

Making matters of fraud: Sociomaterial technology in the case of Hwang and Schatten

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Abstract

This paper revisits the “Hwang case,” which shook Korean society and the world of stem cell research in 2005 with the fraudulent claim of creating patient-specific embryonic stem cells. My goal is to overcome a human-centered, Korea-oriented narrative, by illustrating how materials can have an integral role in the construction and judgment of fraud. To this end, I pay attention to Woo Suk Hwang’s lab at Seoul National University as a whole, including human and nonhuman agents, that functioned as what I call sociomaterial technology, and Gerald P. Schatten at the University of Pittsburgh, Hwang’s collaborator, who played a crucial role in demonstrating the potency of this technology to the members of the scientific community. By recasting the whole event as the “case of Hwang and Schatten,” I argue that fraud is, like all knowledge claims, a sociotechnical construct, and that matters of fraud are locally judged. Fraud leaves its mark on materials, but I show that material evidence alone never tells the whole story and instead can be used to limit the range of responsibility.

Keywords

Scientific fraud, sociomaterial technology, materiality, research integrity, Woo Suk Hwang, Gerald Schatten, stem cell, ethics

Introduction

What can historians of science tell us about fraud? They can certainly do the yeoman’s job of analyzing research notebooks, rummaging through letters and emails, and collecting circumstantial evidence, but they do not usually take the role of a whistleblower or

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an apologist in the court of scientific misconduct.¹ Instead, they seek to go above the fray in order to have a better understanding of scientific personae, laboratory practices, and sociopolitical contexts. To take a few examples: Gerald Holton uncovered Robert Millikan's selective use of data for the oil drop experiment, but explained his judgment with the notion of the "suspension of disbelief," the way to hold on to a promising hypothesis for some time.² Similarly, regarding whether or not Gregor Mendel manipulated data for his rules of heredity, Robert Scott Root-Bernstein suggested that Mendel's peas represent a "fuzzy set" of data, which required "subjective analysis" to fit them into a set of discrete categories.³ In his highly controversial biography on Louis Pasteur, Gerald L. Geison also delved into the private side of scientific practice. Geison unearthed two examples of what might be called scientific misconduct today – appropriating an experimental method from a competitor and conducting human experiments with few safety tests – and yet used them to deconstruct the heroic image of Pasteur, not his science.⁴

Cases of alleged fraud in contemporary science present a much more complicated picture than these examples centered on great scientists. The laboratory setting has changed, first and foremost. Any good-sized research project would have a principal investigator, junior collaborators, postdocs, and graduate students. Information-flows within the group are no less important than thought-processes in one's mind. Power and reward are concentrated, but labor and responsibility are diffused. No longer a leisurely gentleman's pursuit, science has become an enterprise fueled by ferocious competition and public funds. This is well exemplified in Daniel J. Kevles's book on the case of David Baltimore, Nobel laureate, and his coworkers at MIT – the case that gripped the attention of scientists and publics in the 1990s.⁵ It began with a postdoc accusing her immediate boss for the discrepancy between data recorded in the lab notebook and those shown in the published paper. But it escalated into charges of cover-up and fraud. The case itself moved beyond

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1. A few notable exceptions can be found in literature on the social, political, and cultural production of ignorance: See Robert N. Proctor, *Agnostology: The Making and Unmaking of Ignorance* (Stanford: Stanford University Press, 2008); Naomi Oreskes and Erik M. Conway, *Merchants of Doubt: How a Handful of Scientists Obstructed the Truth on Issues from Tobacco Smoke to Global Warming* (London: Bloomsbury Press, 2011); Allan M. Brandt, *The Cigarette Century: The Rise, Fall, and Deadly Persistence of the Product that Defined America* (New York: Basic Books, 2007).
 2. Gerald Holton, "Subelectrons, Presuppositions, and the Millikan-Ehrenhaft Dispute," *Historical Studies in the Physical Sciences* 9 (1978): 161–224, 212–13.
 3. Root-Bernstein considered the categories like the pea's color and shape to be man-made rather than existing objectively in nature. Robert Scott Root-Bernstein, "Mendel and Methodology," *History of Science* 21 (1983): 275–95, 289–90.
 4. Gerald L. Geison, *The Private Science of Louis Pasteur* (Princeton: Princeton University Press, 1995), pp.277–8. He did not deny the fruits of Pasteur's scientific work, but was critical of the dominant image forged "in a context in which heroic biographies were used to transmit widely accepted moral verities and in which science was seen as straightforwardly useful and 'positive' knowledge."
 5. Daniel J. Kevles, *The Baltimore Case: A Trial of Politics, Science, and Character* (New York/London: W. W. Norton & Company, 1998).

university walls into the public domain, debated in the halls of Congress, scrutinized by the government's investigative committees, and saturated by media attention. This prolonged, multifaceted trial saw the reversal of verdicts (from innocent to guilty to innocent) and the swing of public opinions (from sympathy for the whistleblower to a victory for science). Here, what was on trial was not just a laboratory practice but politics, science, and character. Kevles clearly saw science entangled with power from outside, but did not dissect power relations within the lab. This was his blind spot.⁶

Here I revisit what is widely known as the “Hwang case” (also called the “Hwang scandal,” the “Hwang affair,” or “Hwang-gate”), which shook Korean society and the world of stem cell research in 2005 and beyond. The main figure is Woo Suk Hwang, a disgraced scientist and fallen national hero, who claimed in two papers published in *Science* to have created the world's first cloned human embryos, extracted stem cells from them, and produced patient-specific embryonic stem cells.⁷ It was revealed, however, that Hwang had not only committed ethical violations in procuring human eggs but also used fabricated experimental images. Hwang's rise and fall, which have elements of a Shakespearian drama, full of complicated plots and supporting casts, have been the focus of a huge body of literature.⁸ The alliance-making is scrutinized in both rise and fall sides of the story: that is, the emergence of a formidable science–media–government complex, and the formation of a counterforce among a whistleblower, civic activists, a small number of investigative reporters, and anonymous young scientists.⁹ Yet they are mostly human actors residing in Korea. Noticeably missing is the analysis of Hwang's global network, which was built on the sharing of technologies, images, and materials. To put it simply, the existing literature pays little attention to Hwang's most important

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6. See Sheila Jasanoff, “Not Proven: Truth by Exhaustion in the Baltimore Case,” *Isis* 90 (1999): 781–3.
 7. Woo Suk Hwang et al., “Evidence of a Pluripotent Human Embryonic Stem Cell Line Derived from a Cloned Blastocyst,” *Science* 303 (2004): 1669–74; Woo Suk Hwang et al., “Patient-specific Embryonic Stem Cells Derived from Human SCNT Blastocysts,” *Science* 308 (2005): 1777–83.
 8. On the dramatic character of the case, see “Ethics and Fraud” (editorial), *Nature* 439 (2006): 117. For a snapshot summary of the case, see David Cyranoski, “Rise and Fall: Why Did Hwang Fake His Data, How Did He Get Away with It, and How Was the Fraud Found Out?” *Nature*, 11 January 2006 (published online), <<https://www.nature.com/news/2006/060109/full/060109-8.html>> (April 7, 2018).
 9. To date, the “Hwang case” has been studied in diverse disciplines (bioethics, law, journalism, sociology, economics, Science and Technology Studies, and so on), examined from multiple angles (stem cell controversy, feminism, developmental state, social movement, academic capitalism, and so on), and framed in different ways (scandal, affair, and “gate”). There are already several books: for example, Geun Bae Kim, *The Myth of Hwang Woo Suk and Science in Korea* (Seoul: Yuksawoa Bi-pyung, 2007) [in Korean]; Yang-gu Kang, Byoungsoo Kim, and Jaegak Han, *Silence and Enthusiasm: A Record of Seven Years in the Hwang Scandal* (Seoul: Humanitas, 2006) [in Korean]. There are about 200 articles published on Hwang, according to the Korean database DBPIA, and dozens of articles published in English. For a general overview, see Sungook Hong, “Introduction: The Hwang Scandal that ‘Shook the World of Science’,” *East Asian Science, Technology and Society* 2 (2008): 1–7. For papers in English, see also Herbert Gottweis and Byoungsoo Kim, “Explaining Hwang-gate: South Korean Identity Politics between Bionationalism and Globalization,” *Science, Technology,*

American collaborator, Gerald P. Schatten, and his most important experimental materials, human eggs, in conjunction with scientific fraud.¹⁰ Why should we broaden the scope beyond Korea? What do materials have to do with fraud?

This article explores the materiality of scientific fraud by closely examining the intertwined processes of fraud-making and fraud-judgment in two different locales, Seoul and Pittsburgh. I consider fraud, like all knowledge claims, to be a *sociotechnical construct*. This symmetrical approach to fraud and knowledge provides us with a constructivist lens to look into the operation of power. First and foremost, the understanding of fraud as a concept that is defined and judged in local contexts, rather than as timeless and universal, redirects our attention from the question of who has done it to that of what constitutes wrongdoing. This shift is important, because the distinction between error and fraud, mistake and misconduct, is not always obvious and sometimes difficult to make. Intentionality may be investigated for that distinction, but, again, benign and serious intentions are also hard to discern. More important, there remains a question of whose intention it is. Can there be an isolated act of wrongdoing in today's labs? What act, then, should be held accountable? Giving direction? Conducting benchwork? Making image files? Or writing a draft? How could, in this case, Schatten avoid any career-threatening punishment by the University of Pittsburgh, which sentenced him with the verdict of "scientific misbehavior," instead of "scientific misconduct"?¹¹ To locate responsibility becomes a complicated and contested matter, which can reveal power relations within and between the labs.

and Human Values 35 (2010): 501–24; Leo Kim, "Explaining the Hwang Scandal: National Scientific Culture and Its Global Relevance," *Science as Culture* 17 (2008): 397–415; Sang-Hyun Kim, "The Politics of Human Embryonic Stem Cell Research in South Korea: Contesting National Sociotechnical Imaginaries," *Science as Culture* 23 (2014): 293–319; Tae-Ho Kim, "How Could a Scientist Become a National Celebrity? Nationalism and the Hwang Woo Suk Scandal," *East Asian Science, Technology and Society* 2 (2008): 27–45; Jongyoung Kim, "Public Feeling for Science: The Hwang Affair and Hwang Supporters," *Public Understanding of Science* 19 (2009): 670–86; Seyoung Hwang and Margaret Sleeboom-Faulkner, "Bioethical Governance in South Korea: Tensions between Bottom-Up Movement and Professionalization and Scientific Citizenship," *East Asian Science, Technology and Society* 8 (2014): 209–28.

10. Even the most comprehensive studies on the Hwang case, the books mentioned above, deal with Schatten only in passing. One notable exception is R. Saunders and J. Savulescu, "Research Ethics and Lessons from Hwanggate: What Can We Learn from the Korean Cloning Fraud?" *Journal of Medical Ethics* 34 (2008): 214–21.
11. University of Pittsburgh, "Summary Investigative Report on Allegations of Possible Scientific Misconduct on the Part of Gerald P. Schatten, Ph.D.," 8 February 2006, <<https://ecommons.cornell.edu/handle/1813/11589>> (April 7, 2018) (hereafter UP report). In relation to Hwang, see Seoul National University, "Final Report on Professor Woo Suk Hwang's Research Allegations," 10 January 2006, <www.nibp.kr/xe/info4_6/1487> (April 7, 2018) (hereafter SNU report). See also Seoul Central District Prosecutors' Office, "Investigative Report on the Fraud Case of Stem-Cell Papers," 12 May 2006, available in the National Library of Korea (hereafter Prosecutors' report).

Yet the main goal of this paper is not so much to reiterate the “context-dependency” or “situatedness” of fraud as to reveal the critical role of materials as an integrated element in the construction and judgment of fraud. In other words, it aims to overcome a human-centered narrative. This perspective itself is hardly novel in view of the growing interest in “material culture,” the “material turn,” and “new materialism” in recent decades. Diverse schools of thoughts – actor–network theory, assemblage theory, feminist theory, and so on – have enlivened the material world with power and agency, seeking to dissolve a set of modernist dualisms of nature and culture, science and society, matter and mind, object and subject, nonhumans and humans.¹² Theorists are still grappling with the issues of agency and causality, however. As one sociologist puts it: “Just what does it mean to say that nonhumans have agency?”¹³ Following Michel Callon, who depicted scallops as if they could stage “silent mutinies” together with fishermen against researchers’ new farming strategy, we can employ anthropomorphic words for the “behavior” of nonhumans in their network with humans.¹⁴ Yet this kind of “flat ontology” of treating human and nonhuman actions in an equal manner has yet to deal with moral criticisms; as Sheila Jasanoff aptly points out, it is “too distributive, too promiscuous in attributing cause and agency” to “diffuse responsibility” and “depoliticize power by making its actions opaque or invisible.”¹⁵ In a similar vein, Gabrielle Hecht notes the significance of spatiality and temporality in turning a material into an entity having materiality. As she argues: “Nuclearity, when it emerged at all, did so slowly, unevenly, according to different historical rhythms. Radiation did not, by itself, turn uranium mining into nuclear work. *It had to be made perceptible and allied to human agency.*”¹⁶

The notion that materiality is not an attribute of materials but a manifestation of socio-technical assemblages or hybrids of social and technical things is particularly insightful

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12. For example, see Michel Callon, “Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay,” in John Law (ed.), *Power, Action and Belief: A New Sociology of Knowledge?* (London: Routledge, 1986), pp.196–223; Bruno Latour, *The Pasteurization of France* (Cambridge, MA: Harvard University Press, 1988); Bruno Latour, “Give Me a Laboratory and I Will Raise the World,” in Mario Biagioli (ed.), *The Science Studies Reader* (New York: Routledge, 1999), pp.258–75; Manuel DeLanda, *A New Philosophy of Society: Assemblage Theory and Social Complexity* (London: Continuum, 2006); Rick Dolphijn and Iris van der Tuin (eds), *New Materialism: Interviews and Cartographies* (Ann Arbor: Open Humanities Press, 2012); Tony Bennett and Patrick Joyce (eds), *Material Powers: Cultural Studies, History and the Material Turn* (New York: Routledge, 2010).
 13. Edwin Sayes, “Actor–Network Theory and Methodology: Just What Does It Mean to Say That Nonhumans Have Agency?,” *Social Studies of Science* 44 (2014): 134–49.
 14. Callon, “Some Elements of a Sociology of Translation,” p.220 (note 12).
 15. Sheila Jasanoff, “Future Imperfect: Science, Technology, and the Imaginations of Modernity,” in Sheila Jasanoff and Sang-Hyun Kim (eds), *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power* (Chicago: University of Chicago Press, 2015), pp.1–33, 15–19.
 16. Gabrielle Hecht, *Being Nuclear: Africans and the Global Uranium Trade* (Cambridge, MA: The MIT Press, 2012), pp.248–9. Emphasis is mine.

and useful, as it allows us to regard nonhuman agency not as cause but as *effect*.¹⁷ Building on this notion of materiality, I show how Hwang's lab as a whole, including human and nonhuman agents, became what I call *sociomaterial technology* for embryonic stem cell research, and how human eggs – key materials in this technology – emerged in Seoul as an ethical touchstone amidst a clarion call from civic activists and re-emerged in Pittsburgh as evidence of Schatten's neglect of regulations for human-subject research. In contrast to Steven Shapin and Simon Schaffer, who distinguished material technology and social technologies in their study of Boyle's lab, I use the combined term, *sociomaterial technology*, in order to emphasize this hybridity of human and nonhuman agents.¹⁸ Human eggs embodied not only *physical* linkages between humans and nonhumans but also *moral* codes practiced in society. Matters of fraud intersected with matters of ethics in this case. In what follows I examine the transformation of Hwang's *sociomaterial technology* from a knowledge-producing tool to a fraud-making one, Schatten's role in this process, and the way his responsibility was investigated and assessed in Pittsburgh.

The lab as a *sociomaterial technology*

It was in December 2003, at the international stem cell meeting held in Seoul, when Woo Suk Hwang and Gerald P. Schatten met for the first time. On this occasion, Hwang invited Schatten from the University of Pittsburgh to his lab at Seoul National University where some forty researchers worked together.¹⁹ In one room, a group of blue-coated researchers pulled out about six hundred eggs per day from the ovaries of cows, pigs, and dogs. The next room had a dozen micromanipulators, the workstations where researchers could punch holes in the eggs, squeeze out their nuclei, and insert the nuclei from adult cells into them, while watching the objects under the microscope. The eggs with new nuclei were then taken to another room to grow cells. Researchers worked diligently under Hwang's strict time management. There were no Saturdays, no Sundays, and no holidays for all the lab members, including Hwang himself.²⁰

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17. On "effect," see Tim Ingold, "Materials against Materiality," *Archaeological Dialogues* 14 (2007): 1–16. Among the philosophers of new materialism, I have found Karen Barad's "agential realism" conducive to this emphasis on effect. As she explains: "The primary ontological units are not 'things' but phenomena . . . And the primary semantic units are not 'words' but material-discursive practices through which boundaries [between humans and nonhumans] are constituted. This dynamism is agency." Karen Barad, "Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter," in Stacy Alaimo and Susan Hekman (eds), *Material Feminisms* (Bloomington: Indiana University Press, 2008), pp.120–54, 135.
18. Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1985), pp.25–6.
19. For a detailed picture of Hwang's lab in that year, see David Cyranoski, "Crunch Time for Korea's Cloners," *Nature* 429 (2004): 12–14. The size of Hwang's lab grew from five in 1986 to 23 by 1999, and to 60 by 2005. See Leo Kim, "'Your Problem Is That Your Face Reveals Everything When You Are Lying': Making and Remaking of Conduct in South Korean Life Sciences," *New Genetics and Society* 30 (2011): 213–25, 217. See also Eve Herold, *Stem Cell Wars: Inside Stories from the Frontlines* (New York: St. Martin's Press, 2006).
20. See Woo Suk Hwang, *My Story on Life* [in Korean] (Seoul: Hyohyung Publishers, 2004).

To Western scientists, this level of dedication, loyalty, and discipline in the lab was more than impressive. The lab itself was a place of wonder. A reporter for the magazine *Slate* wrote that “Korean scientists aren’t just more technically skilled, they are also more diligent. Korean scientists work much harder than Americans.” This virtue of diligence and persistence seemed incredibly valuable in stem cell research where “repetitive, tedious, and factorylike [*sic*]” routine was common.²¹ In other words, Hwang’s lab was like a machine, a whole package of *sociomaterial technology* that produced not only experimental data but the public image of Hwang’s scientific work, which resonated greatly with that of South Korea striving to catch up with scientific achievement in ‘developed’ countries through the demands of dedication, coordination, and personal sacrifice. The epistemic uniqueness and authority of Hwang’s lab came from well-disciplined research workers and well-supplied research materials. This coalition of human and nonhuman agents was the essence of Hwang’s technology, which became the envy of other stem cell researchers.

A private space though it was, the lab was shown from time to time, like a machine on display, to selected groups of visitors such as influential politicians, potential collaborators, and members of the press. Hwang was the lab’s ultimate gatekeeper, or the main choreographer of the machine’s performance. He could decide what to show, to whom, where, and in what ways.²² This practice of selective display was aimed at selling promise, hope, and the feasibility of cloning research, and yet there were also important social dynamics. Absolutely out of sight was the facility for human embryonic stem cells that should be kept in separate, secure locations. Therefore, visitors had to extrapolate from what they could see (cloning experiments on other animal eggs) to what they could not (those on human eggs). Eye-witnessing was only partially valid, and it had to be undergirded by a leap of imagination. This demand of trust was an important aspect of Hwang’s alliance-making.

Sending the sociomaterial technology abroad

The emergence of Schatten’s collaboration with Hwang should be understood in this setting. In order to have access to Hwang’s *sociomaterial technology*, one needed to become enrolled as his ally. No trust, no access. The power of Hwang’s technology expanded through this alliance-making. When Schatten was told about the first cloned human embryonic stem cell line and the difficulties of getting the paper accepted in *Science*, he could immediately demonstrate his value as a potential collaborator: with the experience of publishing his papers in that journal, he knew how to respond effectively to the reviewers’ criticism. Schatten “volunteered to help steer the manuscript through acceptance by

21. David Plotz, “The Seoul of Clones,” October 19, 2005, <www.slate.com/id/2128361/> (April 7, 2018).

22. See, for instance, “President Roh Called It Not a Technology in Bioengineering But a Magic,” *The Korea Economic Daily*, December 10, 2003, <<http://news.hankyung.com/article/2003121050128>> (April 7, 2018).

providing some editorial input into a revision which had already been written.”²³ He even called the *Science* editor during the review process and “lobbied hard for publication of this paper in *Science*, without any direct knowledge of the veracity of the data.”²⁴ The editor’s decision to publish it was swiftly made on December 9.²⁵ To Hwang, Schatten appeared a scientist with influential connections.²⁶

What made Schatten rush to help Hwang? Four years older than Hwang (b. 1953), Schatten had much in common with him. Both of them were trained in non-medical fields: Hwang was a veterinarian specialized in animal cloning, and Schatten a developmental biologist who had worked on assisted reproductive technology (ART) for primates. They were also extremely ambitious. While Hwang sought to raise his stem cell research to the level of a national project, Schatten aspired to make it an international enterprise, circumventing the Bush administration’s regulation on stem cell research in the United States. “We should behave in a complementary manner . . . We don’t have to do everything in every country,” said Schatten after the publication of the 2004 *Science* paper.²⁷ If called in, he was eager to serve as Hwang’s ambassador to the West in the stem cell field.

Yet Schatten was no ordinary scientist with cooperative spirit: he had a deep-seated agenda of his own, becoming an Ian Wilmut for nonhuman primates. In other words, he endeavored to grab the scientific prize of monkey cloning with the technology of somatic cell nuclear transfer (SCNT), the same technology used for creating Dolly the sheep in 1997. Schatten had launched his study on primates while working at Oregon National Primate Research Center, where he successfully engineered a monkey carrying a gene from another organism, a jellyfish, in 2001. This research produced a windfall of publicity, which allowed him to land a faculty position at the University of Pittsburgh with a multimillion-dollar offer

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23. UP report, p.6 (note 11). This account of their initial meeting is based on Schatten’s testimony to the University of Pittsburgh’s Investigative Board.
24. Ibid. Regarding Schatten’s lobbying, the editor of the *Journal of American Medical Association* found it acceptable to “discuss a paper’s merit with an editor before submission, but not during the review process.” Donald Kennedy, the *Science* editor, disagreed. He was quoted as saying, “If that’s a sin, the jails will soon be full.” He found Schatten’s lobbying problematic, though: it “was not out of line, but it was toward the edge.” Nicholas Wade, “University Panel Faults Cloning Co-Author,” *The New York Times*, February 11, 2006.
25. SNU report, pp.26–7 (note 11). The first draft of the manuscript was originally submitted in mid-May to *Nature*, which did desk-rejection. Subsequently, Hwang’s team submitted the manuscript to *Science* in June. By the time Schatten got involved in early December, the manuscript had already been revised a few times. This reveals the level of *Science*’s interest in this work.
26. Hwang recollected that Schatten seemingly had already been informed about the manuscript submission, which could have been a tip-off from Donald Kennedy. See Hwang’s 2018 interview in Gab-sik Moon, “Woo Suk Hwang, Creator of Dogs, Speaks in 10 Years,” *Monthly Chosun*, February 2018, <<http://monthly.chosun.com/client/news/viw.asp?ctcd=E&nNewsNumb=201802100010>> (January 15, 2020).
27. Helen Pearson, “Cloning Success Marks Asian Nations as Scientific Tigers,” *Nature* 427 (2004): 664. For the regulations and debates on human embryo research in general, see J. Benjamin Hurlbut, *Experiments in Democracy: Human Embryo Research and the Politics of Bioethics* (New York: Columbia University Press, 2017).

for creating a research center. He worked on monkey cloning, went through repeated failures, and then studied the reason for the failures. This study, which was about the problem of an unintended removal of a protein needed for cloning while sucking the nucleus out of the monkey eggs, catapulted Schatten to an authority in the cloning field to the extent that he was invited in 2002 to President Bush's Council on Bioethics, where he said: "primate cloning, including human cloning, will not be in our lifetimes."²⁸ This pessimistic view, albeit overstated, was a shrewd move to stake out an ethically safe space for conducting research on human embryonic stem cells, as it implied that cloned human embryos would not develop further into fetuses at least with the current technology. He published the experimental ground of his statement in *Science*.²⁹ Furthermore, from the standpoint of safeguarding assisted reproductive technologies, which faced market pressure to create human embryonic stem cell lines, Schatten called for an Asilomar-type approach for ART, or "ART-silomar," in order for the National Institutes of Health (NIH) to "continue to sponsor frontier biomedical research while not allowing federal mandates to usurp its leadership and stewardship roles."³⁰ He did not yet embark upon human embryonic stem cell research, but approached it with the study of nonhuman primates as animal models for unraveling the cellular and molecular events during the cloning process.³¹ No wonder he received a five-year NIH grant of 6.4 million dollars in 2003 for cloning at least ten monkeys.³²

To Schatten, therefore, Hwang's cloning of human embryos meant the existence of a technology that might circumvent the seemingly insurmountable obstacle he had reported with monkey cloning. It also meant that, if so, he must seriously reconsider how he would carry out his NIH-sponsored research. The development of stem cell therapy, which Hwang had promised to Korean people, might not be under the radar of Schatten's immediate concern. Instead, he felt compelled to learn the new technology as soon as possible for cloning monkeys.

The Hwang-Schatten collaboration literally started at their first meeting and became steady and routine throughout 2004. They "met almost monthly, at one meeting or another, and they exchanged e-mails or phone calls almost daily to discuss scientific matters related to cloning."³³ A postdoctoral fellow from Hwang's lab, Sang Hwan Hyun, a specialist in pig cloning, began working with Schatten's monkey team in December 2003.³⁴ Subsequently, Eul Soon Park, another member of Hwang's lab, joined the team in

28. Quoted in Antonio Regalado, "With Public Wary, Cloning Scientists Watch Their Words: Dr. Schatten Wants to Copy a Monkey, but Declares He Won't Try Humans," *Wall Street Journal*, December 22, 2004, <www.wsj.com/articles/SB110365882177306237> (January 7, 2020).

29. Calvin Simerly et al., "Molecular Correlates of Primate Nuclear Transfer Failures," *Science* 300 (2003): 297.

30. Gerald P. Schatten, "Safeguarding ART," *Nature Cell Biology and Nature Medicine*, fertility supplement (2002): s19-s22.

31. Laura Hewitson and Gerald Schatten, "The Use of Primates as Models for Assisted Reproduction," *Reproductive BioMedicine Online* 5 (2002): 50-5.

32. Regalado, "With Public Wary" (note 28).

33. UP report, p.6 (note 11).

34. Sang Hwan Hyun came to Pittsburgh with a postdoctoral fellowship from the Korea Science and Engineering Foundation (KOSEF). He returned to Korea in the summer of 2004, though, to take up his faculty position at Chungbuk National University.

Pittsburgh.³⁵ Park was most coveted by Schatten, as she had earned the reputation as *the* master of the “squish” technique, which was to gently squeeze out the egg’s nucleus through the punctured hole rather than sucking it out, that is to say, “extrusion” rather than “extraction.” It was with her help that Schatten’s team created a total of 135 clone monkey embryos and transferred them into twenty-five female monkeys.³⁶ None of them succeeded in pregnancy, but despite these difficulties in the area of reproductive cloning, they reported confirmation that “therapeutic cloning for human and NHP [nonhuman primates] stem cell research has been dramatically accelerated by the findings of Hwang et al. (2004)” in a paper published in the December issue of *Developmental Biology*.³⁷ In the meantime, Hwang’s team had focused on the establishment of new embryonic stem cell lines with improved efficiency. With some experimental progress coming out in late 2004, Schatten became more deeply involved from Pittsburgh in preparing a manuscript.³⁸ He laid out the structure of the paper with images and tables to be included, received relevant experimental data from Hwang, asked for more data, and so on. In the course of 2004–2005, he also accepted Jong Hyuk Park and Sun Jong Kim, specialists in culturing stem cells at Hwang’s lab, as postdocs.³⁹ Hwang and Schatten were convinced they could lead the field together, especially after the publication of the paper in *Science* in June 2005, where they claimed the creation of eleven patient-specific embryonic stem cell lines through the transfer of somatic cell nuclei.⁴⁰

The nature of the Hwang–Schatten collaboration can be seen from the perspective of mutual benefits. Certainly, Hwang took advantage of Schatten’s standing within the academic circle of reproductive and therapeutic cloning; Schatten, Hwang’s new cloning technology. Hwang’s lab was the place to produce and supply experimental data; Schatten’s, the place to interpret and turn them into scientific evidence. There emerged a division of labor and a flow of workforce between the two labs.⁴¹ It should be noted, however, that no sample of human embryonic stem cells or other research materials had

35. Eul Soon Park received her master’s degree at Seoul National University in 2003, working on the effects of apoptosis inhibitors in a somatic cell nuclear transfer program, under Jeong Mook Lim, but she became a key member within Hwang’s lab.

36. Quoted in Regalado, “With Public Wary” (note 28).

37. Calvin Simerly et al., “Embryogenesis and Blastocyst Development after Somatic Cell Nuclear Transfer in Nonhuman Primates: Overcoming Defects Caused by Mitotic Spindle Extraction,” *Developmental Biology* 276 (2004): 237–52. In an interview with *Nature*, Rudolf Jaenisch, a developmental biologist at the Whitehead Institute for Biomedical Research, raised questions concerning whether the work had been done entirely in the United States or in part in South Korea and what role Hwang had played in the paper, given that he was listed as a co-author. Schatten did not offer any explanation. Erika Check, “Schatten in the Spotlight,” January 11, 2006, <www.nature.com/news/2006/060109/full/060109-7.html> (January 28, 2019).

38. UP report, p.6 (note 11).

39. Jong Hyuk Park and Sung Jong Kim were researchers from MizMedi Hospital, where stem-cell culturing and photographing took place. They came to Pittsburgh after receiving doctoral degrees from Hanyang University, respectively in 2004 and in 2005.

40. Hwang et al., “Patient-specific Embryonic Stem Cells” (note 7).

41. Schatten’s lab emerged as a preferred place to go for doctoral training or postdoctoral research among Hwang’s researchers. See Prosecutors’ report.

yet to be sent to Pittsburgh, as the main research focus of Schatten's lab remained nonhuman primate cloning. Schatten was about to change his focus.

The pinnacle of their collaboration was the opening of the World Stem Cell Hub in October 2005 with the support of 50 million dollars from the Korean government. The Hub was aimed to serve as the human embryonic stem cell bank, building the global network for exchanging materials (stem cell lines), cloning technology (somatic cell nuclear transfer technology), and stem cell researchers (those trained in Hwang's lab). The Hub would be headed by Hwang, and its international board of directors chaired by Schatten. The Hub's headquarter was to be located at Seoul National University Hospital, with its first regional branches set to open soon in the United Kingdom and the United States. More branches were expected to appear in Spain, Sweden, and France. Each branch would have to secure its own funding, but the Korean government already laid out a plan to establish a non-profit foundation to support the regional branches and the spread of Korean technicians to foreign sites.⁴² The Hub was undoubtedly the product of Korean initiatives. In a practical sense, however, it was Schatten, not Hwang, who would preside over the global network.⁴³ This was the way they envisioned the Hub as the *de facto* center of therapeutic cloning. "I'm pleased that the Koreans have been as willing as they have to share their technology," said Arnold Kriegstein, director of the Institute for Stem Cell and Tissue Biology in San Francisco, whom Schatten would certainly work with through the Hub.⁴⁴ Schatten was also able to reinforce his position as a leading stem cell researcher in the United States with another five-year NIH grant worth 16.1 million dollars, the result undoubtedly helped by his collaboration with Korean researchers.⁴⁵

Whistleblowing: Turning the sociomaterial technology inside out

But there came no Pasteurian moment for Hwang and Schatten – no chance for a public demonstration like the Pouilly-le-Fort field trial of an anthrax vaccine for sheep or a clinical trial on Joseph Meister for rabies. The World Stem Cell Hub faltered upon its founding because the integrity of their research came under intense public scrutiny. Why did the question of fraud surface at that particular juncture? It is one thing to attribute the decisive turn of events to the heroic act of a whistleblower, but it is quite another to understand the circumstances that made the former collaborator speak publicly despite

42. Carina Dennis, "Korea Launches Network to Share Cloning Information," *Nature* 437 (2005): 1077. See also Herold, *Stem Cell Wars* (note 19).

43. According to Curie Ahn, one of the co-authors in both the 2004 *Science* paper and the 2005 *Science* paper, Schatten desired to practically run the Hub as its head, while Korean partners planned to ask him to take charge of the California regional center. She was doubtful of Schatten, because of information received from a friend in Oregon, and even advised Hwang to keep a distance from Schatten. See Kwang-jun Noh, "Curie Ahn's Testimony: Schatten Is No Trustful Person," *Plus Korea Times*, <<http://m.pluskorea.net/10046>> (February 6, 2019).

44. The quote is from Dennis, "Korea Launches Network" (note 42).

45. This became a big issue when the university investigations turned up fraudulent activities. Jennifer Bails, "Schatten grant data still unclear," *Pittsburgh Tribune-Review*, March 8, 2006, <<https://archive.triblive.com/news/schatten-grant-data-still-unclear/>> (January 15, 2020).

potential backlash. There was no assurance the whistleblower would prevail, and no guarantee he or she would be in control of all the contentious facts. Whistleblowing is a risky process of making inside-out and outside-in at the same time.

The initial sign of trouble emerged before the whistleblowing. It came first in the form of an allegation about *physical linkage* between human eggs and lab workers, that is, the ethical concern that female researchers' eggs might have been used for cloning experiments. Ironically, it was the distinctive power of Hwang's *sociomaterial technology* – which consumed a huge amount of human eggs and demanded personal sacrifices of lab workers – that made some people suspicious when Hwang's first *Science* paper was published online in February 2004. Womenlink, a nongovernmental organization (NGO) in Korea for women's health and rights, immediately raised questions about how such a large number of human eggs (a total of 242 eggs from sixteen volunteers as reported in the paper) could be obtained and whether the research team had followed ethical guidelines in recruiting volunteers.⁴⁶ They were concerned because extracting superovulated eggs from women could be a painful and potentially harmful procedure. The Center for Democracy in Science and Technology, another NGO, also warned that this kind of research could speed up the commodification of human eggs, making women "egg factories."⁴⁷

The civic groups' demand for transparency on egg donation, however, largely fell on deaf ears in the atmosphere of celebrating Hwang's achievement, until *Nature* published a one-page article in May, titled "Korea's Stem-cell Stars Dogged by Suspicion of Ethical Breach."⁴⁸ While covering the issues of egg procurement, the reporter revealed a new finding that two of the sixteen egg donors might be from Hwang's lab, based on an interview with one of them. If it was true that junior members of the lab had been 'coerced' to 'volunteer' in donating their eggs, this could be seen as clear evidence of an ethical violation – a violation of the Declaration of Helsinki on the ethical principles of medical research involving human subjects. As expected, Hwang denied all the charges.⁴⁹ He also had to deal with the long-standing question of whether or not his research on therapeutic cloning had been permissible in the first place. In an open letter sent to *Science* in August, the President of the Korean Bioethics Association condemned Hwang's research team for not waiting until a social consensus about cloning was achieved, especially as the Bioethics and Safety Act, passed in December 2003, was set to take effect in early 2005.⁵⁰

46. Eun Kyung Choi and Ock-Joo Kim, "A Shift of Ethical Debates by Hwang's Scandal: From Embryo Ethics toward Egg Ethics," *Journal of Korean Bioethics Association* 7 (2006): 81–97, 88.

47. Center for Democracy in Science and Technology, "The Case that Exposes Irresponsibility of the Ministry of Science and Technology and Researchers," February 12, 2004, <www.peoplepower21.org/Solidarity/736110> (January 21, 2019). For the activities of the civic groups as a source of alternative sociotechnical imaginaries of biotechnology in Korea, see Kim, "The Politics of Human Embryonic Stem Cell Research" (note 9).

48. David Cyranoski, "Korea's Stem-cell Stars Dogged by Suspicion of Ethical Breach," *Nature* 429 (2004): 3.

49. Dennis Normile, "South Korean Cloning Team Denies Improprieties," *Science* 304 (2004): 945.

50. Sang-Yong Song, "Stem Cell Research in Korea," *Science* 305 (2004): 944–5. *Science* also published Hwang's rebuttal after Song's letter.

This was the critical moment for stem cell researchers, as the ethics of egg extraction came to intersect with the ethics of embryo manipulation. They were related, but not the same. The former was concerned with the potential exploitation of women's bodies for biomedical research, whereas the latter was centered on the issue of reproductive and therapeutic cloning, which veered into the philosophical, religious, and scientific debates on how "human being" should be defined. The ethics of egg extraction was practiced as part and parcel of the professional code of conduct in medicine, generally in tune with international guidelines, but the ethics of embryo manipulation was used to lay out principles of bioethics law at the national level.⁵¹ It is noticeable that, unlike *Nature*, which foregrounded the ethical problem of egg donations, *Science* was keen on turning attention back to the cloning issue. This was not unrelated to *Science*'s interest in changing public opinion about stem cell research in the United States with the groundbreaking work done in Korea. "The Korean experiment illustrates some important international differences with respect to the legal status of this kind of research," wrote Donald Kennedy, editor-in-chief of *Science*.⁵² He noted that it could have been performed in Israel, Sweden, or the United Kingdom, but not in Germany or in the United States using federal funds. "The Korean success reminds us," he contended, "that stem cell research, along with its therapeutic promise, is under way in countries with various cultural and religious traditions. Our domestic moral terrain is not readily exportable: U.S. politicians can't make the rules for everyone, and they don't have a special claim to the ethical high ground." He regarded politically motivated decisions in the United States as "real penalties for its own scientific enterprise." *Science* published Hwang's paper and used his work to alarm domestic politicians, while setting aside the ethical issue of egg donation.⁵³

In the fall of 2004, the voices of ethical concern were seemingly kept under control amidst the joint efforts to make Hwang a national hero and to showcase Korea's support as an international exemplar of rational science policy. Yet they were not totally silenced. There were still lingering debates on voluntariness of donation, validity of informed consent, and the truthfulness of information on eggs used. Then came a whistleblower, Young June Ryu, who contacted the Center for Democracy in Science and Technology. Ryu was the second author of the 2004 *Science* paper.⁵⁴

The first and the only medical doctor working in Hwang's lab, Ryu led the stem cell research team while pursuing his master's degree. There were other cloning teams in the lab for different animals, such as tiger, pig, cow, and dog. Each team worked more or less independently. Ryu's diligence and drive were so much like Hwang's that he was

51. Eun Kyung Choi and Ock-Joo Kim argue that, in retrospect, Hwang's scandal led to a shift of debates from embryo ethics to egg ethics. See Choi and Kim, "Shift of Ethical Debates" (note 46).

52. Donald Kennedy, "Stem Cells, Redux," *Science* 303 (2004): 1581. This editorial was written for the issue (on March 12, 2004) that included Hwang's paper, reflecting on all the attention given to this paper after its online appearance three weeks earlier.

53. See also a news article published in *Science* in October 2004. Constance Holden, "Stem Cell Researchers Mull Ideas for Self-Regulation," *Science* 306: 586.

54. For their specific assignments, see SNU report, p.27, and Prosecutors' report.

nicknamed “Little Hwang.” He had a variety of responsibilities in the lab: for example, recording the delivery of human eggs from MizMedi and other infertility clinics; keeping track of their use in nuclear transfer experiments; preserving stem cells in a freezer and overseeing their distribution and maintenance; collecting and interpreting the relevant experimental data; and drafting the paper. In short, he was in control of information about how many eggs were consumed, where they came from, who used them, how much money was spent, and what data were produced. From this standpoint, Ryu could see a distinctive culture in Hwang’s lab – the love–hate relationship between Hwang and his students that was analogous to the relationship between parents and children – which, he thought, was based on more emotional behavior than rational thinking.⁵⁵ It was in this intimate relationship, he found, that female members of the lab were subtly encouraged to ‘volunteer’ egg donations. In fact, Eul Soon Park revealed to him her agony and regret after the donation: “At first, it was I who started it, but I am fearful. General anesthesia. Self-cloning. This shouldn’t happen – how can I clone with my own egg. I am so cruel.”⁵⁶

Under these circumstances, Ryu pursued an independent line of research for his thesis, in parallel with research for the *Science* paper, exploring the option to use immature eggs from ovaries excised surgically for therapeutic purposes. He sought to overcome the “greatest obstacle” for therapeutic cloning research, that is, the availability of human eggs, by demonstrating that high quality eggs could be “ethically” obtained from discarded ovaries, rather than from stimulated ovaries of volunteers.⁵⁷ Disenchanted with Hwang’s lack of scientific rigor as well as research ethics, Ryu found no reason to stay in the lab after defending his thesis and seeing the paper accepted in December 2003. He decided to return to the medical profession, searching for a position of residency training in a hospital.

Considering the magnitude of the impacts that Ryu’s whistleblowing might provoke, the Center for Democracy in Science and Technology was extremely cautious about publicizing it. Their top priority was to protect Ryu from all but certain attacks by the Hwang supporters everywhere in society – politicians, government officials, journalists, scientists, and citizens – as the power of Hwang’s coalition had grown by leaps and bounds despite ethical questions. While the Center waited for the opportune time to take action, in spring 2005, Ryu learned that *Science* would publish another paper by Hwang’s research team, which claimed the creation of eleven patient-specific embryonic stem cell lines using less than two hundred eggs. Ryu could not believe it for good reason. To his

55. For Ryu’s observation of Hwang’s lab, see Gottweis and Kim, “Explaining Hwang-gate,” pp.515–16 (note 9).

56. National Bioethics Committee, “Interim Report on Professor Woo Suk Hwang’s Research Ethics,” February 2, 2006, p.34. See also MBC News Desk, December 31, 2005, <<https://vimeo.com/224640524>> (January 24, 2019); Ryu’s interview, “I Wished I Could Save a Ten-Year-Old Boy’s Life,” March 5, 2014 <<http://na-dle.hani.co.kr/arti/issue/650.html>> (April 1, 2018).

57. Young June Ryu, *Use of In Vitro Matured Human Oocytes from Ovaries Excised Surgically as an Alternative Source for In Vitro Fertilization and Somatic Cell Nuclear Transfer* (Master’s Thesis, Seoul National University, 2004). Quotes are from its abstract. This thesis was submitted in November 2003, while the manuscript for *Science* was still under review.

understanding, there were very few experienced researchers available for therapeutic cloning in the lab: after Ryu and his wife Eu Gene Lee's departure, Jong Hyuk Park and Eul Soon Park left for Pittsburg, and Ja Min Koo was hired as a faculty member at Gacheon Medical School. Sun Jong Kim, a relatively inexperienced junior member from MizMedi Hospital, was the only holdover from the team led by Ryu. He also knew how much time and effort it would take to create a single stem cell line. On top of these technical difficulties, he was well aware of Hwang's penchant to exaggerate experimental results, sidestep rigorous testing, and jump to conclusions. What worried him most was the announcement that Hwang would conduct clinical trials of cloned stem cells on patients, including a ten-year-old boy whose somatic cell Ryu had taken out before, with little knowledge about the procedure's safety. Shocked and furious, Ryu contacted a producer of the investigative journalism program at MBC, one of the major broadcasting corporations in Korea, on June 1. This time, his whistleblowing was directed at scientific fraud, but he had no evidence yet.⁵⁸

The MBC team's six-month investigation had its own element of drama, enough to make a blockbuster movie later.⁵⁹ Like the secret informant "Deep Throat" during Watergate, Ryu assisted the team by giving tips and directions for investigation from behind the public scene, his identity and whereabouts being protected as much as possible by the Center for Democracy in Science and Technology. As the pressure of investigation intensified, and pieces of evidence suggesting scientific fraud were released, a loud revolt rose from within Hwang's research network. On November 12, 2005, Gerald Schatten surprised the world by announcing his intention to end the high-profile collaboration with Hwang, meaning that he would disengage himself from the World Stem Cell Hub. He said to the *Washington Post*: "I now have information that leads me to believe [Hwang] had misled me [about egg donation] . . . My trust has been shaken. I am sick at heart."⁶⁰ From whom did Schatten get that crucial information? He never divulged the identity of his informant, but it was not too difficult to surmise it would be Eul Soon Park, an egg donor herself. Since Schatten's severance announcement, Park had dropped out of sight for months, even cutting contacts with Hwang's group, until she had to show up for testimony in the Seoul Prosecutors' Office in early 2006. It was evident that she sought to stay in the United States as she applied for permanent residency, with the University of Pittsburgh's support.⁶¹

The impact of Schatten's decision was immediate and far-reaching. Many stem cell scientists around the world, who had expressed their interest in working with the Hub,

58. Ryu's interview, "Ten-Year-Old Boy's Life" (note 56).

59. *The Whistleblower*, the 2014 film based on this case, sold more than a million tickets in box offices in only eight days.

60. Rick Weiss, "U.S. Scientist Leaves Joint Stem Cell Project," *Washington Post*, November 12, 2005. See also David Cyranoski and Erika Check, "Stem-cell Brothers Divide," *Nature* 238 (2005): 262–3; Gretchen Vogel, "Collaborators Split Over Ethics Allegations," *Science* 310 (2005): 1100.

61. "Key Stem Cell Researcher Vanishes," *Chosunilbo*, December 1, 2005, <english.chosun.com/site/data/html_dir/2005/12/01/2005120161015.html> (January 14, 2020). "Hwang Team Members Seek Urgent U.S. Residence," *Chosunilbo*, December 7, 2005, <english.chosun.com/site/data/html_dir/2005/12/07/2005120761014.html> (January 14, 2020).

began to reconsider their position. Hwang's domestic network was also shaken. Sung Il Roh, a fertility expert at MizMedi Hospital and co-author on the 2005 *Science* paper, admitted the illegal payment for human eggs, which subsequently forced Hwang to make a formal apology and announce his resignation from official positions on November 24.⁶² The MBC investigation team continued to press Hwang with a demand for public testing of whether or not the DNA of cloned stem cells would match with that of patients.⁶³ While their attempt to broaden the issue from ethical violations to scientific fraud met with serious resistance from other media and opinionmakers, unexpected assistance came from the online community of young biomedical researchers in Korea, who anonymously jumped into the 'play' of finding out and reporting manipulated images and data in Hwang's papers.⁶⁴ On December 12, Schatten dropped another bombshell by requesting *Science* to retract his co-authorship on the paper and urged other co-authors to do the same. "My careful re-evaluation of published figures and tables, along with new problematic information, now casts substantial doubts about the paper's accuracy," wrote Schatten.⁶⁵ A few days later, Roh divulged that nine out of eleven patient-specific stem cell lines reported in the *Science* paper were fabricated, with the identity of the rest also questionable. Hwang then admitted that there were "mistakes made, human errors, in taking photographs and in the preservation of the stem cells," promising to investigate how such mistakes were made.⁶⁶

Hwang never cast doubt on the existence of "our original core technology" for cloning stem cells – a shining product of his *sociomaterial technology* – although further investigation by Seoul National University concluded that even those two stem cells were not clones but drawn from embryos produced by in vitro fertilization. The investigation also discredited the 2004 *Science* paper that the first embryonic stem cell was made with the somatic nuclear transfer technology. Once close collaborators, Roh and Hwang got into a vociferous quarrel of blaming and denial, in which Sun Jong Kim, a MizMedi researcher who had worked in Hwang's lab, emerged as the key person. He confessed his wrongdoings – the production of multiple images out of two stem cell lines

62. See David Cyranoski, "Korean Stem-cell Crisis Deepens," *Nature* 438 (2005): 405; David Cyranoski, "Stem-cell Pioneer Resigns," *Nature*, November 24, 2005 (published online), <www.nature.com/news/2005/051121/full/051121-12.html> (January 29, 2019); Anthony Faiola and Joohee Cho, "S. Korean Stem Cell Expert Apologizes for Ethical Breach," *Washington Post*, November 25, 2005. See also "Timeline of a Controversy: Chronology of Woo Suk Hwang's Stem-cell Research," *Nature*, December 19, 2005, <www.nature.com/news/2005/051219/full/news051219-3.html> (April 7, 2018).

63. David Cyranoski, "TV Tests Call into Question Cloner's Stem-Cell Success," *Nature* 438 (2005): 718.

64. Quoted in Sei Chong and Dennis Normile, "How Young Korean Researchers Helped Unearth a Scandal," *Science* 311 (2006): 22–5.

65. Quoted in Erika Check, "Stem-Cell Scientist Asks for Retraction," *Nature*, December 14, 2005 (published online), <www.nature.com/news/2005/051214/full/news051212-5.html> (January 31, 2019).

66. David Cyranoski, "Stem-Cell Pioneer Accused of Faking Data," *Nature*, December 16, 2005 (published online, corrected), <www.nature.com/news/2005/051215/full/news051212-14.html> (January 31, 2019).

to look as if eleven lines were established (under explicit direction by Hwang), and the mixing of cloned stem cells from Hwang's lab with fertilized ones from MizMedi to make it appear that viable cloned stem cell lines were created (under the pressure of making it up in the lab, albeit not specifically directed by Hwang).⁶⁷ Missing in their dog-fighting of whodunit was Schatten. Like the German meaning of his name, he remained in the "shadow."

Unhinged in Pittsburgh: The linkage between materials and words

The situation in Pittsburgh was different. On December 6, 2005, amidst the claims of fraud spreading through Korean news media and internet, and with Hwang formally acknowledging unintentional technical errors, the University of Pittsburgh's Office of Research Integrity received a letter from "a member of the University community" regarding the allegations.⁶⁸ This could have been sent by Schatten himself, or his colleague in the lab, or someone in the stem cell field, as it included specific points of disputes. In accordance with the university's Research Integrity Policy, Arthur S. Levine, Dean of the School of Medicine and Senior Vice Chancellor for the Health Sciences, formed an Inquiry Panel with "six senior investigators" to conduct a preliminary study and determine whether the allegations would merit a formal investigation. Schatten "joined in the call for an inquiry."⁶⁹ At this stage, however, it appeared unclear how they approached Schatten, who could be a target of investigation as well as an inside informer. For this reason, it is difficult to understand why the Panel's first meeting was held on December 14, two days after Schatten asked to retract his authorship from *Science*. The Panel "quickly" decided to open a formal investigation, redefining itself as an "Investigative Board" following the university's mandate.

The University of Pittsburgh's Investigative Board set out the scope of their investigation by raising the university's definition of "research misconduct" – which includes fabrication, falsification, and plagiarism but does not include "honest error or differences of opinion" – and by listing three publications to scrutinize: the 2004 *Science* paper, the 2005 *Science* paper, and the 2005 *Nature* paper, where the cloning of a dog was reported.⁷⁰ To be sure, the board conceived the task as a very focused, narrowly defined one on research misconduct, rather than a comprehensive investigation on a range of wrongdoings including ethical violations and funds management. Moreover, their chief goal was

67. Nicholas Wade, "Korean Scientist Said to Admit Fabrication in a Cloning Study," *New York Times*, December 16, 2005; Nichola Jones and David Cyranoski, "Investigation Says Hwang Lied," *Nature*, December 23, 2005 (published online), <www.nature.com/news/2005/051219/full/news051219-17.html> (January 31, 2019); Gina Kolata, "Amid Confusion, Journal Retracts Korean's Stem Cell Paper," *New York Times*, December 31, 2005; David Cyranoski, "Blow Follows Blow for Stem-Cell Work," *Nature* 439 (2006): 8. For Sun Jong Kim's role, see Prosecutors' report.

68. UP report, p.1 (note 11).

69. The six members of the Panel (later the Board) have remained unidentified. *Ibid.*, pp.2–3.

70. Byeong Chun Lee et al., "Dogs Cloned from Adult Somatic Cells," *Nature* 436 (2005): 641.

not simply to determine whether any misconducts had occurred and whether they were results of honest mistakes or intentional deception, but to verify whether Schatten played any role in the falsification and fabrication processes and what overall role he assumed in this collaborative project with Korean partners. In short, the University of Pittsburgh's investigation was about Schatten, and possibly for him.

By the time the board transferred their report to the university on February 8, 2006, many details of research misconduct had been uncovered in Seoul National University's final report, submitted about a month earlier.⁷¹ Although the board had done their part in collecting valuable testimonies about data manipulation, mostly from former members of Hwang's group and now in Schatten's lab, the scope of their study on the experimental side could not go beyond what was already known. However, the board was in a unique position to interrogate Schatten and double-check his account with known facts. What "role" did Schatten play in the course of the research? What "oversight" did he give to ascertain the "integrity of the data"? When did he learn of the charge of fraud? These were the questions that the board put forward to him.⁷² Interestingly, the board interpreted that these questions would boil down to the issue of authorship, that is, the meaning of *writing* in the collaborative project.⁷³

To Hwang, authorship meant more than a recognition of one's contribution to the paper: it was an instrument of network-building. This was well exemplified in the 2004 *Science* paper, where Shin Yong Moon, professor of medicine at Seoul National University and director of government-funded Cell Application Project, was listed last as senior author. Hwang's decision was a strategic move to gain legitimacy and visibility in the stem cell field within Korea.⁷⁴ Similarly, Hwang offered Schatten co-authorship for the 2004 *Science* paper after Schatten's brief yet crucial involvement in its publication. It is rather surprising that Schatten not only declined this offer but requested to be not mentioned even in the acknowledgment.⁷⁵ Why was he so careful about accepting authorship at that time?

The board looked more closely into the case of the 2005 *Science* paper from an authorship angle. Based on the interviews with Schatten and the analysis of his emails before the paper's online publication in May 2005, they could establish the following facts: it was in November 2004 when Hwang and Schatten began to talk about preparing an article for *Science* about patient-tailored embryonic stem cell lines. On January 1, 2005, Schatten sent Hwang an email with "a detailed list of what should go into the figures."

71. SNU report (note 11). Its English translation, provided by Seoul National University, was also widely distributed. See "Text of the Report on Dr. Hwang Woo Suk," *New York Times*, January 9, 2006, <www.nytimes.com/2006/01/09/science/text-clonereport.html> (January 3, 2019).

72. UP report, p.5 (note 11).

73. Michael Barany discusses the question of what constitutes an author in his contribution to this special issue. See his "Impersonation and Personification in Mid-Twentieth Century Mathematics," *History of Science* 58 (2020): 417–36.

74. SNU report (note 11); Prosecutors' report. It turned out that Moon's contribution to the paper was limited only to technical assistance and editorial help. For Hwang's marginal position within Korea's stem-research community, see Kim, "Your Problem Is" (note 19).

75. UP report, p.8 (note 11).

Two weeks later, they drafted the first version of the paper, while in India for a conference. It was on this occasion that Hwang offered senior authorship to Schatten, who deferred his response. In late January, Hwang began sending experimental data and continued that into March, while many versions of the manuscript were exchanged between them by email. The board found that “Schatten reviewed the figures and tables and, in one instance, insisted on receiving the claimed teratoma plates.” In short, Schatten was the *head* of the project, composing “the first and each subsequent draft of the text,” whereas his Korean collaborators played the role of the *hands*, generating the data or the figures and tables for the text.⁷⁶

In his first interview with the board on December 15, Schatten talked about his initial reluctance to accept senior authorship, because of the restrictions he should declare about his contributions as follows:

All experiments, and all results were obtained in Korea by Korean scientists, and all results were obtained in Korea, using Korean equipment and Korean sponsorship. G.S. (Schatten) and J.-H.P. (Jong Hyuk Park) are grateful for *the private philanthropy of the Magee-Womens Foundation*, which supported their advisory roles in the analysis and for the interpretation and preparation for publication of these results obtained in Korea. *No U.S. federal or Commonwealth of Pennsylvania funds* were used in any aspect of this report.⁷⁷

He confided that he had consulted with *Science* editors, his dean, his project officers at NIH, and university legal counsel before agreeing to take up the senior author position. The board was then puzzled to find a major inconsistency in Schatten’s response to the questions from Seoul National University’s investigating committee, three weeks later, where he asserted that “he did not write the paper.” In the second interview with Schatten, then, the board saw him maintaining this changed account: “he denied that he was senior author, saying that his specially designated role as a co-author was as one of the two co-corresponding authors.” “This second version,” the board found, “does not correspond with the fact, for example, that he is the one who responded to reviewers’ comments.” He was the “sole signer of the cover letter.”⁷⁸

This finding clearly illustrates that Schatten attempted to evade potential charges of fraud by maintaining that he did not produce the data. The board judged Schatten to be “disingenuous” in “harping on strict definitions of ‘writing’ and ‘senior author’.”⁷⁹ Regardless of his effort at hairsplitting, the board discovered, there were many areas he should have or could have exercised better oversight and critical judgment. For example, he did not demand an explanation of why some data were reported differently in two successive versions of the same table. In another example, after being told about a contamination accident in mid-January 2005, which killed several stem cell lines, he did not suspect that there might not have been enough time to grow and analyze new cell lines

76. Ibid., p.6. The expressions of *head* and *hands* are mine.

77. Hwang et al., “Patient-specific Embryonic Stem Cells,” footnote 32 (note 7). Emphasis is mine. UP report also used this quote.

78. UP report, pp.7–8.

79. Ibid.

by March 15, the date he set for manuscript submission. He appeared too naïve in trusting Hwang's assurance, or too ambitious in ignoring details. Furthermore, the board pointed out that Schatten benefited from being senior author or simply being listed as the last author in numerous ways, including "enhancement of his scientific reputation, improved opportunities for additional research funding, enhanced positioning for pending patent applications, and considerable personal financial benefit."⁸⁰ These benefits, the board maintained, should be accompanied by "responsibilities for the manuscript as a whole, approval of the manuscript by all co-authors, and the veracity of the data reported" – the responsibilities Schatten "shirked." This was a "serious failure that facilitated the publication of falsified experiment in *Science* magazine."⁸¹

Despite all these important findings, the board could not convict him of scientific misconduct within the narrowly prescribed university policy. As all the experimental work was done in Seoul, and the relevant data produced there, it was almost impossible to contend that Schatten fabricated or falsified experimental data in Pittsburgh. Nor could the board prove that he intentionally overlooked doubtful or undesired data. Hence the final conclusion: "While this failure would not strictly constitute *research misconduct* as narrowly defined by University of Pittsburgh policies, it would be an example of *research misbehavior*" (emphasis is mine).⁸² This verdict, however, served only as moral chastisement, lacking the legal, punitive results within the technical definition of fraud. The board failed to recognize the linkage between *writing* and *experimenting*, *texts* and *data*, *words* and *materials*.

The "Schatten affair" and the ethical dimension of fraud

Yet, one may wonder why the Investigative Board created a new category of "research misbehavior" with no attempt to give its practical definition.⁸³ Why did the board treat "shirking one's responsibilities" as if it were a behavioral problem, a personal trait, or an honest mistake? It is critically important, at this point, to consider the fundamental constraints of the board's work, which might be more *structural* than *functional*. Operating under the Office of Research Integrity's guidelines, the board was ill-equipped to deal with a case where matters of fraud were deeply intertwined with other matters of ethics (especially about human protection). The board's investigators in Pittsburgh were compelled to see only one side, matters of fraud, whereas their counterparts in Seoul, which had no university-level office to deal with research misconduct, went after any wrongdoing. Seoul National University's report included a section that examined the total number of human eggs used in Hwang's lab, the ethical violations of egg donation from a junior member of

80. Ibid., p.9.

81. Ibid.

82. The University of Pittsburgh's final verdict was not without critics. See Nicholas Wade, "University Panel Faults Cloning Co-author," *The New York Times*, February 11, 2006; Steve McIntyre, "What Happened to Gerald Schatten," May 31, 2011, <<https://climateaudit.org/2011/05/31/what-happened-to-gerald-schatten/>> (April 1, 2018).

83. On the problem of using "research misbehavior" with no definition, see Jennifer Bails, "Pitt Says Scientist Shirked Duty," *Pittsburgh Tribune-Review*, February 11, 2006, <<https://archive.triblive.com/news/pitt-says-scientist-shirked-duty/>> (January 10, 2020).

the lab, and the procedural problems of the Institutional Review Board (IRB) conducted in hospitals and universities.⁸⁴ This is well contrasted with the way the board reported about egg donation: “We received direct testimony from a former staff member in Dr. Hwang’s lab that one staff member had voluntarily donated oocytes for the 2004 paper. In fact, Dr. Hwang was aware of this since he drove the donor to the hospital on one occasion for the donation procedure. It was the report about this same donor that prompted Dr. Schatten to sever his collaboration with Dr. Woo Suk Hwang.”⁸⁵ There was no further elaboration. To them, this was a matter to be handled by another office in charge of IRB processes.

The *Pittsburgh Tribune-Review*, a local newspaper that closely followed what it called the “Schatten affair,” found that the University of Pittsburgh’s “lax policies and disregard for federal guidelines” allowed Schatten to be part of “one of the biggest scientific frauds in history.”⁸⁶ Based on a month-long review of university and federal records and dozens of interviews with medical researchers and bioethicists, the newspaper reporters detailed the procedural problems in the university oversight. First, Schatten initially contacted the University’s IRB to get approval for his collaboration with Hwang’s group in February 2005, more than a month *after* the project had begun. He should have sought formal written clearance from the IRB *before* beginning their research. Second, Schatten informed the IRB that the project involved *no identifiable human subjects*, the declaration that prompted the IRB to determine that it had no jurisdiction over the work. This was simply untrue: not only was Hwang aware of egg donation by his female researcher, but, under Korean law, at least one of the researchers should be able to trace back the identities of the donors from records in order to allow the families of the donors to receive priority for any future treatments.⁸⁷ In the United States, research involving unidentifiable people could be considered *not* to be human-subject research, but nonetheless, the newspaper found, some ethicists contended that the university should have conducted a full review of Schatten’s participation in human embryonic stem cell research, at least because it was a high-impact project consuming a number of human eggs. In essence, the university allowed its scientists to determine if their work would constitute human-subject research, a policy that disregarded federal recommendations. Third, the IRB sent Schatten a formal letter on March 16 that it would not further review his work because of no involvement of human subjects, à la given information, *one day after* Schatten and Hwang submitted the paper to *Science*. This procedural violation in itself was clear evidence that

84. SNU report, pp.29–35 (note 11).

85. UP report, p.4 (note 11).

86. See Jennifer Bails, “Pitt Limiting Schatten Probe,” *Pittsburgh Tribune-Review*, January 12, 2006 <<https://archive.triblive.com/news/pitt-limiting-schatten-probe/>> (January 10, 2020); Luis Fábregas, “Lax Oversight by Pitt Enabled Schatten Fiasco,” *Pittsburgh Tribune-Review*, April 23, 2006, <<https://archive.triblive.com/news/lax-oversight-by-pitt-enabled-schatten-fiasco/>> (January 15, 2020); “The Schatten Affair: Explanation and Oversight,” *Pittsburgh Tribune-Review*, February 26, 2006, <<https://archive.triblive.com/news/the-schatten-affair-explanation-oversight/>> (January 15, 2020).

87. This stipulation is clearly mentioned in “supporting online material” of the 2005 *Science* paper. On the failure of Schatten and the University of Pittsburgh’s IRB to recognize the difference between the Korean law and the U.S. law, see Saunders and Savulescu, “Research Ethics and Lessons from Hwanggate,” p.219 (note 10).

the IRB was cooperating with Schatten for the speedy publication of the paper. Furthermore, the newspaper reporters found that the university adopted a policy of not applying federal rules for the protection of human subjects to privately funded research. The *Pittsburgh Tribune-Review's* exposé could not make a dent in the final verdict on Schatten but clearly illustrated the ethical dimension of this fraud case.

Conclusion

During the nearly two-year collaboration with Schatten, Hwang's public image was strikingly consistent: a national "hero," risen and fallen. No one was more influential in Hwang's rise and fall than Schatten, who developed multiple self-images as the saga went on: an unselfish "helper" for getting the 2004 paper accepted by *Science*; a generous "advisor" for spearheading the writing process for the 2005 *Science* paper; a well-networked "ambassador" of Hwang to the stem cell research community in the West; a global "leader" perching high at the World Stem Cell Hub; a resolute "whistleblower" after reaffirming Hwang's ethical violation in egg procurement; a deliberate "investigator" for reexamining data and figures; and an innocent "victim" of scientific fraud. Combining all these images, Schatten might be likened to Icarus's father Daedalus in Greek mythology, who made human flying possible. But falling was Icarus's fault.

This portrait of Schatten as a guiltless collaborator has been embedded in the standard narrative of the "Hwang case." It was partly an outcome of Schatten's decisive action to cast off the alliance at the critical moment of November 2005, but it was also partly due to the limited scope of any investigation of him in Korea and in Pittsburgh. Seoul National University's Investigation Committee focused on Hwang, not Schatten, from the beginning; the Prosecutors' Office in Seoul was not interested in indicting Schatten, a U.S. citizen; and the University of Pittsburgh's Investigative Board could not convict him of research misconduct, as it worked within the purview set by the Office of Research Integrity. With no official authority, by contrast, reporters for the *Pittsburgh Tribune-Review* could uncover only some aspects of the "Schatten case."

By recasting the whole event as the "case of Hwang *and* Schatten," we can see more clearly why materiality mattered in fraud-making and fraud-judgment. The Hwang-Schatten case not only illustrates the sociotechnical construction of fraud, in which the normative imperative to enforce procedural rigor becomes subservient to the competitive imperative to claim an indisputable breakthrough before anyone else. It also reveals the sociotechnical judgment of fraud, which often overlooks power relations within the hierarchical ambience of the lab *and* the informal division of labor in the global network. Fraud leaves its mark on materials, but material evidence alone never tells the whole story and instead can be used to limit the range of responsibility. Hwang's trial started in 2006 and went all the way up to the Supreme Court, which sentenced a probated one-and-a-half-year prison term for embezzlement and ethical violations in 2014. Hwang was *never* indicted for fraud in the law court, though he was fired by the university for that reason.⁸⁸

88. David Cyranoski and Soo Bin Park, "News Blog: South Korean Supreme Court Confirms Hwang's Sentence," *Nature*, February 28, 2014 (published online), <<http://blogs.nature.com.ezp-prod1.hul.harvard.edu/news/2014/02/south-korean-supreme-court-confirms-hwangs-sentence.html>> (February 3, 2018).

It was Sun Jong Kim, and he alone, who was found guilty of fraud. This judicial decision must have disappointed the whistleblower Young June Ryu, who considered Hwang and his lack of proper oversight the source of problems in the lab.⁸⁹ In a similar vein, Schatten was *never* publically punished, despite his failure to oversee the veracity of data and to follow the proper procedure for IRB clearance.

Fraud and ethics were intricately intertwined in the Hwang–Schatten case. The fraud might not have been revealed, and the alliance between the two scientists would not have been broken up, if it had not been for ethical concerns about the protection of human subjects. The Hwang–Schatten case took place at a critical juncture when Korea rushed to legislate and implement bioethics laws in order to promote itself into a leading position in the emerging field of bioindustry, and when it scrambled to learn and apply categories of scientific misconduct while conducting investigations. In the United States, by contrast, this case took place at a time when stem cell research became a political hot potato, and when guidelines for research integrity were up and running, well codified after going through the tumultuous decades of high-profile fraud reports.⁹⁰ The case of Hwang *and* Schatten sheds light on the combined manifestation of ethical concerns and material manipulations, centered around their once-acclaimed sociomaterial technology, in two different contexts and with two different outcomes.

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89. In fact, Hwang has reemerged in media as the head of an increasingly visible animal-cloning institute in Seoul: David Cyranoski, “Cloning Comeback,” *Nature* 505 (2014): 468–71; Sang-Hun Choe, “Korean Scientist’s New Project: Rebuild After Cloning Disgrace,” *New York Times*, February 28, 2014.

90. See Hurlbut, *Eperiments in Democracy* (note 27); Horace Freeland Judson, *The Great Betrayal: Fraud in Science* (Orlando: Harcourt, Inc., 2004).

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