *The Social Function of Science*, New York: Macmillan, 1939, pp. 150–151.

4 William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture*, Princeton: Princeton University Press, 1994, Chapter 10. Ernan McMullin, 'Openness and secrecy in science: some notes on early history', *Science, Technology and Human Values* (1985) 10, pp. 14–23.

5 Vannevar Bush, *Science, the Endless Frontier: A Report to the President*, Washington: US Government Printing Office, 1945; Alex Wellerstein, 'Knowledge and the bomb: nuclear secrecy in the United States, 1939–2008', PhD thesis, Harvard University, 2010, AAT 3435567. See also Michael Aaron Dennis, 'Reconstructing sociotechnical order: Vannevar Bush and US science policy', in Sheila Jasanoff (ed.), *States of Knowledge: The Co-production of Science and Social Order*, London: Routledge, 2004, pp. 225–253.

6 Steven Shapin, *The Scientific Life: A Moral History of a Late Modern Vocation*, Chicago: University of Chicago Press, 2008, pp. 113–115.

7 Edward Shils, *The Torment of Secrecy: The Background and Consequences of American Security Policies*, Glencoe: The Free Press, 1956, p. 176.

8 Sissela Bok, *Secrets: On the Ethics of Concealment and Revelation*, New York: Vintage, 1989, p. 170. For an updated but similar view see David Resnik, 'Openness versus secrecy in scientific research', *Episteme* (2006) 2, pp. 135–147.

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its being made available for public use', and then were rewarded by the state for making their knowledge public. Across the Atlantic, Michael Polányi voiced similar sentiments in his proposal for patent reform in 1944. A staunch opponent of a planned economy of science, Polányi considered the threat of commercial secrecy dire enough to warrant government intervention. The contemporary patent system needed to be replaced by government licensing to support the free circulation of knowledge.[9]

For long, the history of science simply accepted the existence of Mertonian norms at face value, and simply reiterated that modern science is essentially open, while technology is secretive.[10] As economic historians have argued, this openness might have been the result of the institutional framework of early modern Europe. Paul David suggested that modern science was born out of the system of courtly patronage, which rewarded scientists for open publication.[11] And, as Joel Mokyr has claimed, the Enlightenment's growing openness and lower access costs to scientific knowledge led to the Industrial Revolution.[12] While these current narratives do not neglect the advantages that secrecy might have for individual scientists, they claim that the modern infrastructure of science is distinct by developing powerful incentives for the practice of openness, a public good.[13]

Secrets for profit or security

Secrecy became a major research topic in the history of science only in the last twenty-five years. Historians have come to realize how suffused scientific practice is with issues of secrecy. Yet they too often consider secrecy simply a manner of protecting intellectual property to gain economic or military advantage over competitors.[14] Rational individuals restrict physical and informational access to their knowledge only because they value their property, and governments establish regimes of secrecy only to ensure their military primacy in competition with other states.[15] Writings in this genre share

9 Michael Polányi, 'Patent reform', *Review of Economic Studies* (1944) 11, pp. 61–76; Adrian Johns, 'Intellectual property and the nature of science', *Cultural Studies* (2006) 20, pp. 145–164.

10 H. Floris Cohen, *The Scientific Revolution: A Historiographic Inquiry*, Chicago: University of Chicago Press, 1994, pp. 200–204; Derek de Solla Price, *Science since Babylon*, New Haven: Yale University Press, 1961, pp. 117–135; McMullin, op. cit. (4); David Hull, 'Openness and secrecy in science: their origins and limitations', *Science, Technology and Human Values* (1985) 10, pp. 4–13.

11 Paul David, 'The historical origins of "Open Science": an essay on patronage, reputation and common agency contracting in the Scientific Revolution', *Capitalism and Society* (2008) 3(2), Article 5.

12 Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy*, Princeton: Princeton University Press, 2004.

13 For the Netherlands see Karel Davids, 'Openness or secrecy? Industrial espionage in the Dutch Republic', *Journal of European Economic History* (1995) 24, pp. 333–348.

14 See, for example, the bibliography up to 1985 which, apart from general background literature, is divided into two sections: 'University/Industry relations' and 'National Security'. 'Selected bibliography on openness and secrecy in science and technology', *Science, Technology, and Human Values* (1985) 10, pp. 110–114.

15 On the spatial aspects of secrecy see Owen Hannaway, 'Laboratory design and the aim of science: Andreas Libavius versus Tycho Brahe', *Isis* (1986) 77, pp. 584–610; Jole Shackelford, 'Tycho Brahe, laboratory design and the aim of science: reading plans in context', *Isis* (1993) 84, pp. 211–230; William R. Newman, 'Alchemical symbolism and concealment: the chemical house of Libavius', in Peter Galison and

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their interpretive framework with Merton, except that the relative importance of private interests and social norms is inverted.[16] Some argue that trade secrets and patents help scientists reap financial rewards for their scientific discoveries, and are therefore beneficial to the development of science. Others show that openness is not necessarily a social norm: it can be a rational, individualistic strategy again to maximize private benefits. As a result, the opposition between secretive technology and open science has been qualified, nuanced and contextualized.

As an individual strategy, secrets have received most attention in the context of the early modern 'Scientific Revolution'. As historians came to argue for the role of artisans in the development of modern science, they began to explore how craft secrets and trade secrets played a role in early modern practices of knowledge production. Pamela Long famously argued that craft secrets as a category developed only in the late Middle Ages, when guilds in the urbanized centres of Europe first formed a concept of knowledge as intellectual property, and claimed monopoly ownership of it. The picture Long paints is subtle and complex, making distinctions between the rhetoric of openness and actual openness, pointing at differences between individual writers or traditions, and placing them in their practical, intellectual and political context.[17] Writing in a similar vein, Larry Epstein suggested that the invention of craft secrets did not necessarily hamper the development of scientific and artisanal knowledges. Partly proto-intellectual property and partly a form of tacit knowledge, craft secrets provided an incentive for innovation in a world without the modern patent system, and were also disseminated through apprenticeship within existing guild structures, thereby ensuring that knowledge did not become lost after the inventor's death.[18] From the start, however, there also existed incentives for openness, although the early modern patent system was not one of these: as Mario Biagioli argued, patent disclosure became standard practice only after the American and French revolutions.[19] The world of patronage might have acted as a stronger incentive, as artisans frequently touted their skills and knowledges in printed

Emily Thompson (eds.), *The Architecture of Science*, Cambridge, MA: MIT Press, 1999, pp. 59–77. See also Myles W. Jackson, *Spectrum of Belief: Joseph von Fraunhofer and the Craft of Precision Optics*, Cambridge, MA: MIT Press, 2000, Chapter 3.

16 For an early example of such an inversion see Ian I. Mitroff, 'Norms and counter-norms in a select group of the Apollo moon scientists: a case study of the ambivalence of scientists', *American Sociological Review* (1974) 39, pp. 579–595, esp. 592–593.

17 Pamela Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance*, Baltimore; Johns Hopkins University Press, 2001. In a special issue edited by Karel Davids, a number of scholars have elaborated on the tradition of craft secrets. See Karel Davids (ed.), *Early Science and Medicine* (2005) 10, and especially Karel Davids, 'Craft secrecy in Europe in the early modern period: a comparative view', *Early Science and Medicine* (2005) 10, pp. 341–348. For a review of early modern secrecy see Kristie Macrakis, 'Confessing secrets: secret communication and the origins of modern science', *Intelligence and National Security* (2010) 25, pp. 183–197.

18 Stephan Epstein, 'Craft guilds, apprenticeship and technological change in preindustrial Europe', *Journal of Economic History* (1998) 29, pp. 684–713; Stephan Epstein and Maarten Prak, 'Introduction: guilds, innovation, and the European economy, 1400–1800', in Stephan Epstein and Maarten Prak (eds.), *Guilds, Innovation, and the European Economy, 1400–1800*, Cambridge: Cambridge University Press, 2008, pp. 1–24.

19 Liliane Hilaire-Pérez and Catherine Verna, 'Dissemination of technical knowledge in the Middle Ages and the early modern era: new approaches and methodological issues', *Technology and Culture* (2006)

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publications to attract potential patrons.[20] Similarly, as science became commercialized during the early modern consumer revolution, the circulation of advertisements and users' guides might have contributed to the larger public's awareness of the importance of technoscientific know-how.[21] Increasing communication and the overlap between artisan and learned cultures also played a role.[22] By the eighteenth century, France and other countries in continental Europe offered prizes and organized competitions for artisans who were willing to part with their secrets.[23]

The Enlightenment culture of openness (*Öffentlichkeit*), so eloquently described by Jürgen Habermas, might well have been another incentive for scientific practitioners to abandon secrecy.[24] Yet Enlightenment openness is usually interpreted in contrast to elite culture and the private sphere rather than to secrecy. The interpretation and translation of *Öffentlichkeit* as the public sphere, a space of free exchange and critical discussion, has guided recent work in the history of science, which has studied the rise of provincial academies and scientific salons; of professional and amateur journals; of scientific shows and demonstration lectures; of scientific discussions in coffee houses, clubs or newspapers; as well as other modes of openness and popularization.[25] In this Enlightenment rhetoric, even technological inventions had to be made available to all. The publication of technological secrets took an important place in the French *Encyclopédie*. Diderot wrote and believed that 'discoveries are only valuable and secure

47, pp. 536–565; Mario Biagioli, 'Patent republic: specifying inventions, constructing authors and rights', *Social Research* (2003) 7, pp. 1129–1172.

20 Long, op. cit. (17), Chapter 4; Marcus Popplow, 'Why draw pictures of machines? The social contexts of early modern machine drawings', in Wolfgang Lefèvre (ed.), *Picturing Machines 1400–1700*, Cambridge, MA: MIT Press, 2004, pp. 17–48; David, op. cit. (11).

21 Daniel Margócsy, 'Advertising cadavers in the Republic of Letters: anatomical publications in early modern Netherlands', *BJHS* (2009) 42, pp. 187–210; Liliane Hilaire-Pérez and Marie Thébaud-Sorger, 'Les techniques dans l'espace public. Publicité des inventions et littérature d'usage au XVIIIe siècle (France, Angleterre)', *Revue de synthèse* (2006) 127, pp. 393–428.

22 Long, op. cit. (17), Chapters 6 and 7.

23 Liliane Hilaire-Pérez, *L'invention technique au siècle des Lumières*, Paris: Albin Michel, 2000.

24 Jürgen Habermas, *Strukturwandel der Öffentlichkeit: Untersuchungen zu einer Kategorie der Bürgerlichen Gesellschaft*, Neuwied: Luchterhand, 1962; translated as *The Structural Transformation of the Public Sphere*, Cambridge, MA: MIT Press, 1989.

25 For a first assessment see Thomas Broman, 'The Habermasian public sphere and science in the Enlightenment', *History of Science* (1998) 36, pp. 123–149. For an update, Mary Terrall, 'Public science in the Enlightenment', *Modern Intellectual History* (2005) 2, pp. 265–276; and Larry Stewart, 'Feedback loop: a review essay on the public sphere, pop culture and the early-modern sciences', *Canadian Journal of History* (2007) 42, pp. 463–483; Larry Stewart and John Gascoigne, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660–1750*, Cambridge: Cambridge University Press, 1992; Jan Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760–1820*, Cambridge: Cambridge University Press, 1992; Bernadette Bensaude-Vincent and Christine Blondel (eds.), *Science and Spectacle in the European Enlightenment*, London: Ashgate, 2008; Anne Secord, 'Science in the pub: artisan botanists in early nineteenth-century Lancashire', *History of Science* (1994) 32, pp. 269–315; Daniel Roche, *Le siècle des Lumières en province: Académies et académiciens provinciaux, 1680–1789*, Paris: Mouton, 1978; Stéphane Van Damme, 'La sociabilité intellectuelle. Les usages historiographiques d'une notion', *Hypothèses* (1997), pp. 121–132; Oliver Hochadel, *Öffentliche Wissenschaft. Elektrizität in der deutschen Aufklärung*, Göttingen: Wallstein Verlag, 2003. For a revisionist account see Jacob Soll, *The Information Master: Jean-Baptiste Colbert's Secret State Intelligence System*, Ann Arbor: University of Michigan Press, 2009.

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when they circulate among the general mass of people. I am impatient to take them there'.[26] Yet the historiography of the Enlightenment has not fully addressed how to distinguish between the related philosophical and sociological concepts of the private, the elite and the secretive; and the judgment is still out whether Enlightenment openness was a progressive step of modernity, or rather the reconfiguration of traditional cultural and societal boundaries with new forms of privacy and secrecy arising.[27] Except for the groundbreaking work of Liliane Hilaire-Pérez, the practices of scientific secrecy are relatively understudied for this period.[28]

According to Habermas, the public sphere disappeared with the development of a mass consumer culture and the welfare state. The historiography of secrecy in recent science reflects these concurrent developments. Commercialization and increasing competition are often invoked as one explanation for increased secrecy today. A survey has shown that while in 1966 50 per cent of scientists felt safe about discussing their ongoing work with others, the percentage had dropped to 26 per cent by 1998, heralding a new era of entrepreneurial science.[29] As Stephen Hilgartner recounts in this issue, scientists operating in the culture of venture capital develop elaborate rituals to communicate results only partially, shirking from the open discussion of unpublished data at scientific conferences lest competing research teams poach their ideas. At the extreme, some companies might even actively suppress publicly available scientific information relating to their products, and deliberately create doubt and ignorance where consensus had existed before.[30] Secrecy is especially prevalent in the world of modern biotechnology, a discipline at the crossroads of science, technology and the market.[31] In the crop industry, for instance, purchasing a genetically modified seed only entitles the owner to plant it, but not to subject it to scientific research.[32] Scientific journals now consider trade secrets and strict confidentiality agreements with employees a standard for modern biotech companies, and offer policy recommendations on how to inculcate the norm of secrecy in openness-oriented academic scientists.[33] Yet, as the debates around gene patenting have shown, although commercial considerations and the quest for scientific credit often

26 Diderot cited in J.H. Mason, *The Irresistible Diderot*, London: Quartet Books, 1982, p. 5. See also Liliane Hilaire-Pérez, 'Diderot's views on artists' and inventors' rights: invention, imitation and reputation', *BJHS* (2002) 35, pp. 129–150.

27 Max Horkheimer and Theodor W. Adorno, *Dialectic of Enlightenment*, Stanford: Stanford University Press, 2002 (first published 1944); Michel Foucault, *Surveiller et punir: Naissance de la prison*, Paris: Gallimard, 1975.

28 Hilaire-Pérez, op. cit. (26).

29 John Walsh and Wei Hong, 'Secrecy is increasing in step with competition', *Nature* (2003) 422, pp. 801–802.

30 Robert Proctor and Londa Schiebinger (eds.), *Agnotology: The Making and Unmaking of Ignorance*, Stanford: Stanford University Press, 2008.

31 Susan Wright and David Wallace, 'Varieties of secrets and secret varieties: the case of biotechnology', *Politics and the Life Sciences* (2000) 19, pp. 33–45.

32 Emily Waltz, 'Under wraps', *Nature Biotechnology* (2009) 27, pp. 880–882.

33 Sharon Mollman Elliott, 'The threat from within: trade secret theft by employees', *Nature Biotechnology* (2007) 25, pp. 293–295; Kerry Medd and Antoinette Konski, 'Workplace programs to protect trade secrets', *Nature Biotechnology* (2003) 21, pp. 201–203.

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clash, full secrecy hardly ever emerges.[34] As Mario Biagioli argues in this issue, scientists at the boundaries of academia and industry do not necessarily seek complete secrecy, but rather the establishment of the proper temporal order of making knowledge public.

Yet, *pace* Habermas, commercial secrecy is not a new development of consumer society. As historians have shown, the Spanish empire was using secrecy as a tool to maintain its monopoly in transatlantic trade already in the sixteenth century, and all colonial empires routinely controlled the movement of skilled practitioners and the flow of information related to maps, trade routes and economic botany.[35] As Vera Keller's article argues in this issue, the secrets of nature were also *arcana imperii*. What is new for the globalized world of the twentieth and twenty-first centuries is first and foremost the unprecedented scale of secrecy, creating a world of classified science that rivals in size the knowledge that is publicly available.[36] While commercial secrecy has shifted from mercantilist governments to multinational companies, the modern state maintains a strong interest in the technoscientific as it relates to the military and issues of national security.[37] For the historiography, the epitome of this explosion of secrecy is Second World War nuclear research. As the Allied Forces came to realize the potential of nuclear fission in 1940, the British and American physicist community voluntarily stopped publishing their results in scientific journals.[38] And with the establishment of the Manhattan Project, secrecy was no longer exclusively oriented towards the outside. Most scientific contributors to the bomb worked in isolation from each other, as Lieutenant General Leslie Groves compartmentalized nuclear research, and forbade the open discussion of findings between the different research groups of the Los Alamos community as well.[39]

The secrecy of nuclear science did not disappear after the dropping of the bomb. During the Cold War, a whole culture of secret science emerged in America, with its

34 T. Caulfield *et al.*, 'Evidence and anecdotes: an analysis of human gene patenting controversies', *Nature Biotechnology* (2006) 24, pp. 1091–1094; see also Stephen Hilgartner, 'The Human Genome Project', in Sheila Jasanoff *et al.* (eds.), *Handbook of Science and Technology Studies*, Thousand Oaks: Sage, 1995, pp. 302–315.

35 María M. Portuondo, *Secret Science: Spanish Cosmography and the New World*, Chicago: University of Chicago Press, 2009; Kees Zandvliet, *Mapping for Money: Maps, Plans and Topographic Paintings and Their Role in Dutch Overseas Expansion During the 16th and 17th Centuries*, Amsterdam: Batavian Lion, 1998; Londa Schiebinger and Claudia Swan (eds.), *Colonial Botany: Science, Commerce and Politics in the Early Modern World*, Philadelphia: University of Pennsylvania Press, 2005; Reinhold Reith. 'Know-how, Technologietransfer und die *Arcana artis* im Mitteleuropa der frühen Neuzeit', *Early Science and Medicine* (2005) 10, pp. 349–377; John Harris, *Industrial Espionage and Technology Transfer: Britain and France in the Eighteenth Century*, Aldershot: Ashgate, 2000.

36 Peter Galison, 'Removing knowledge', *Critical Inquiry* (2004) 31, pp. 195–223.

37 For a recent overview see *Limiting Knowledge in a Democracy*, a special issue of *Social Research* (2010) 77.

38 Michael Aaron Dennis, 'Secrecy and science revisited: from politics to historical practice and back', in Judith Reppy (ed.), *Secrecy and Knowledge Production*, Cornell University Peace Studies Program Occasional Paper #23, 1999; Michael Gordin, *Red Cloud at Dawn: Truman, Stalin, and the End of the Atomic Monopoly*, New York: Farrar, Straus and Giroux, 2009, p. 30.

39 Robert S. Norris, *Racing for the Bomb: General Leslie R. Groves, the Manhattan Project's Indispensable Man*, South Royalton: Steerforth Press, 2002, Chapters 12 and 13.

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own, alternative, system of authorship, peer review and classified journals.[40] The big science of physics was studied in the two separate spheres of academia and the military, at times leading to discovering the same results twice. And the situation barely improved with the fall of the Berlin Wall. After the promise of declassification in the mid-1990s, government secrecy has gained new powers in the years since 9/11. Within the United States, the government spent almost nine billion dollars on security classification in 2009, a sum that has doubled since 1995.[41] Many of these investments actually fund commercial enterprises, as the US government has been outsourcing much of its intelligence operations to private companies.[42] While the defenders of these policies claim that the culture of secrecy is only for the protection of sensitive information and vulnerable populations, opponents are eager to point out the dangers of the existence of a classified universe on par with the public world.[43] According to these critics, the contemporary culture of secrecy not only is about the protection of intellectual property, for commercial or military reasons, but also has a self-sustaining power of its own. It creates hierarchies of inclusion and exclusion, and leads to a government that is only responsible to itself. From the understanding of secrets as protected intellectual property, we have arrived in the world of secrecy.

From secrets to secrecy

The prevalence of craft secrecy, intellectual property and state secrets in the historiography of science betrays a focus on the content of the *secret*; that is to say, on the invention, method or recipe that people wanted to keep hidden for security reasons or for making a profit.[44] With this special issue, we want to give the state of research on scientific secrecy, but we also want to hint at the richness of historiographical work still to be done when the focus is shifted from secrets to *secrecy* as a dynamic social relation. In many instances, *what* is kept secret is not even relevant for studying the dynamics of secrecy, i.e. the practices of simulation and dissimulation, the rhetoric of secretiveness or the strategies of hiding and revealing that are employed.

The work of the German sociologist Georg Simmel is a rich source of inspiration for studying the dynamics of secrecy. For him, secrecy, 'one of the greatest accomplishments

40 Hugh Gusterson, *People of the Bomb: Portraits of America's Nuclear Complex*, Minneapolis: University of Minnesota Press, 2000.

41 Information Security Oversight Office, *2009 Cost Report*, Washington, DC, 2010.

42 Tim Shorrock, *Spies for Hire: The Secret World of Intelligence Outsourcing*, New York: Simon & Schuster, 2008.

43 Steven Aftergood, 'Government secrecy and knowledge production', in Judith Reppy, op. cit. (38); Daniel Patrick Moynihan, *Secrecy: The American Experience*, New Haven: Yale University Press, 1998; Peter Galison and Rob Moss, *Secrecy*, Film Premiere: The Sundance Film Festival (2008).

44 For more recent work on science and secrets see the French–Portuguese journal *Sigila*, devoted to a transdisciplinary study of the secret, which has a 2005 special issue on science and secrets. Just before the current issue went into print, a new collective volume on secrets appeared: Elaine Leong and Alisha Rankin (eds.), *Secrets and Knowledge in Medicine and Science, 1500–1800*, London: Ashgate, 2011.

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of humanity', was a necessary element of human society.[45] Just as the circulation and exchange of gifts, the non-circulation and withholding of knowledge was a structuring force of society and social hierarchy. While Simmel's work had a large influence in anthropology and religious studies, it has had virtually no impact on the historiography of science. This is unfortunate, because understanding the sociopsychology and sociology of secrecy is crucial for the study of the practices of secrecy in the history of science, as Koen Vermeir argues in this issue. At least, such a study will help us to overcome too simplistic, monolithic and reductionist definitions of secrecy and openness.

Secrets evoke excitement and desire. Those who have a secret are under constant tension: they want to keep the secret, but they also want to indicate that they have a secret, to veil and unveil it at the same time. Those who have a secret are teased and tempted into betraying the secret, and reach release and climax only when the secret is shared with others.[46] At the same time, those who know about the secret, but do not have it, desire it. They project their hopes and fears on it, and these passions are heightened by the unknown character of the secret. In these scenarios, owners do not use secrets as a tool of monopoly, but rather to establish a special bond with those to whom they reveal their knowledge.[47] Such a desire to share could also lead to open publication: one example is that after the invention of the printing press, books of secrets were among the most popular and most widely published.[48] This seems incomprehensible when historians stay focused on the knowledge content of the secret instead of on the psychodynamics of secrecy.

As objects of desire, secrets accrue a special value, even if their content would in itself be valueless. They hide the real value of the content by keeping it hidden. Blacked-out spaces in texts, empty spaces on maps or even neurotic symptoms indicate that something has been intentionally hidden, and spark speculation about its extraordinary value or meaning.[49] Secrecy can thus be used to support beliefs that are mediocre, irrational, unverifiable and nonsensical, in science as well as in esoteric practices.[50] Therefore alchemists or professors of secrets were often disappointed when they exchanged secrets and assessed the real value of what they received in return. Yet, in other cases, the mark of secrecy serves as a correct indicator of the object's importance. In 1941, for instance, the Russian scientists Georgii Flerov inferred that it might be

45 Georg Simmel, 'The sociology of secrecy and of secret societies', *American Journal of Sociology* (1906) 11, pp. 441–498, esp. 462.

46 Simmel, op. cit. (45), p. 466, also describes the 'joy of confession', for instance, 'which may contain that sense of power in negative and perverted form, as self-abasement and contrition'.

47 See, for instance, Giorgio Vasari's account of Jan van Eyck's sharing of his secret of oil painting. Marc Gotlieb, 'The painter's secret: invention and rivalry from Vasari to Balzac', *Art Bulletin* (2002) 84, pp. 469–490; Michael Herzfeld, *The Body Impolitic: Artisans and Artifice in the Global Hierarchy of Value*, Chicago: University of Chicago Press, 2004, Chapter 4.

48 For these books of secrets see Eamon, op. cit. (4), who is more sensitive than most to the dynamics of secrecy but does not devote much explicit reflection to it.

49 J.B. Harley, 'Silences and secrecy: the hidden agenda of cartography in early modern Europe', *Imago mundi* (1988) 40, pp. 57–76.

50 Shils, op. cit. (7); Bok, op. cit. (8), p. 155; Tanya Luhrman, 'The magic of secrecy', *Ethos* (1989) 17, pp. 131–165.

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possible to build an atomic bomb by noticing the suddenly secretive behaviour of American researchers about nuclear physics, and wrote that 'a stamp of silence has been laid on this question, and this is the best sign of what kind of burning work is going on right now'.[51] A proper assessment of a secret's value is especially complicated when the classified information is publicly available elsewhere.[52] As recent events have shown, government censorship and secrecy are often about maintaining the illusion of information control even when everyone is able to download classified documents from a website. The concept of censorship can also be used to undo the dichotomy of private and public, and the inner and the outer, as Peter Galison makes clear in this issue. Drawing on contemporary practices of censorship, Freud could even interpret forgetting as secrecy, as the intentional concealment by a hidden internal censor. Secrecy is essential to our internal lives; we cannot even trust ourselves.[53]

Objects of desire and bearers of value, secrets are a social phenomenon. Indeed, as Stephen Hilgartner points out in this issue, secrecy is often a performance aimed at an audience. For example, when Greek shepherds shared their secret stories of animal theft with anthropologist Michael Herzfeld, they acted as if they were approaching him surreptitiously, but in fact also ensured that their fellow shepherds noticed and appreciated this secretive behaviour.[54] In a similar vein, sociologists argue that secrecy can make as well as break a social group. According to Simmel, a child gets a sense of an 'I' when it becomes aware that it can keep secrets from others, and then, those who share a secret amongst each other become a 'we'. Secrecy has a strong effect on practices of inclusion, exclusion and group formation. The internal role of secrecy is to elicit reciprocal confidence and trust, a group identity and a tight community. Pythagoreans even did a mock burial of those who betrayed their secrets, and afterwards ignored these expelled initiates as if they were dead. An even stronger bond arises when a secret about the 'we' is mutually created, as with accomplices in a shared crime, or a shared ritual. This bond will be the stronger if this secret is socially unsupported and cannot be revealed by one of the participants without risk to himself.[55]

Understood as a tool of group formation, secrecy is also about control and the establishment of hierarchies. Having a secret gives one a strong sense of identity, and also control over others. It binds those with whom you share the secret to you, morally and psychologically. Furthermore, the possibility of disclosing the secret gives everyone power over the group as a whole. A different kind of power arises when one not only knows more than the others, but also knows *that* one knows more. This means that the others' desire for the secret or for being part of the group can be manipulated and

51 Cited by Gordin, op. cit. (38), p. 31.

52 Shils, op. cit. (7), p. 221, argued that much of the 'secret' information of the government was in fact openly available and was often not worth keeping. It did not justify the 'tremendous disturbance and degradation that America has suffered from its own zealots of secrecy'.

53 For a similar perspective see Miklós Haraszti, *The Velvet Prison: Artists under State Socialism*, New York: Basic Books, 1987.

54 Herzfeld, op. cit. (47), pp. 108–109.

55 For example, in Laurel Richardson, 'Secrecy and status: the social construction of forbidden relationships', *American Sociological Review* (1988) 53, pp. 209–219. See also the work of Slavoj Žižek for many examples of the complex psychodynamics of secrecy.

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exploited. Secrecy gives rise to strong feelings, of freedom (you are special), but also of frustration and oppression (you cannot be like the others, or you are part of a group closely knit around the secret). Secrecy is a way of controlling the interface between what is kept hidden and what is made public, the access to information, and who knows what. Secrecy is often hierarchically structured: some know more than others, in different gradations, and these levels of knowing are closely guarded.[56]

Such practices of secrecy are prevalent both in social networks and in formal institutions. As Max Weber showed at the institutional level, secrecy plays a central role in bureaucracies. From combining Weber's and Simmel's arguments, it follows that the current bureaucracy of scientific and governmental institutions can fruitfully be analysed according to the social structures of secrecy, with different levels of access to and control of information.[57] Yet looser networks similarly operate by the establishment of a differential access to secrets. As Lawrence Principe and William Newman have shown, when the alchemist George Starkey communicated his alchemical secrets to Robert Boyle and not to other alchemists, this was a marker of their relationship in which trust, respect, class and patronage played an essential role.[58] Secrets could establish even longer chains of relationships. When Henry Oldenburg sent a secret to Samuel Hartlib, for instance, he instructed the recipient to only tell it to Robert Boyle, who surely would only communicate it to Lady Ranelaugh, who also knew how to keep a secret. Secrecy here is a social marker that defines sometimes highly specific social relationships, including those that govern scientific exchanges.[59]

Viewed as a social phenomenon, secrecy can have very real effects, negatively, in hampering circulation, in creating distrust and making social relations crumble. Yet it also has more positive psychological and social effects. As Tanya Luhrman has argued, sharing secrets within a closed group can also have therapeutic, sometimes even psychosomatic, effects – hence the attraction of many esoteric communities.[60] Secrecy can also accrue deeper, symbolical powers, and it can become the focus of ritualized practices. The mystery around secrets gives their bearers an aura of superiority. Secrets can be icons and indices of political power, used for controlling people. Secrets can even be transcendent, as divine secrets, at the core of religious mysteries or of the book of nature, only partially revealed to the faithful. In the end, the meaning of secrets is overdetermined, because they are hidden, and this allows diverse political, religious and other meanings and values to be projected onto them.[61]

56 See, for example, Agnes Ku, 'Boundary politics in the public sphere: openness, secrecy, and leak', *Sociological Theory* (1998) 16, pp. 172–192. Hugh Urban, 'The torment of secrecy: ethical and epistemological problems in the study of esoteric traditions', *History of Religions* (1998) 37, 209–248.

57 Max Weber, *From Max Weber: Essays in Sociology*, Oxford: Oxford University Press, 1958. Lisa Blank, 'Two schools for secrecy', in Jan Goldman and Susan Maret (eds.), *Government Secrecy: Classic and Contemporary Readings*, Westport: Libraries Unlimited, 2008.

58 William Newman and Lawrence Principe, *Alchemy Tried in the Fire: Starkey, Boyle, and the Fate of the Helmontian Chymistry*, Chicago: Chicago University Press, 2002.

59 In Eamon, op. cit. (4), p. 345.

60 Luhrman, op. cit. (50).

61 Urban, op. cit. (56).

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Of course, this dynamical analysis of secrecy has to be historicized in order to better understand the historical specificity and conditions of specific instances of secrecy, with due attention to actors' categories and the richness of the practices involved. In this issue, we put forward an analysis of secrecy that goes beyond its usual understanding as the rational behaviour of an opportunist scientist or state interested in maintaining their intellectual property. Such an analysis allows us to place secrecy in a broader context of phenomena such as dissimulation, lying, fraud, imposture, theatricality, illusionism, which do not necessarily involve 'a secret' that has to be hidden but do involve practices of hiding and revealing.[62] Many different, sometimes flamboyant, characters enter the stage of the history of science, and historians need all the tools of their trade to describe them. In the early modern period, scientists were characterized as hunters, seeking out the hidden truths of nature.[63] We could also imagine the scientist as a trickster, trying to outwit nature by his cunning practices. The aim of our dynamic analysis of secrecy, of the play of veiling and revealing, is to try to capture even that fleeting and cunning character of the trickster scientist.[64]

62 For example, Tara Nummedal, *Alchemy and Authority in the Holy Roman Empire*, Chicago: Chicago University Press, 2007; Jon Snyder, *Dissimulation and the Culture of Secrecy in Early Modern Europe*, Berkeley: University of California Press, 2009; Toon van Houdt *et al.* (eds.), *On the Edge of Truth and Honesty: Principles and Strategies of Fraud and Deceit in the Early Modern Period*, Leiden: Brill, 2002; Rob Iliffe, 'Lying wonders and juggling tricks: nature and imposture in early modern England', in J. Force and D. Katz (eds.), *Everything Connects: In Conference with Richard H. Popkin. Essays in His Honor*, Leiden: Brill, 1998, pp. 183–210.

63 Eamon, op. cit. (4), Chapter 8. For the emergence of the sixteenth- and seventeenth-century metaphor of the natural inquirer as seeking secrets contained inside the naked body of a personified female Nature, see also Katharine Park, 'From the secrets of women to the secrets of nature', in Jane Donawerth and Adele Seeff (eds.), *Crossing Boundaries: Attending to Early Modern Women*, Newark: University of Delaware Press, 2000, pp. 29–47.

64 There is an interesting comparison to be made between the figure of the trickster and contemporary scientists, for instance in their use of technology to outwit nature, in their moral ambiguity, and in their goals, working to further their own interests or for the common good. For the trickster see, for example, Lewis Hyde, *Trickster Makes This World: Mischief, Myth, and Art*, New York: Farrar Straus & Giroux, 1998.

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