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Recovering and Learning from Scientific Misconduct in Networks of Knowledge Production

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Abstract:

Between 1998 and 2002, a young physicist quickly rose to fame. News of his breakthrough and near magical abilities spread like wildfire and promised nothing less than a revolution in computers and technology. Mere months later, an investigation concluded that many of the papers contained falsified or completely fabricated data. Investigating this case from the rise to fall of Jan Hendrik Schön to the reactions of the scientific community tells a tale of networks of knowledge production in the early 21st century, their problems and repair mechanisms. Starting with the dangers of breakthrough narratives and public imaginations of the scientific community following up with issues of peer review, charisma, and co-authorship, this thesis investigates the gaps within the system that allowed this to happen. In repairing the damage caused by scientific misconduct, networks of knowledge production discussed imaginations of science and ethics to improve the production of certifiable knowledge.

Contents

Introduction

> "It's hard to find a silver lining in the cloud cast by the Schön affair, but it would be good if it were to trigger a thoughtful examination of the issue."[1]
>
> - Donald Kennedy, Editor-in-Chief of Science Magazine 2002.

Donald Kennedy, then Editor-in-Chief of 'Science' magazine, just as many of his peers within the scientific community had been through a lot at the point of stating his disappointment. A young physicist by the name of Jan Hendrik Schön had promised breakthrough upon breakthrough, one more revolutionary than the other. Nearly four years of progress, publications, and promises to the network of knowledge production commonly referred to as science, but also to the public, had come crashing down a month before. An internal investigation of 25 papers had revealed that 16 were based upon duplicated or outright falsified data.[2] The following shakedown of the library of Schön's entire work revealed many more. 'Science' and the other magazines in which he had published his papers came under scrutiny for having been blinded by his popularity and overly flashy promises.[3]

Thoughtful examination of the matter of scientific fraud was triggered, just as Kennedy had hoped, but it revealed an ugly side to conceptions of science and deep cracks between what science was perceived to be and the harsh reality. Examining Schön's rise and fall meant grieving the promises he was supposed to deliver on, dealing with broken trust, and accepting that the glorified imagination of science and impeccable and heroic scientists did not hold up to scrutiny. The silver lining brought about new perceptions of responsibility and new approaches to teaching ethics.

Schön, by breaking the trust and crashing from a high pedestal, had revealed the dangers of excited narratives of breakthroughs and building such pedestals in the first place. Scientifically relevant progress, especially in developing technology, rarely happens in land-slide events on an individual scale, but in small, procedural steps building upon each other. In most cases vast networks of laboratories, helpers, researchers and co-authors chip away at larger problems one small step at a time. Every now and again new discoveries quickly and fundamentally change the current understanding of our world, be that new source material for historians, new species for biologists or new observations in a laboratory for chemists and physicists, usually with massive implications for the understanding of the past and providing a new stepping stone

[1] Kennedy, Next Steps in the Schön affair, p. 495.
[2] Beasley et al., Report, p. 14.
(as to not inflate the footnotes, the short form of this citation has been chosen rather than the full "Report of the Investigation Committee on the Possibility of Scientific Misconduct in the Work of Hendrik Schön and Coauthors).
[3] Kennedy, Next Steps in the Schön affair, p. 495.

towards a hopefully better future. Such reveals of scientific progress are often referred to as breakthroughs by the authors, as well as the public sphere. The time frame referred to as breakthrough can vary a lot, but is oftentimes a rather short period of significant progress and accelerated communication activity with fringed edges as smaller observations and numerous steps of preparation precede big scientific discoveries.

Breakthroughs are the part of science that extends beyond the laboratory door, beyond the office, and beyond the papers aimed at a few highly specialised experts. They are what gets turned into movies, reach the heated discussions at a bar table on the weekend nights, and promise a place not only in the fourth-year science books but also potentially history books. Their rarity and inherent hope for improvement are what makes tales of breakthroughs intoxicating and ever so often, dangerous. Their reach also allows historically inclined onlookers to trace them throughout the immediate network of their production and beyond, far into the public sphere of perception. Schön's bright flash of a career cast deep shadows historians can trace to paint a picture of the scientific community of the early 2000s and its reaction to a massive case of scientific misconduct. This picture reveals how science was seen at the time by the public eye, but also by the scientists themselves and how they tried to fix it along with repairing the record of scientific truth.

Schön was in the middle of a near perfect storm heading for a field of science that was, at the time, deemed unlikely to fall for scientific misconduct as it was thought of as based upon proof and math.[4] To the public what science could achieve had become part of their everyday experience, living through a new age of science consumption in the ever-evolving technological progress in the home. What science should achieve was framed by new tales of scientific greatness centred around heroic scientists, which had a profound impact upon the public imagination of what it meant to do science.[5] Examining the heroic tale of Schön and how it was built, lays the foundation of this examination of the interaction of scientists, their networks, and the public.

It was the tale of a German physicist discovering new materials, new methods and technologies in a laboratory in America, that quickly caught the world's attention in the early 2000s. 'Science' magazine named his papers on organic transistors as part of their "Breakthrough of 2001".[6] The buzz grew quickly using words like "ultrafast, ultrasmall computers" and promises of new laser

[4] Broad, Betrayers of Truth, p. 20.
[5] Kohlenberger, The New Formula for Cool, p. 43.
[6] Service, Breakthrough of 2001, 20. Dec. 2001.

and computer technology.[7] Approval for the young super star was strong. Having won the highly coveted "Otto-Klung-Weberbank-Preis" for physics by the FU-Berlin and the presumption that he was well headed for the Nobel prize thanks to his 'sensational' discoveries.[8] At age 31 by June 2002 Jan Hendrik Schön was the superstar of technology and science. The MIT Technology Review ended their brief biography of him with hopes for the entire field stating "[…]it won't be a surprise if Schön helps transform microelectronics"[9]. Unbeknownst to the editors at the MIT the high pedestal they had put him on had already started to crumble mere days before the article was published.[10]

The shocking revelation, however, still had to wait until the report in the works would go public in September 2002. Although not the first, and by far not the last case of scientific misconduct, the investigation into Jan Hendrik Schön would reveal deep cracks in the networks of knowledge production and shake the foundations of trust built by institutions, publishers and the public. The question quickly arose: "How could Jan Hendrik Schön have come so far?"

In answering the question, the scientific community revealed a lot of its inner structures to be full of cracks and biases, which had allowed the rise of such a star figure. Breakthrough narratives had driven up hopes, blinding peer-review processes and maybe even himself, responsibilities miscommunicated and abandoned in the face of sheer charismatic influence and lies. All contributing to a star growing too quickly, ready for a disruptive supernova. As it was a massive case with many connections, the answers were plenty. The "Schön affair", as Kennedy called it sparked a massive outrage.[11] The plenitude of papers, the perception of physics being more or less exempt from scientific misconduct, heroic imaginations of scientists, new codification of scientific misconduct, the prominence of publishers in question, large networks of co-authors, the fame of bell laboratories, as well as the strong promises broken all came together in a massive discourse initiated by the Schön affair.

This thesis is aimed at examining the fallout, the repair works and the recovery of the scientific community, but also its build up to the point where such a star figure could come far enough to be as disruptive as Schön had been. Its main questions are thus stated as:

> "How did imaginations of science in the early 2000s enable such a scandal to form, how did networks of knowledge production work to repair damages caused by scientific misconduct and what traces did the Schön affair leave in its wake?"

[7] MIT, Technology Review, p. 87.
[8] Seer, Nobelpreisverdächtig, p. 13.
[9] MIT, Technology Review, p. 87.
[10] Beasley et al., Report, p. 2.
[11] Kennedy, Next Steps in the Schön affair, p. 495.

The process of finding answers to this question will lead through several important structures of the scientific community and, at times, beyond. From the ideas of what science could and should do, charismatic perceptions of Schön and his work place, publication structures, blinding tales of greatness, to official approval of his abilities through titles and prizes. Each of them had a strong influence on the reactions to the scandalous misconduct. Having been essential to his rise, the tale of the breakthrough strongly informed the investigation thereafter, and found itself often repeated only to be disproven by the following reaction. As such, media reporting on the Schön scandal was forced to reflect upon the way they had told the story.

How Schön was investigated by the first report was itself informed by new ideas of investigating misconduct. Just as the news of his case broke, a major change within the field of misconduct investigations had been codified. Whereas previous cases were mostly blamed on personal shortcomings, his case was systematically investigated. This, at the time new, systematic approach, forced the institutions to position themselves and investigate their role in producing certifiable knowledge. Rather than blaming his misconduct on personal shortcomings or even deviance[12], this thesis will look at the cracks in the system formed by the pressure of public hopes and expectations, to review processes rushed, from praise given too early and public ideas of science, names tainted by the crisis to the silver lining Kennedy had hoped for as new codes of science ethics emerged with Schön in mind.

The thesis progresses through four main chapter chapters, tracing the story of Jan Hendrik Schön from the first, hopeful promises of greatness, through an ever-increasing network of trust and lies, over to the fall and reaction by the scientific community moving on from the shock to new ways of teaching science ethics.

As this thesis would not be possible without a greater debate about the network commonly referred to as science, its self-perception, its ideals, its external idealisation, and concepts of responsibility and proper conduct, previous research is honoured in the following chapter.

In the second main chapter, which is split into four sub-chapters, methodological questions are discussed. The first relates to issues of the source material, as availability of such is for one heavily biased by the outcome of the affair, and for the other influenced by greater trends in the history of the early 2000s. The second is directed at the question of what science means as a term and how it constitutes a network of individuals subscribing to determined imaginations of idealised scientific conduct. In contrast, the third sub-chapter discusses the rather impactful definitions of fraud and misconduct, as both of which and many more terms have been widely

[12] Ben-Yehuda, Deviance in Science, p. 1.

used to describe the work of Jan Hendrik Schön and its shortcomings in conforming to the scientific standard. The fourth applies this to the investigation of the Schön scandal and the reception thereof.

The second main chapter 'Charismatic Cooperation' is dedicated to the networks of charismatic trust within the scientific community, split into individual charisma, institutional charisma and the third chapter 'Blinding Approval', considering public approval and the role of prizes in networks of knowledge production.

'Treacherous Tales', the third main chapter, will review the dangers posed by the publicised anticipation of Schön's breakthroughs. 'Poisonous Promises' scrutinises tales of anticipated technological revolutions based upon his research, whereas the second chapter 'Magic Hands and Funky Machines' delves deeper into the attempts of legitimising Schön's research beyond the immediate data and research he has produced, whenever doubt crept in.

In the fourth chapter 'Reactions and Repairs' the different repair mechanisms are presented, for they too reflect ideas of what scientists think science should be, and how it can be repaired. 'Reversing the Spell' tackles the difficulties of undoing the near superhuman tales of Schön. Structured along the reactions of the networks of knowledge production to the misconduct, 'Re-check' describes the first attempts of checking the claims of misconduct against Schön. 'Report' goes into the details of the preliminary report by Beasley et al. as well as how the story of the emerging news was first disseminated. 'Remove' presents three instances of formally removing Jan Hendrik Schön from the scientific community. The first of which was his firing from the position at Bell laboratories, the second his removal from the "Deutsche Forschungsgemeinschaft" (DFG), and the third the legal action against Schön in revoking his doctor title. 'Repair' considers the different mechanisms of repairing the chain of scientific integrity through errata, retractions and an overall awareness of data integrity related to projects involving Jan Hendrik Schön. 'Remember' shows the longer lasting legacy of Schön, where a shift in the discourse is noticeable as his name slowly became synonymous with scientific misconduct. The second to last sub-chapter 'reflect' opens up the discussion of instances where the case of Jan Hendrik Schön is used as a teaching method for scientists, concluding the arch formed by the rising star falling back down to the education of entry level scientists. The last of the sub-chapters is dedicated to one of the more picturesque sources produced by the Schön-affair in which his misconduct is presented as potentially having saved humanity from a dystopian future in a science-fiction environment. Although definitely outlying from the other source material, it too shows how public perceptions of science developed at the time and how those perceptions might have been influenced by the Schön affair, while allowing rare glimpses

into the inner most circle of his network and how they perceived him as the undoubtable future of technology.

The final chapter will present conclusions drawn in the writing of an answer to the question posed above and what they might reveal about the networks of knowledge production commonly referred to as science.

Previous Research

Perceptions of science, both of its participants and its consumers, have rapidly evolved in the second half of the 20th century and the early 2000s. This time frame can be considered the "Age of Science", as Gerard Piel argues in his 2001 monograph of the same title. From his own experience, accessible publication of science was, at least in 1938, a rather difficult endeavour, as scientists were wary of their research being presented in an overheated and improbable manner.[13] The attitude towards communicating science drastically changed in the second half of the 20th century, with one example evolving around Piel himself. As the magazine "Scientific American" had fallen into decline it had to be relaunched by Piel and his colleagues, which they did by May 1948.[14] In itself a success story of scientific communication the 'Scientific American' had reached a regular readership of 1 million in its English version by 1986 with translations into 9 other languages being added over time.[15] For him the term science is an evolving self-descriptor as "Science Is What Scientists Do", which puts scientists at a conflict with authority, as "a scientist can recognise no authority, but his or her own judgment, and must, at all times, hold that authority in suspicion"[16]. However, this paradigm slowly shifted into "the recognition, that science is the work of fallible human beings".[17]

By the early 2000s, the popular perception of 'what scientists do' had undergone significant changes compared to 1938. The epitome of heroic scientists in popular media materialised in a franchise of crime series based upon the exaggerated abilities of forensic scientists. This cultural phenomenon had become strong enough to influence the very idea of science.[18] In "The CSI Effect: Television, Crime, and Governance", editors Michele Byers and Val Marie Johnson, as well as their co-authors, investigated the portrayal of science-based investigation and delivered a cultural analysis of its potential implications. Although the ever feared "CSI-

[13] Piel, The Age of Science, p. XIV.
[14] Piel, The Age of Science, p. XIX.
[15] Piel, The Age of Science, p. XX.
[16] Piel, The Age of Science, p. 1.
[17] Piel, The Age of Science, p. 11.
[18] Byers, CSI-Effect, p. XXI.

Effect", probably had very little influence on court jurors and the criminal justice system[19], it and the fear thereof are representative of how scientists, and thus science as a network of capabilities had been portrayed as infallible and impeccable in the early 2000s.[20] Elizabeth Harvey and Linda Derksen conclude that this depiction of science probably precedes the series in saying, that it is unlikely, that CSI spawned anything new, but that artistic depictions of realism may have morphed to equate with reality in the minds of some viewers.[21]

The Schön affair and other cases of scientific misconduct have left a large library of discussions on the cause and consequences of scientific misconduct, the previous research thus offers a wide range of literature essential to the understanding of how networks of knowledge productions perceived themselves and came to define correct and incorrect scientific conduct.

The history of networks of knowledge production, such as what is now referred to as the scientific community is closely linked to the history of its surrounding society. Large historical events, which restructured great parts of the world also had their effect on the networks of science. The Second World War, with its tendency to mobilise and create large networks of production, changed the way science was funded and restructured towards "Big Science", which brought it closer to the state, changing what it meant to be a scientist from a "calling" (Berufung) to a job (Beruf).[22] Economic developments throughout the 20th and early 21st century further shaped this network. Financial adversity and a progressively competitive structure had over time increased the pressure for results, which made fraud more viable.[23] The situation reached a boiling point, where, in the interest of upholding the public trust within scientists and their institutions, the state had to step in. [24] First steps of the U.S. government into investigating scientific misconduct started in 1981 when, especially the field of biomedicine, but also the structures of science as a community came under heavy scrutiny.[25]

How scientific misconduct was thought about during the 1980s is best represented by articles such as "Deviance in Science" by Nachman Ben-Yehuda, who wrote his systematic study of deviant behaviour for the British journal of Criminology in 1986. He argues for a more structural approach in investigating the phenomenon of 'deviant scientists'.[26] Further he urges that "it is time for a 'criminology of science' to be developed.[27] Deviance, in theories of social

[19] Byers, CSI-Effect, p. 19.
[20] Byers, CSI-Effect, p. 20.
[21] Byers, CSI-Effect, p. 21.
[22] Di Trocchio, Der große Schwindel, p. 10.
[23] Di Trocchio, Der große Schwindel, p. 10.
[24] Broad, Betrayers of Truth, p. 12-13.
[25] Di Trocchio, Der große Schwindel p. 13.
[26] Ben-Yehuda, Deviance in Science, p. 1.
[27] Ben-Yehuda, Deviance in Science, p. 22.

control is not caused, but made and controlled through external norms, such as "communality", "organised scepticism", and an overall high degree of trust, thus social control mechanisms in science are much weaker, leaving structural and personal incentives to commit deviance.[28] Norms, such as 'organised scepticism', appear vulnerable to other social orders, such as seniority, aggression, reluctance to openly confront each other, and own biases of the scientific branch.[29] Ben-Yehuda reacts to a previous crisis rooted in the changing landscape of science. The 1960s and 1970s featured great expansions of scientific institutions, but also a crisis of opportunities in the late 1970s leading to the prominence of the "publish or perish" attitude.[30] This led to the aforementioned crisis in the scientific network, which completely escalated when Darsee was caught faking data for his experiments.[31] Breakthrough-research, as it is more contested or "hot" as Ben-Yehuda puts it, is more likely to reveal deviance, whereas the majority of scientific work is "non-breakthrough research", making it much less likely to detect issues within.[32]

In 2007 the former vice provost, and thus main spokesperson in cases of scientific misconduct at Caltech, David Goodstein summarised nearly two decades of his experience in codifying and administrating science and ethics.[33] Extensively discussing the primary ethics concerns and ever critical of overly simplified principles Goodstein then developed the thought processes that led from informally idealised scientific conduct to its codification.[34] Chapter four "Codifying Misconduct: Evolving Approaches in the 1990s" details how the scientific community and legislation came to the first binding codification of scientific misconduct.[35] The sixth chapter is dedicated to fraud in physics and discusses the cases of Jan Hendrik Schön and Victor Ninov, who although less prominent, had claimed nothing less than having expanded the periodic table.[36] The Schön case, through its size and prominence, made it adamantly clear, that a clear policy for scientific fraud, although previously absent from Bell Labs, was needed and raised new questions in responsibilities and issues within the greater scientific community.[37] Goodstein recognised three principles which appear to be present in almost all cases of scientific fraud consisting of scientists under (perceived) career pressure,

[28] Ben-Yehuda, Deviance in Science, p. 1-2.
[29] Ben-Yehuda, Deviance in Science, p. 4.
[30] Ben-Yehuda, Deviance in Science, p. 9.
[31] Ben-Yehuda, Deviance in Science, p. 10.
[32] Ben-Yehuda, Deviance in Science, p. 18.
[33] Goodstein, On Fact and Fraud, p. xi.
[34] Goodstein, On Fact and Fraud, p. 6-10.
[35] Goodstein, On Fact and Fraud, p. 59-68.
[36] Goodstein, On Fact and Fraud, p. 97.
[37] Goodstein, On Fact and Fraud, p. 100.

the assumption of knowing the end-result before the measurement and work in a field where precise reproducibility is not expected.[38] Especially the second is clearly present in some of the few direct statements by Jan Hendrik Schön.[39]

In «Der grosse Schwindel: Betrug und Fälschung in der Wissenschaft», the 1994 German translation of the 1993 Italian original «Le bugie della scienza. Perché e come gli scienziati imbrogliano» the idea of a specific science to counter scientific fraud emerges. "Defraudistik", a science of fraudsters needed to combine bureaucratic knowledge about the network of funding with technical knowledge.[40] Schön had delivered the perfect sample for the scientific community to conduct a field study in "Defraudistik".

Although Diederik Alexander Stapel, who has 58[41] retractions to his name only came to light much later than Jan Hendrik Schön, many of the issues align. In response, the Team of Wolfgang Stroebe, Tom Postmes and Russel Spears wrote an assessment of the situation including damages to the network and how he could have gotten away for so long.[42] Their ideas of damages were the implication for careers of people associated with fraudulent authors, suffering patients in the case of clinical studies, the delay of scientific progress and waste of resources as well as the damages to the image of the field in which fraud was committed and reduced trust in science in general.[43] Schön's work obviously did not affect patients, but the remaining damages remain true for this case.

The two largest works on Jan Hendrik Schön were the report of the management of Bell Labs and Eugenie Reich's "Plastic Fantastic", published in 2009. The former was the first summary of cases in which scientific fraud was suspected and later proven, in an attempt to find a structural issue within the scientific community. The latter was a social investigation into just how something like this could even happen and how Schön got so far in the first place. Eugenie Reich conducted 125[44] interviews with people who interacted with Schön, greatly expanding the base upon which this case can be investigated in regards to his network.

[38] Goodstein, On Fact and Fraud, p. 129.
[39] Beasley et al., Report, p. H-1.
[40] Di Trocchio, Der große Schwindel p. 7-8.
[41] https://retractionwatch.com/the-retraction-watch-leaderboard/
[42] Postmes et al. Scientific Misconduct, p. 671-672.
[43] Postmes et al. Scientific Misconduct, p. 670-671.
[44] Reich, Plastic Fantastic, p. 8.

Methods

To the historical eye the Schön affair is an interesting case because of the massive reaction it evoked. Although others had faked data before, the reaction to Schön's misconduct produced a surprisingly strong echo. Several factors played into this, which can be grouped into nine primary motives why the affair was discussed so prominently.

1) The sheer productiveness of Schön: having published a paper every eight days during his most productive phase between 1998 and summer 2001[45], of which many were later revoked, left an already large corpus to react to and discuss about. Thus, the size of the scandal partially explains the size of the reaction. 45 papers were either retracted, corrected or noted as untrustworthy by the co-authors.[46]
2) Perceptions of the specific field: Physics had been thought of as an unlikely field for scientific misconduct as its math-based logical structure was thought to preclude falsification.[47] Yet within months Victor Ninov and Jan Hendrik Schön had proven this to be a wrong assumption of epic proportions. Whereas Ninov presented a much smaller case that is much less discussed, his misconduct at Berkeley combined with the much larger portfolio of Schön led to new guidance and training in ethics within the American Physical Society, which represented the nation's 40'000 physicists at the time.[48] Together, Ninov and Schön had brought about a "very strange year" for the physics community.[49]
3) Popular perception of science at the time: Kohlenberger described the issue:

> "I argue, that the new coolness of technoscience has noticeable effects on the status of scientific knowledge and practice, and might in fact have to be understood as responding to, complementing, or even indeed substituting former sources of scientific legitimation as incubated in popular cultural texts."[50]

Popular imagination of science, scientists and their abilities and responsibilities had undergone drastic changes. These popular imaginations had been played with in reporting Schön's success story. 'coolness' as produced by the breakthrough narrative could in some cases substitute former sources of scientific legitimation. In turn, ideas of decreasing public trust in science through misconduct were also used to explain measures against him.[51]

[45] Beasley et al., Report, p. 8.
[46] A compiled overview over Schön's impressive library of 45 retracted or critical papers can be found in the appendix of this thesis. It is to note that other sources have left out contested papers, or did not count all of them.
[47] Broad, Betrayers of Truth, p. 20.
[48] Overbye, After Two Scandals, p. 2.
[49] Rodgers, A very strange year, physics world, 01.Dec. 2002.
[50] Kohlenberger, The New Formula for Cool, p. 44.
[51] Deutscher Bundestag, Drucksache 17/5758, p. 2.

4) New codification in a legal sense informed the reaction to Schön's misconduct: New policies had only been written down in December 2000.[52] Lucent Technologies did not have a formal policy in place at the time Schön's misconduct was investigated, but the committee decided to apply the new federal regulation, even if the research had not been federally funded to appeal to the consensus of the American scientific community.[53] Discussing Schön, thus also meant positioning oneself within the discourse of federal legislation and institutional responsibility, even if it technically did not apply to private research institutions.
5) Responsibility was also discussed in regards to those who had made his claims popular: All publishers involved had each let several papers slip through their review processes, hinting at a systematic issue within each of them. The magazines 'Science', 'nature', 'Physical Review', 'Thin Solid Films (Elsevier)', 'Synthetic Metals (Elsevier)', 'Physical Status Solidi (Wiley)', 'Advanced Materials (Wiley)', and 'Applied Physics' had to position themselves in reaction to Schön, addressing questions of their own responsibility and ability to review scientific publication. Besides the publication of those papers, publishers who had reported about Schön within their news sections had to review how they handle news of scientific breakthrough.
6) Schön was the primary, and at times sole author in all of his 45 retracted or contested papers: He also had 27 co-authors, of which three – Christian Kloc (33 papers), Bertram Batlogg (28 papers), and Zhenan Bao (8 papers) – had significantly more co-publications than the others.[54] Their responsibility and the role of co-authors in general had to be discussed in the immediate report and in the following discussion of ethics within science.
7) What it meant to be a scientist at an institution such as Bell laboratories changed in the years prior to Schön's promises of breakthrough: The self-perception of being a birth-place of the transistor led to new tales of greatness being possible within Bell Labs.[55] The institution's culture nurtured a highly incentivised environment to produce such applicable and marketable greatness. Scientists were incentivised with bonuses of $1000 per patent application, leading to more than six applications per day by 1999.[56]

[52] Federal Register Vol. 65. No. 235, p. 76260.
[53] Beasley et al., Report, p.5.
[54] Full graphical overview of the network of co-authorship in the appendix of this thesis.
[55] MIT, Technology Review, p. 87.
[56] Reich, Plastic Fantastic, p. 81.

Lucent technologies thus had fostered a culture in which Schön could rise, which had to be reflected in the reaction to Schön.

8) The tales of greatness, breakthrough and applicability, as well as tales of approval through prizes had made Schön a prominent name to people who might not have been familiar with his papers, but who consumed media related to science: Dismantling those promises meant grieving technological developments that would never come, but also reflecting how scientific networks approve tales through functions of hope, trust and reliability.
9) The consequences Schön should face were widely discussed: For one, this meant repairing and correcting the record of scientific truth through retractions, notes and errata. For another, it necessitated removing Schön from the scientific community through firing him at Bell Laboratories, removing him from the Deutsche Forschungsgemeinschaft (DFG), and ultimately the legal discussion of revoking his degree. Especially the last point produced the legal documents, but also reactions to this process and further discussion of handling scientific misconduct years after the initial report.

Essential issues of the endeavour of writing a history about Schön within his networks are explained in this chapter. For one, as always, sources of controversy are written with certain ideas and intentions in mind. Some, such as the previously introduced Donald Kennedy might write with the intention of saving their reputation. Others, such as news articles might criticise in a harsher tone to appeal to their readers in an effort to bring them back as repeated customers. Their controversial nature also tends to threaten their persistence.

It is easy – probably too easy – to write a thesis within a scientific network of pre-established notions of what science is and not to question them. Science as a term has heavily evolved even in the past 3 decades, spanning the start of Schön's career to the writing of this thesis. As such, the nature of the scientific network and its evolution have to be discussed to accurately orient this analysis along conceptions of science in the early 2000s.

What happens when the ideas of accurate science are considered hurt, and how such deviation has been codified, is discussed in the chapter "Fraud or Misconduct?", as the distinction reveals more about the network in how it phrases misconduct, but also about its perceivers. As new legal codification was finalised mere months before the news of Schön broke, it has strongly informed the way his case was handled by the primary report by Beasley et al., but also the public discussion thereof.

As science is a network of pre-established trust in a mutual agreement on ideals in an effort to produce certifiable knowledge, the last sub-chapter examines which functions of charisma can overrule the self-checking structures of the network. This overruling was but one step of Schön's 'successful' scientific misconduct and was itself shaped by the structures of codified, and non-codified, trust within the scientific community.

Source Problematics

> "In the interest of openness and scientific integrity, Bell Labs would like to make the findings of the Investigation Committee as public as possible."[57] – Beasley et al. 2002

As the story of Jan Hendrik Schön played out in the early 2000s there are several period specific benefits and problems regarding source materials. Accessibility of relevant sources has been shaped by three major developments.

The first is the generally increased accessibility with a shift towards online publication. In the early 2000s, public media outlets switched to online publications, especially those with an interest of reaching an international audience and self-perception of being at the cutting edge of shifting means of publication. Thus, online publication had been reasonably normalised very early on for publishers close to the scientific network. The urgency emanating from the sheer size of Schön's misconduct and its importance for ongoing research also led to a mindset in which widespread accessibility was pushed. In the interest of repairing statements reaching a wide audience quickly, many of the important sources, such as the Beasley report are either accessible online by design, or have been written with simultaneous online and offline publication in mind, such as the commentary on the scandal on the websites of 'Science' and 'nature', as well as retractions were published with this sense of urgency in mind.[58]

The second development decreased the accessibility. The time frame of the unfolding scandal being primarily discussed on the internet also comes with a significant disadvantage regarding permanence. Many of the less privileged records, such as private blogs of co-workers and other publicly accessible statements, were lost in the aftermath of the bursting dot-com bubble, drastically reshaping the internet between 2000 and 2002, permanently destroying large parts of it. Ironically, this development appears to be not yet finalised or destructive enough, as the American Physical Society (APS) drastically restructured the accessibility of its archive in March 2024[59] towards a not yet finalised mess, only accessible through not established trade

[57] Beasley et al., Report, A-1.
[58] Service, More of Bell Labs Physicist's Papers Retracted, p. 31.
[59] Torres, Introducing the Physics Archive, March 12. 2024.

connections, thus rendering certain sources – even recent ones, such as Dan Garisto's article in August 2022 – inaccessible without additional means depending on luck with randomised scanners, such as the 'Internet Archive'.

The third prevented production of sources in the first place. Its scandalous nature hindered some from speaking publicly about the affair. Accessing a deeper, non-public layer of the scandal such as statements from co-authors or even Schön himself proved nearly impossible. In contacting Eugenie Samuel Reich for this thesis, it became clear, that non-public material regarding Jan Hendrik Schön greatly informed the discourse, but would remain inaccessible for the foreseeable future. Former co-workers had informed Reich of their impressions of Jan Hendrik Schön, but many of them wanted to stay off the record as to not be associated with him or out of fear for their own employment.[60] Prof. Dr. Holger Zuck, who had represented Schön in front of the German courts denied comments on the matter as he is bound to confidentiality by law.[61] An offer to initiate contact to Jan Hendrik Schön to comment on the matter has also been denied as Schön does not wish to be contacted.[62] This wish has been respected by the author of this paper, although his perspective on the matter would have greatly advanced the source material regarding Schön's self-perception as a scientist and how it evolved throughout his experience.

Even though a comment by Schön would have greatly improved the sources for this thesis, the reactions to the development of the case still offer a wide variety of sources which allow for a greater, although forever incomplete, picture of the networks of knowledge production.

Several of the primary sources used for this thesis come with their unique challenges. The main investigation and following "Report of the Investigation Committee on the Possibility of Scientific Misconduct in the Work of Hendrik Schön and Coauthors" of September 2002 brings about several problematic issues. For one, it is the first, and thus mostly incomplete rapport of the scandal investigating 25 allegations of which 24 were scrutinised.[63] Another issue with this source is, that Bell Labs did not have a formal policy in place for handling scientific misconduct.[64] This means that at the time of Schön's work in the laboratory, there was a significant gap between the internal communication of the Bell Labs network on what constitutes ideal scientific conduct and the way the misconduct was investigated. However, in

[60] E-mail correspondence with Eugenie Samuel Reich, 11.12.2023.
[61] E-mail correspondence with Prof. Dr. Holger Zuck, 21-22.03.2024.
[62] E-mail correspondence with Prof. Dr. Holger Zuck, 21-22.03.2024.
[63] Beasley et al., Report, p. 2.
[64] Goodstein, On Fact and Fraud, p. 100.

applying the U.S. Federal Policy on Research Misconduct, the committee hoped to represent a wider consensus of the U.S. scientific community on the issue of scientific misconduct.[65]

The motivation bias to report on Schön and his misconduct depended on numerous factors. People close to him, such as co-authors, had their livelihood to defend. The Beasley Report itself appears rather benevolent in regards to answering the question of responsibility for the co-authors, clearing all coauthors of any scientific misconduct.[66] Reports by publishers on the matter were motivated by restoring the scientific record of integrity with errata and retractions, but might appear biased in questions of peer-review processes failing in scientific papers. In the face of journalists' critique of being overeager to publish flashy papers Donald Kennedy, then Editor-in-Chief of 'Science', admitted, that the Schön affair raised doubts if the peer review process at 'Science' worked, but remained adamant, that "it is asking too much for peer review to expect it to immunise us against clever fraud" and that their faith in the process remains solid.[67]

The level of communication at which the Schön case was received varied greatly, and at times significantly added to the scandalous nature in which it was seen. Several of the reactions in newspapers, such as the Freiburger Nachrichten titling "Bschiss beim Physiker"[68] (Bschiss being the Swiss German word for fraud, betrayal or deception) reveal more about the emotional side of the discourse as topics such as betrayal of trust and fraud were publicly discussed. It is to note that the translation of the Swiss German term has led to an interesting discussion between the author and several people who were asked to translate the term. 'Bschiss' to non-native speakers of Swiss German has an infantilised bias, leading to a more emotionally charged reading of the headline by the 'Freiburger Nachrichten'. For Swiss German native speakers, 'Bschiss' is a word worthy of a grown-up vocabulary and constitutes a strong, at times criminal, offence and is, in this context, better translated as fraud or deception.

Even though the factual reporting can be considered correct in almost all newspapers, the choice of words and quality in which the case was reported has varied considerably. Such sources definitely have their place in the picture of the public discourse, but it is clear that on the scale between the in-group of scientists and public outrage for the attention of it they are on the far end of the latter. The choice of words in reporting on the Schön case matters to the public perception and will be discussed in the chapter 'Fraud or Misconduct?'

[65] Beasley et al., Report, p. 5.
[66] Beasley et al., Report, p. 16.
[67] Kennedy, Next Steps in the Schön affair, p. 495.
[68] Freiburger Nachrichten, Bschiss beim Physiker, p. 24.

Another issue regarding all sources regarding the nomination of Jan Hendrik Schön for the Nobel Prize is the confidentiality clause of the committee. Names of the nominees cannot be revealed until 50 years after their nomination according to the rules of the Nobel Prize.[69] As such, all sources mentioning Schön's potential nomination, or the overall perception that he was headed towards a Nobel Prize cannot be validated until at least 2051 or maybe even 2052 if he was nominated in the brief window between 1. September 2002 (The start of the nomination period) and 26. September 2002 when the Beasley Report was released.[70] The chapter 'Blinding Approval' is thus focussed on the perception of Jan Hendrik Schön as potential candidate and what such a perception might do to the surrounding networks, rather than validating or disproving such a claim.

What even is Science?

Science is a network, the perception of which has been primarily shaped by its success story, whereas admittance of its failures has been usually met with silence.[71] It is thus biased towards a narrative of progress. As many other idealistic networks, it upholds sanctified units. The smallest unit on which science works and the lowest step of the 'cognitive structure' of the network is the fact upon which hypotheses about its properties are formed.[72] It is this verifiability of the fact that upholds the entire network. No matter if social sciences or natural sciences, the goal of educative structures within the broader scientific community is to train future researchers own ability to recognise and interpret those facts. People who enter the scientific networks of knowledge production do so out of preconceived notions of what this network does and what they can achieve within. This perception is, as McIntyre put it in the introductory sentence of this paragraph, shaped by its success story. Failed experiments, hours upon hours of lab-work spent on training and marginally promising results and the sheer boredom of systematic research are not, or if at all, rarely part of the imagination of scientists and even rarer communicated to potential students before they attend their first lecture.[73] The contrast between glory and reality, can easily turn into cynicism and the contrast between the perception of community and the reality of it being a race proves a bitter fruit.[74]

[69] https://www.nobelprize.org/nomination/
[70] Garisto, Schön Scandal Report is Released, APS News Online.
[71] McIntyre, The Scientific Attitude, p. 5.
[72] Broad, Betrayers of Truth, p. 16.
[73] This one, dear reader, stems from my own, miserable experience of staying in the labs until late at night, trying to get a faulty pH-meter to work. There are many reasons why I write a thesis in history instead of chemistry, but that night most certainly was one of them.
[74] Broad, Betrayers of Truth, p. 214.

Defining what science actually is proves essential to the understanding of scientific misconduct. After all, scientific misconduct is the deviation from the prescribed ideal code of scientific conduct. Definitions of scientific misconduct are based upon the idealised state of scientific networks of knowledge production and the individuals within. What constitutes science also massively depends on the level at which it is perceived. As public understanding of the term "science" has been shaped by far more than just first-hand experience at a laboratory or regular exposure to scientific papers, the boundary lines of the term are blurry at best. However, one cannot discard the public perception of science, as it was this public sphere, that was at least partially addressed by promising news of breakthroughs and the following debate about science, misconduct and public trust.

Public, partially fictitious, perception of science had itself undergone significant change in the early 21st century as scientifically savvy characters such as Horatio Caine in CSI Miami and Jack Hall in the Day After Tomorrow had become highly popular, performing miraculous science and thus stepping out of the shadow that had been cast by scientists being primarily portrait as villains before.[75] Especially technoscience, such as forensics, climatologists or physicists were re-codified in the eyes of the public.[76] This also created expectations in the public eye for science and its achievements to increase exponentially.[77]

Even before the early 21st century fictitious perceptions of scientists' abilities became highly relevant for the perception of the network. For the avid reader of science fiction novels, science bears promise of future development, but also the threat of imminent dystopia. Concrete accuracy rarely matters in this more publicly available imagination of science, yet it still appears to be the acting force upon the very foundation of the network of trust between the public and scientific institutions. To the average reader, science is an arcane procedure, and even to trained scientists, specialised papers are very hard to reliably disprove without extensive knowledge of the field. Arthur C. Clarke's third law, "Any sufficiently advanced technology is indistinguishable from magic", first appeared in close relation to networks of scientific knowledge, when Clarke wrote a Letter to 'Science' in 1968, five years before taking the law into the 1973 reworked edition of 'Profiles of the Future', which made it famous to a wider audience.[78] As discussed later on, near magical abilities would feature in the discourse surrounding Schön in the chapter 'Magic Hands and Funky Machines'

[75] Kohlenberger, The New Formula for Cool, p. 43.
[76] Kohlenberger, The New Formula for Cool, p. 43.
[77] Kohlenberger, The New Formula for Cool, p. 46.
[78] Clarke, Clarke's Third Law on UFO's, Science, p. 255.

In between the hard application of science on the lab bench and the fringed perception of science in its fictionalised form exists a spectrum of perceptions of science: Intraspecialist (in this case Batlogg, Schön et.al), interspecialist (publishers and meetings), pedagogical (textbooks) and popular (documentaries, public outlets like 'American Scientist' and newspapers).[79] Schön's success had been discussed in all but pedagogical literature, although this was most likely due to the long production time compared to his short burst before being discovered. His misconduct on the other hand has been discussed on all four level. Public communication of science has long been scrutinised for its inaccuracies, but these do not matter in moments where public ideas of science influence behaviours such as grant funding, priorities within universities and even the individual scientists themselves as the interact with their surrounding society.[80]

When William Broad and Nicholas Wade wrote "Betrayers of Truth" in 1982 they too investigated what it meant to participate in science and how misconduct could reveal more about the behavioural patterns within. As they define it in "Betrayers of Truth": "Science is a community of scholars engaged in the production of certifiable knowledge."[81]

Science is a network of individuals, guided by ideas of certifiability, expansion of knowledge and reliability. Its statements of ideals make it highly susceptible to blind spots, as the idea of peer-review practically eliminates an argument of misconduct going unnoticed. The conventional ideology of science cannot explain the phenomenon of scientific misconduct except by denying it, but in doing so also hiding the realities of the scientific process.[82]

Science as an ideology is highly idealised and is rarely representative of the actual processes, which is why there is little to no room in the picture for scientific fraud.[83] For Broad and Wade the most significant blind spot are the scientists themselves:

> "Where the conventional ideology goes most seriously astray is in its focusing on the process of science instead of the motives and needs of scientists. Scientists are not different from other people. In donning the white coat at the laboratory door, they do not step aside from the passions, ambitions and failings that animate those in other walks of life. Modern science is a career. Its stepping stones are published articles in the scientific literature. To be successful, a researcher must get as many articles published as possible, secure government grants, build up a laboratory and the resources to hire graduate students, increase the production of published papers, strive to be awarded a tenured post at a university, write articles that may come to the notice of committees that award scientific prizes, gain election to the National Academy of Sciences and hope one day to win an invitation to Stockholm"[84]

[79] Bucchi, Science and the media, p. 9.
[80] Kohlenberger, The New Formula for Cool, p. 83.
[81] Broad, Betrayers of Truth, p. 18.
[82] Broad, Betrayers of Truth, p. 212.
[83] Broad, Betrayers of Truth, p. 19.
[84] Broad, Betrayers of Truth, p. 19.

Ultimately, it is a network of production that can be influenced by other ideas, such as economic developments, financial gain, or peer pressure. Science rarely writes about most of its scientist, unless that is in jubilation or in crisis. Both of which Jan Hendrik Schön had presented in the early 2000s. He was both famous enough to have been written about extensively as a respected scientist, as well as infamous enough to stay in the minds of writers until this very day.

A core value of science is conformity in the form of provability. The desire for conformity to the ideas of science was what might have driven Schön rather than the previously introduced idea of deviance. As he left very few statements about his own motivation, it is difficult to judge, but Eugenie Samuel Reich, who had become an expert on the case through writing 'Plastic Fantastic' paints Schön as a product of the ideal code of science and desire for conformity taken too far.[85] Rather than financial benefits or fame, his data was fabricated to fit into what he expected would be proven right later on, as his statement in the Beasley report, discussed later on in this thesis, would show.[86] Broad and Wade categorise this mechanism as "lying on the truth's behalf".[87] Thus his actions might have been shaped by an idea of where he had to take science, based upon general ideas where science was headed.

Further elaborations on the changing perception of science will be discussed in the chapter 'Treacherous tales'.

Fraud or Misconduct?

David Goodstein argues, that "That distinction [between fraud and research misconduct] is no longer considered important either at the institute or within the larger scientific community."[88] However, both are legal terms with their own implications and histories. Especially the history of codifying scientific misconduct became highly relevant to the case of Jan Hendrik Schön. The 1970s can be considered the first decade in which matters of scientific integrity were first discussed on a legal basis.[89] However, first hearings on the matter would have to wait until 1981 and the first actions until 1985 with the "Health Research Extension Act" and the creation of the Office of Scientific Integrity (ORI) in 1989.[90] Even though the matter was considered to

[85] Ross, An Interview with Eugenie Samuel Reich, AmSci online.
[86] Beasley et al., Report, p. H-1.
[87] Broad, Betrayers of Truth, p. 224.
[88] Goodstein, On Fact and Fraud, p. 57.
[89] Goodstein, On Fact and Fraud, p. 59.
[90] Goodstein, On Fact and Fraud, p. 59.

be important enough to be investigated in the early years of official investigations there has been a tendency to omit the word "fraud".[91]

The first solid stepping stones towards a more unified and ultimately codified understanding of scientific misconduct as it was understood by the time Jan Hendrik Schön was found guilty of it, were laid in the early 1980s, by developments closely resembling those to follow two decades later. At the time the common view within the scientific community had been that misconduct or even fraud had been rare and "anyone who tried to fake scientific data must have been crazy".[92]

In 1980 the Alsabti affair disrupted public trust in the publication and review process by the sheer volume of plagiarised papers in his bibliography.[93] He had published 60 papers in 1979, many of which were pirated, some based upon completely fictitious authors and yet informed enough to fly under the academic radar for quite some time.[94] In the congressional hearings between 31. March and 1. April 1981 led by Albert Gore Jr. scientists were asked to testify on the issue of scientific fraud.[95] Their common view was, that fraud was a minor or barely existing problem, and that self-correction and peer review would be sufficient, much to the disagreement of the congressional representatives.[96] They saw the danger of public trust in science being eroded, which denial and arrogance within the scientific community would not help with.[97]

Mere weeks after the hearings a new scandal at Harvard involving the young cardiologist John Roland Darsee who had made up data for several papers began to unravel.[98] Much of which reads very similar to Schön. Darsee had published groundbreaking research progress at an astounding pace of nearly one hundred papers and abstracts in two years.[99] He got caught red-handed by coworkers faking data in May 1981, which turned out to be far from a onetime deal as he adamantly promised and the work of several co-authors was contaminated, but ultimately other researchers were not informed of the flaws initially and he was even kept in the lab for another five months until October 1981.[100]

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[91] Goodstein, On Fact and Fraud, p. 60.
[92] Broad, Betrayers of Truth, p. 13.
[93] Broad, Betrayers of Truth, p. 54-55.
[94] Ben-Yehuda, Deviance in Science, p. 12.
[95] Broad, Betrayers of Truth, p. 11.
[96] Broad, Betrayers of Truth, p. 12.
[97] Broad, Betrayers of Truth, p. 12-13.
[98] Broad, Betrayers of Truth, p. 13-14.
[99] Broad, Betrayers of Truth, p. 13.
[100] Broad, Betrayers of Truth, p. 14-15.

In a public speech in October 1991 the OSI director Suzanne Hadley offered a short definition of scientific fraud to "out of bounds' research conduct" such as "data selection, failure to report discrepant data and overinterpretation of data".[101] The codification of scientific fraud and misconduct remained controversial throughout the 1990s, primarily because the federal definition did not work well with what the majority of scientists agreed to be unsuitable research conduct.[102]

After decades of work and discussion new legislation came into action on 6. December 2000 stating the need to uphold reliability of the research record in the interests of health, national security and public trust.[103] In the supplementary information for the legislation the public sphere and potential benefits were perceived to be considerable influences. The new legislation mirrored the core values of idealised science. Looking closer into the legislative sphere reveals two main points. For one, it obviously informed how scientific misconduct should be judged and investigated. For another, it also reveals what science was perceived to be in the early 2000s. It should be regulated, potentially beneficial and fair.[104] Given its federal nature it came with significant shortcomings. The institutions in which the law was immediately applied were limited by the reach of federal legislation:

> "This policy applies to federally funded research and proposals submitted to Federal agencies for research funding. It thus applies to research conducted by the Federal agencies, conducted or managed for the Federal government by contractors, or supported by the Federal government and performed at research institutions, including universities and industry."[105]

Science and science ethics were to be regulated. Legally speaking it could only reach so far.

In practice, even with an underlying understanding of ideal science and a legal codification of misconduct deciding which papers deserve to be retracted is a difficult task. The reasons can usually be grouped into a few main categories, such as error, duplication, misconduct or plagiarism. Estimates vary on how common each category is within the corpus of scientific literature. Ferric C. Fang reviewed 2047 cases of retractions between the 1970s and 2012, of which only 21.3% were attributed to error, 43.4% to misconduct including fraud and suspected fraud, 14.2% duplicated publication and 9.8% plagiarism.[106]

However, not every mistake is automatically worthy of being called scientific misconduct. The line of separation is blurry at best. James R. Wible separates "honest mistakes" and dishonest

[101] Goodstein, On Fact and Fraud, p. 60-61.
[102] Goodstein, On Fact and Fraud, p. 67.
[103] Federal Register Vol. 65. No. 235, p. 76260.
[104] Federal Register Vol. 65. No. 235, p. 76260.
[105] Federal Register Vol. 65. No. 235, p. 76260.
[106] Fang, Misconduct accounts for the majority of retracted scientific publications, p. 17028.

practices by their intent in "The Economics of Scientific Misconduct: Fraud Replication Failure and Research Ethics in Empirical Inquiry". Wible speaks of fraud where fraudulent and deceptive practices "are authored with rational forethought, purpose and intention".[107]

The idea, that such dishonest practices were based on mere deviance or crazy behaviour faded out of fashion and a more ordered approach towards finding out the systemic issue of reoccurring scientific misconduct was slowly introduced. 'Defraudistik', a science of fraud, as Di Trocchio had proposed in 1993 had to combine bureaucratical knowledge about the network of funding with technical knowledge to disprove the misconduct.[108]

What about Schön?

Schön himself was one of the "cool scientists", a term introduced by Kohlenberger. Lydia Sohn, one of the key people responsible for discovering his falsified data even referred to him as being like "Beckham in Football".[109]

His rise to fame has left many traces in the immediately close networks, but also extending far into the public sphere, with reports of his doing and undoing in newspapers, magazines, articles on websites of leading institutions in the scientific community and beyond. Once the true nature of his work had been revealed, the work on repairing this damage was just as extensive, leaving various sources from reports, to public statements, to legal and ethical decisions and discussions.

When Lucent Technologies published the "Report of the Investigation Committee on the Possibility of Scientific Misconduct in the Work of Hendrik Schön and Coauthors" in September 2002 24[110] allegations were examined. Of those 24 allegations 16 were conclusively ruled as scientific misconduct, 6 were considered "troubling", and 2 were ruled to have no clear relationship to publications.[111] Although the main section – consisting of summary, background, allegations, procedures, findings, conclusions and acknowledgements – is only 19 pages long, the overall document with different appendices is over 120 pages in total. Many of which tell as much about the case of Jan Hendrik Schön, as they reveal about the scientific community and the reaction to the disruption.

[107] Wible, The Economics of Scientific Misconduct, p. 3.
[108] Di Trocchio, Der große Schwindel, p. 7-8.
[109] Horizon, (Documentary title The Dark Secret of Hendrik Schön, shortened to “Horizon” in future references), Time: 04:35-04:40.
[110] Beasley et al., Report, p. 2.
[111] Beasley et al., Report, p. 3-4.

Only Jan Hendrik Schön knows his true intentions, which to this day he clearly wishes not to communicate.[112] In the report he clearly explains his lapses in data management as "mistakes":

> "Although I disagree with several of the findings and conclusions in the report of the investigation committee [...], I have to admit that I made various mistakes in my scientific work, which I deeply regret. Some of these mistakes might have been related to difficult circumstances and others I did not realize in time. Nevertheless, it was my responsibility and there are no excuses for these mistakes and would like to apologize honestly for these mistakes to the coauthors and the scientific community. [...] Although I have made mistakes, I never wanted to mislead anybody or to misuse anybody's trust. I realize that there is a lack of credibility in light of these mistakes, nevertheless, I truly believe that the reported scientific effects are real, exciting, and worth working for"[113]

The quantity in which he used the word "mistakes" in a statement that totals only 265 words in its original extent is quite considerable. Whether this is an indication of him actually thinking of his data substitution as mistakes or whether he worked with it as a signal word in an awareness that it might grant him favour or absolution, as within the wording of the federal register, 'honest error' was to be excluded from investigations of misconduct,[114] remains unclear. He remained adamant, that his misconduct was rooted in mistakes, rather than deception and still upheld the belief of being proven right eventually. He also avoided the use of the word data or facts, rather he wrote of effects, which are far above in the structure of scientific thought.

The Beasley report judged the matter in an overall benevolent, but varied approach:

> "The evidence that manipulation and misrepresentation of data occurred is compelling. In its mildest form, whole data sets were substituted to represent different materials or devices. Hendrik Schön acknowledges that the data are incorrect in many of these instances. He states that these substitutions could have occurred by honest mistake. The recurrent nature of such mistakes suggests a deeper problem. At a minimum, Hendrik Schön showed reckless disregard for the sanctity of data in the value system of science. His failure to retain primary data files compounds the problem. More troublesome are the substitutions of single curves or even parts of single curves, in multiple figures representing different materials or devices, and the use of mathematical functions to represent real data. Hendrik Schön acknowledges these practices in many instances, but states that they were done to achieve a more convincing representation of behavior that was nonetheless observed. Such practices are completely unacceptable and represent scientific misconduct."[115]

It was clear, that the size of the discovered misconduct, even though it only constituted roughly half the overall findings could not be denied. Even if singular substitutions were to be made by mistake, the frequency and gravity had pointed at a deeper and systematic issue. Substituting data with other data was but one charge. Actively faking data by generating it with mathematical functions showed intent and were judged as misconduct. Mentioning his disregard for "sanctity of data in the value system of science" also appears to reflect on the

[112] E-mail correspondence with Prof. Dr. Holger Zuck, 21-22.03.2024.
[113] Beasley et al., Report, H-1.
[114] Federal Register Vol. 65. No. 235, p. 76260.
[115] Beasley et al., Report, p. 3.

thought process of what is considered sanctified within science and why his departure from this conduct was worthy of the strong reactions to follow. Schön maintains that his record keeping practices were not unique for his Department within Bell Labs.[116] In comparison "more troublesome" faking of curves appears to have originated in Schön's desire to prove effects and conformity, rather than to present raw data. Pressure to present thus overruled his own expected mechanisms of producing certifiable knowledge.

The discussion on whether such behaviour constituted scientific misconduct or fulfilled any legal definition of fraud quickly moved out of the hands of the investigators and into the public. The external reactions to Schön's misconduct were split on the matter, at times even using harsh and emotionally charged language. The terms scientific misconduct[117] and (scientific) fraud[118] were both frequently used in reports on the scandal unfolding. German speaking reactions to Schön call him a liar, a fraudster and a "black sheep of science"[119] while the "Freiburger Nachrichten" used the previously discussed term "Bschiss"[120], both exemplify strongly emotional readings of the situation without a clear definition or awareness of the legal implications. Legally speaking:

> "Fraud is both a civil tort and criminal wrong. […] fraud might be based on a misrepresentation of fact that was either intentional or negligent. For a statement to be intentional misrepresentation, the person who made it must either have known the statement was false or been reckless as to its truth." [121]

Schön had already proven his awareness of his misrepresentation and at least admitted to a reckless approach to data. Both fit well within Jan Hendrik Schön's behaviour in the production of artificial data as the report concludes:

> "Hendrik Schön committed scientific misconduct as defined by the falsification or fabrication of data, such that the research is not accurately represented in the research record."[122]

According to the legal definition intent and consequence are important factors to be considered in a potential case of fraud:

> "The speaker must have also intended that the person to whom the statement was made would rely on it. The hearer must then have reasonably relied on the promise and also been harmed because of that reliance."[123]

[116] Beasley et al., Report, p. 10.
[117] Brumfiel, Misconduct funding at Bell Labs shakes physics community, p. 419.
[118] Cassuto, Big trouble in the world of 'Big Physics', The Guardian, 18. September 2002.
[119] Basler Zeitung, Schwarze Schafe im Elfenbeinturm der Wissenschaft, p. 3.
[120] Freiburger Nachrichten, Bschiss beim Physiker, p. 24.
[121] Cornell Law School, fraud, online.
[122] Beasley et al., Report, p. 14.
[123] Cornell Law School, fraud, online.

"Reasonable reliance" is argued through the believability of a claim and the justifiability of the claim. Legally speaking:

> "[…] fraud plaintiffs must prove not only that they relied on the defendant's misrepresentation in question, but that the representation was reasonable. In other words, a person who claims to have been harmed by another's false statements must prove that they were justified under the particular circumstances that the statement was actually true. […] Where a statement is made under conditions or circumstances where reliance on that statement cannot be reasonably anticipated or foreseen, the plaintiff cannot demonstrate reasonable reliance."[124]

Here the legal definition and the structures of the scientific community collide. Proving that one can provide 'reasonable reliance' through structured research is a vital rite of passage into the networks of knowledge production. Stepping stones such as the Master's degree or even Bachelor's degree are considered proof of what might be called reasonable reliance. The latest step, which might be considered definite proof of 'reasonable reliance' in someone's ability to produce scientifically viable knowledge, is the doctorate. According to the common expectations within the scientific community a graduate should know the basics of proper scientific knowledge production, stick to codes of reliability, honesty and proof and refrain from plagiarism, falsification and manipulation. Thus, the fact Jan Hendrik Schön had a doctor title from the University of Konstanz and had done previous research for Lucent Technologies, endorsement by co-authorship and peer-reviewed papers in magazines with a stern review process all gave basis to the assumption of reasonable reliance.

Schön had been aware of the implication of the title and used it to his advantage. According to Eugenie Samuel Reich:

> "In 2001 he added information about his 1993 diploma project on the sputtering of solar cells into a short scientific bio, even though this project had never been considered an important part of his research experience before. […] He told George Sawatzky, a physicist at the University at the University of British Columbia, that he had spent his PhD days sputtering, even though his PhD had focused mostly on photoluminescence."[125]

Changing the description of the PhD project implies, that Schön intentionally used or even abused the approval he had received by the university of Konstanz regarding his technical skills developed during his doctorate. He retroactively manipulated the historical record of his 'reasonable reliance' to better suit the new project he was working on without proper qualification.

The second part of the legal discussion of fraud revolves around the concept of "harm". This is significantly harder to argue. For one, it could be argued through financial means. The paid work of Jan Hendrik Schön was to be done according to specific moral and professional codes,

[124] Cornell Law School, reasonable reliance, online.
[125] Reich, Plastic Fantastic, p. 141.

which he had not delivered upon. Instances of this argument are rare in this case, but the DFG used this argument to remove him from the organisation as will be discussed in the chapter 'remove'

From a social perspective Schön had done 'harm' to the networks of knowledge production that extended beyond mere sloppy work and falsification. His misconduct forced co-authors and all involved institutions to prove themselves as reliable assets, which at some points came close to damaging reputations of those who had failed to keep him in check. Bertram Batlogg, who had been his supervisor faced some critique in the immediate aftermath, wherein the scandal was described as catastrophic for the entire community of physicists:

> " 'Das ist natürlich eine Katastrophe und hat Auswirkungen auf die gesamte Physikergemeinschaft, speziell auch in der Schweiz', sagt ein Physiker, der nicht mit Namen genannt werden möchte. Gemeint ist damit nicht nur Hendrik Schön, sondern die Verknüpfung Schöns zu seinem einstigen Vorgesetzten Bertram Batlogg. Seit zwei Jahren Professor an der ETH Zürich. In Schweizer Physikerkreisen wird das Thema Batlogg zurzeit natürlich heiss diskutiert, allerdings nur hinter vorgehaltener Hand. Niemand hier möchte Batlogg öffentlich kritisieren – man kennt sich. "[126]

This, again, shows the common issue with sources in the Schön scandal previously discussed in the chapter 'Source Problematics'. The community of cutting-edge physicists is close knit and statements were either anonymous or unofficial at best. As the scientific community operates as a network of mutual trust and credit, Batlogg's reputation suffered because of the scandal. This might not always have been openly stated, the invisible atmosphere of distrust off the record carried a high potential for damage beyond the immediate connection of Batlogg and Schön. Batlogg's credentials were tainted from a public perspective as the Basler Zeitung continues:

> “Problematisch ist zudem, wenn Batlogg eine öffentliche Funktion übernehmen würde, zum Beispiel in einer Kommission beim Schweizerischen Nationalfonds. Es stellt sich auch die Frage, ob Studenten und Doktoranden aus Batloggs Labor inskünftig nicht Schwierigkeiten haben werden, Stellen in anderen akademischen Institutionen zu erhalten, vor allem in Deutschland und den USA, wo die Kritik besonders deutlich ausgefallen ist.»[127]

Any public functions Batlogg would take, would continuously be under scrutiny and strongly biased by his connection to Schön as his former supervisor. The author Adrian Heuss even expands these worries about future reputation to other graduates of Batloggs laboratory, even though they would have been controlled and approved by other instances outside of the Batlogg-Schön connection. The Schön affair had raised the potentially very harmful question, if those who had approved his work were even capable of doing so for others.

[126] Basler Zeitung, Schwarze Schafe im Elfenbeinturm der Wissenschaft, p. 3.
[127] Basler Zeitung, Schwarze Schafe im Elfenbeinturm der Wissenschaft, p. 3.

Even though none of the research papers of Jan Hendrik Schön were connected to the ETH except via his former supervisor working there, the lack of an official comment about the situation seems to have been negatively received:

> "Die ETH Zürich, Batloggs jetziger Arbeitgeber, hat bisher kein Interesse gezeigt den Fall Schön entsprechend aufzuarbeiten, so wie das beispielsweise die Universität Konstanz oder auch die Bell Labs gemacht haben. … Anscheinend geht es zurzeit nur darum, Batlogg aus der Schusslinie zu nehmen, anstatt zu hinterfragen, warum die Schusslinie überhaupt besteht."[128]

Adrian Heuss constructs a direct line of critique and responsibility ("Schusslinie") between the Schön case and the institution in Zurich. Even though Batlogg has been cleared of all wrongdoing by the investigative report, the Schön scandal has caused some doubt about the reputation of institutions he was not even directly connected to.

As part of the 2004 ETH Lecture "Scientific Frauds" sociology Professor Andreas Diekmann and Betram Batlogg discussed deception in the scientific network. Diekmann put a strong priority on the loss of trust, as Christoph Meier quotes him for ETH Campus Life:

> "In his lecture the sociologist named loss of trust as the most serious consequence of scientific fraud – both within and outside the world of research."[129]

Schön had partially damaged the confidence within researchers close to him, but also potentially within the public, which definitely posed a danger to all of the network.

Staying within the specialised in-group of Schön's co-author network more damage was done by him in a financial and career-harming way. Thanks to the overall approach of collaborative and procedural research, Schön's crumbling first steps brought down many projects based upon them. As one scientist bases their knowledge on previously established experiments and knowledge inevitably some had based their projects on the falsified claims of Schön. Arthur Ramirez of Los Alamos National Laboratory in New Mexico had devoted his own research to replicating one of Schön's results.[130] Claire Colin spent two years at the City of Paris School of Industrial Physics and Chemistry tasked with recreating and building upon Schön's claims.[131] Eugenie Samuel Reich quotes Claire Colin's sentiment about the years:

> "It was two years I could not use for my CV. It was not a good story to tell. It was my first real research experience".[132]

Schön caused harm to reputations, investments, and public infrastructures, such as funding grants, based upon trust which can be argued to have been 'reasonable reliance' given through his previous work and accreditation as graduate student. If that constitutes fraud and what the

[128] Basler Zeitung, Schwarze Schafe im Elfenbeinturm der Wissenschaft, p. 3.
[129] Meier, Research off the rails, ETH Life online.
[130] Brumfiel, Misconduct funding at Bell Labs shakes physics community, p. 419.
[131] Reich, Plastic Fantastic, p. 134.
[132] Reich, Plastic Fantastic, p. 134.

concrete reaction should have been is a legal argument this paper is not suited to answer, however sources by the DFG and the Bundestag in Germany discussed in the chapter 'remove' use those arguments of harm to justify their reaction.

The committee at Bell Labs was faced with the question how Lucent were to respond to Schön's data being faked. As previously mentioned, the new legislation coming into force by late 2000 theoretically only applied to federally funded institutions. Lucent was not federally funded, but a private company. Chapter III of the policy widens the scope as it regulates "Responsibilities of Federal Agencies and Research institutions"[133], adding the footnote:

> "The term 'research institutions' is defined to include all organizations using Federal funds for research, including, for example, colleges and universities, intramural Federal research laboratories, Federally funded research and development centers, national user facilities, industrial laboratories, or other research institutes. Independent researchers and small research institutions are covered by this policy."[134]

Thus, it potentially includes non-federally funded research institutions.

Even for privately funded scientific institutions a guideline for what was perceived as research misconduct in the early 2000s the federal policy was probably the best received standard within the United States of America. Research misconduct therein became defined as:

> "[...]fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results.
> • Fabrication is making up data or results and recording or reporting them.
> • Falsification is manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record.
> • Plagiarism is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit.
> • Research misconduct does not include honest error or differences of opinion."[135]

Especially the last point led to the discussion if Schön, as he stated, had made honest mistakes. The report ultimately concluded that "the recurrent nature of such mistakes suggests a deeper problem"[136]. The committee of the Schön-report ultimately decided to use those guidelines for their own investigation because of the overall representative value for the consensus of U.S. researchers:

> "In consultation with the Bell Labs management, the Committee elected to use the U. S. Federal Policy on Research Misconduct as its guiding set of principles, definitions and recommended practices in conducting its investigation. The research in question was not Federally funded, and therefore the Federal policies are not legally binding on Lucent Technologies. Nonetheless, the Committee and Lucent agreed that these policies represent, in effect, a consensus view of the U.S. scientific community on the issue of scientific misconduct."[137]

[133] Federal Register Vol. 65. No. 235, p. 76263.
[134] Federal Register Vol. 65. No. 235, p. 76263.
[135] Federal Register Vol. 65. No. 235, p. 76260.
[136] Beasley et al., Report, p. 14.
[137] Beasley et al., Report, p. 5.

The report on the case in question thus stood at the end of a not yet well-established legal interpretation of scientific misconduct. In fact, Bell Labs did not have any formal policies in place on how to handle research misconduct.[138] Being the first case, and a huge and complicated one at that, put significant pressure on the investigative committee, as Schön had plenty of co-authors who might have been part of the issue. Although they were cleared of all charges, because their laboratory practices were considered correct,[139] the report states about them:

> "In addition to addressing the question of scientific misconduct, the Committee also addressed the question whether the coauthors of Hendrik Schön exercised appropriate professional responsibility in ensuring the validity of data and physical claims in the papers in question. By virtue of their coauthorship, they implicitly endorse the validity of the work. There is no implication here of scientific misconduct; the issue is one of professional responsibility. The Committee found this to be an extremely difficult issue, which the scientific community has not considered carefully. Therefore, no clear, widely accepted standards of behavior exist. In order to proceed, the Committee adopted, for working purposes, a minimal set of principles that it feels should be honored in collaborative research. At its core, the question of professional responsibility involves the balance between the trust necessary in any collaborative research and the responsibility all researchers bear for the veracity of the results with which they are associated. The Committee does not endorse the view that each coauthor is responsible for the *entirety* of a collaborative endeavor: the relative responsibility of researchers with very different expertise, seniority and levels of participation must be considered."[140]

At this point in time the question of co-author's responsibility to check in their peers had neither been answered within Bell Labs nor within the scientific community as a whole. The committee noted, that they could not even find "any authoritative document prepared by an appropriate U.S. National body, that discusses comprehensively the responsibilities of coauthors in collaborative work" and stated their dismay on the recommendation of the DFG which implied all authors are always jointly responsible.[141] Co-authorship was seen as an endorsement, but the committee wanted to distance themselves from the more idealistic approach of sharing all responsibility across the evolving case of misconduct. Co-authors, as they had more access to details, appeared to be the first line of defence against misconduct, as they were seen to be in a place of responsibility, and their failure definitely raised the question of whether the community had a right to expect more of them.[142]

[138] Goodstein, On Fact and Fraud, p. 100.
[139] Beasley et al., Report, p. 4.
[140] Beasley et al., Report, p. 4.
[141] Beasley et al., Report, p. 16.
[142] Beasley et al., Report, p. 16.

The relative responsibility within the papers was difficult to judge, as the language in the papers was decisively unclear with phrases such as "we report"[143] and "measurements of […] demonstrated"[144], "we believe, that […]"[145].

Who gets to be on the list of authors was, and in some cases still is a heated discussion. The DFG at the time was strongly against so called "honorary authorship", a view the Bell Labs committee apparently did not share.[146] 'nature' tried to address this issue in November 2004 in their article "Authorship without authorization" reacting to its apparent ubiquity in the networks of knowledge production:

> "When it comes to publications, practically every researcher is aware of the potentially tricky politics surrounding the author list. [...] And while crediting practices vary across communities, whether it be alphabetical or in order of 'importance', most people have a basic understanding of what is fair. All too often, though, this line is crossed. [...] A common form of deliberate authorship abuse occurs when the head of the group claims first authorship instead of the postdoc or student who actually did the work and, in some cases, wrote the paper. Other times, authors who haven't contributed very much are added for the promotion of their careers. [...] Beyond this specific example, is it generally considered acceptable to include co-authors who haven't made a contribution? It's a bit of a no man's land within publishing, so some journals have tried to make author credits more explicit. The *Proceedings of the National Academy of Sciences* has an editorial policy that specifies "authorship should be limited to those who have contributed substantially to the work" and furthermore, "authors are strongly encouraged to indicate their specific contributions" as a footnote [...]. Similarly, Nature and its sister journals also encourage such contributions in the Acknowledgements. It was the hope of *Nature* that this practice would spread and allow authors, editors and readers to appreciate who did what, and encourage fairness, but since this policy was introduced in 1999, not many authors have taken advantage of it. Whether this is due to a general lack of awareness or a more endemic problem is unclear. Should journals push harder for detailed author contributions? And if they did so, would it actually help?"[147]

The problem of discussing authorship thus related to ideas of team structure, responsibility, work effort and promotion of careers alongside co-authors. The policy which was introduced in 1999 has, apparently, not been used nearly as much as 'nature' had intended. The article in 'nature' attributes cases where the system of fairly naming co-authors worked to "author integrity".[148] Cases where it did not were blamed on a "publish-or-perish" culture.[149] The footnotes in many of the Schön papers had been rather unspecific in showing who had done which work.

Officially no legal charges have been raised against him based solely on the papers, although Schön had to face trial in Germany whether or not the university of Konstanz had been right to revoke his title based upon the argument that he had become unworthy of his doctorate, which will be discussed later in this thesis.

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[143] Schön et al., Ambipolar Pentacene, p. 1022.
[144] Schön et al., Ambipolar Pentacene, p. 1023.
[145] Schön et al., Solution processed CdS thin film transistors, p. 271.
[146] Beasley et al., Report, p. 16.
[147] Nature Editorial, Authorship without authorization, p. 743.
[148] Nature Editorial, Authorship without authorization, p. 743.
[149] Nature Editorial, Authorship without authorization, p. 743.

Charismatic Cooperation

When writing "Betrayers of the Truth" in 1983 William Broad and Nicholas Wade were confronted with the question: "What is the conception of science in which scientists such as those who testified before the Gore committee put so much faith, that they sometimes choose to believe it over even the starkest evidence to the contrary?"[150]

They answered with:

> "The conventional conception of science exerts a powerful fascination because it is based on a highly attractive set of ideals about how science should work. It can accurately be described as an ideology, and it would not be so universally subscribed to by scientists did it not, in fact contain much that is true about science"[151]

Inherently the idealised conception of science already exerts fascination, a proactive positive bias towards its possibilities. Working within its own, usually well proven and attractive ideals of being part of a scientific network exudes charisma.

The field of technological research and its research groups, as any network of human relationships shows several instances where charisma in a sense of attractiveness, that can inspire devotion may overrule other factors of human behaviour and Schön being but an extreme one of them. In its daily form charisma at institutions may look like trusting a professor's factual accuracy in a lecture, even though they too might have made a mistake. The self-representation of the scientific network as being part of the advancement of humanity and standing at a public service for a better future mask potential ethical issues within the network. Jan Hendrik Schön, on an inter-personal level, has proven his own charismatic influence in several occasions. However, beyond his own persona lay other points that could be summarised under charismatic structures.

Lucent Technologies as a company lived off a charismatic image as the Bell Labs Innovators as "Bell Labs Innovators" prominently featured in their logos. This logo had been in use between 1996 and 2006 was initially ridiculed as the "million-dollar coffee stain".[152] Besides the more obvious use of the word 'Lucent' to evoke a sense of clarity the symbols and text had gone through a considerable thought process. Patricia Kavanaugh, who was in charge of Lucent's identity program explained her choice for the logo as based in many cultures' uses of circles to represent universality, knowledge and perfection,

[150] Broad, Betrayers of Truth, p. 15.
[151] Broad, Betrayers of Truth, p. 15.
[152] Bowie, The Lucent Logo Legacy, AIGA online.

whereas the loosely drawn shape should represent discovery, creativity and learning.[153] Her use of 'Bell Labs' was intended to serve as a reminder to customers, investors, consumers and competitors, that Bell Labs was the engine that drove the company.[154]

Magazines like 'nature' and 'Science' have a huge, scientifically literate readership, who trust their review process to be accurate and fair, rather than having to doubt every paper published, thus putting their faith in their own charismatic relationship with the names they have made for themselves in the scientific community and beyond.

Universities themselves are hubs of established trust, where the name of an institution on a degree is prominently featured as a sign of approval and testing.[155] The university of Konstanz, by granting the degree to Jan Hendrik Schön, vowed for his scientific integrity. Co-authors and papers trusted his accuracy, rather than tearing every page apart, which, if it were a basic requirement for trust, would bring scientific progress to a grinding halt.

Science, as a network of knowledge production, is also a financial network of mutual trust between financers and financees, in this case scientists, professors, but also investors, public and private funds, companies and institutions. This financial pressure can lead to issues within the network and can motivate fraudulent behaviour and increasingly extreme claims to stand out. Gordin explains the structure of science in the 21st century as:

> "First, today's science is adversarial. The way a scientist makes her reputation is by building on past findings, but if all she does is confirm what everyone already knew, her career stagnates. The pressures in scientific research are to do something new, and that usually means refuting a tenet of contemporary science. [...] Credit in science is allocated for priority (being first) and for being more correct than your competitors investigating the same questions"[156]

Jan Hendrik Schön claimed both, priority and a superior understanding. It was in a mixture of "being first", being "better" and being "unique", that the hype around Schön clouded a correct perception of his scientific misconduct. The network is thus not primarily focussed on correct production but on credit for priority and superiority within science. The recent discussion of the accuracy of university ratings shows a potential trend in questioning this tendency.[157]

The incentives driving science, contrary to the popularised picture of it, are often not advancement, development, betterment of the future, but at the very base level of human existence within late-stage capitalism, financial.

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[153] Kavanaugh, Creating the identity for a $20 Billion Start-up, p. 22-23.
[154] Kavanaugh, Creating the identity for a $20 Billion Start-up, p. 22.
[155] Note to my few readers: I am aware that I too have the UZH Logo on my thesis and I am definitely reconsidering my own scientific validity with nearly every sentence in this document.
[156] Gordin, on the fringe, p. 77.
[157] UZH-Kommunikation, UZH liefert keine Daten mehr für THE-Ranking, 13.03.2024.

"Within a climate of [financial] scarcity, adversarial norms necessarily generate both an incentive for winners to defend their gains and resentment from those who lost."[158] For the early 2000s the field of technological research definitely felt that pressure increase. The financial scarcity produced by the Dot-com bubble laid an essential base upon which behaviours of defending gains was actively encouraged. One example was the previously introduced financial incentive for scientists to apply for patents.[159]

That being said, it seems like Jan Hendrik Schön did not face a lot of resentment for his research breakthroughs, but rather was part of a wider network, that stood at the forefront of scientific discoveries. The reports about these discoveries being for the greater good and useful to humanity led to an atmosphere where outside scrutiny was lessened significantly. The difference between the case described by Gordin where anybody who jeopardises one's research by contradicting it would be seen as a threat, which quickly evokes the reaction of naming something pseudoscience[160], and the case of Jan Hendrik Schön is twofold. For one Schön was within the mainstream doctrine of physics, protected by fellow scientists whose work he used as a base for his own fabrications. More importantly he was, in this case, a professional scientist himself. After all he had a certificate of the University of Konstanz lending him credibility through his doctor title. As such his behaviour can be seen as strongly influenced by public perceptions of science, internal pressures of the reality of being a scientific worker in the early 2000s working within a financially unstable field of computer technology and a not yet well-established approach regarding scientific ethics and misconduct.

[158] Gordin, on the fringe, p. 77.
[159] Reich, Plastic Fantastic, p. 82.
[160] Gordin, on the fringe, p. 87.

Individual Charisma

Science is a network of relationships between individual scientists – ideally – sharing a core belief system of how certifiable knowledge is to be generated. As such the personal aspect of Jan Hendrik Schön interacting with other people cannot be ignored in his rise through the network.

The closest and most condensed source on his behaviour stems from the very people who had to decide to let him go. The report of Lucent Technologies presents a rather benevolent picture and, even though it concludes that there was scientific misconduct, does not condemn Jan Hendrik Schön personally:

> "By all accounts, Hendrik Schön is a hard working and productive scientist. Many coworkers, both from Konstanz and from Bell Labs, have attested to his long hours in the lab, the many samples wired for measurements, extensive use of deposition and measurement apparatus, and extended periods analyzing data at the computer. They have also commended his modest and unpretentious style, and his deep understanding of many aspects of condensed-matter physics. Moreover, Hendrik Schön has undeniably demonstrated an ability to write coherent, stimulating papers at a remarkable rate, an average of one paper every 8 days during 2001."[161]

In this part of the report the personal appearance of Jan Hendrik Schön is described as modest and unpretentious, which stood at a stark contrast with the claimed breakthroughs. His hard work ethic, although in the end leading to falsified claims, adds even more to a characterisation of belonging in the scientific community and presents him as having earned his place at the cutting edge of his industry through hard labour – a theme quite familiar in any American imagination of work places. The publishing frequency of Jan Hendrik Schön during 2001 is mentioned as remarkable, but until the very end did not raise suspicion but admiration. Schön was characterised along ideal character traits for a scientist and co-worker within a close network of high effort.

Already in Konstanz he appeared to be well liked by colleagues and his research was seen as diligent and solid.[162] The Max Plank Society had created a co-directorship for him at Institute for Solid State Research in Stuttgart.[163] During the 18-month Berufung-process "he came over as a very kind and impressive personality who presented his work very convincingly" according to Martin Jansen.[164] Even at that stage where his work must have been reviewed by highly trained specialists, "no objections had been raised"[165].

Batlogg went on to reflect his own personal relationship with Schön in saying

[161] Beasley et al., Report, p. 8.
[162] Abbott, Rising star crashes back to Earth, p. 420.
[163] Abbott, Rising star crashes back to Earth, p. 421.
[164] Abbott, Rising star crashes back to Earth, p. 421.
[165] Abbott, Rising star crashes back to Earth, p. 421.

> "I have learned, with the deepest of regrets, that the verification measures I have followed in this extraordinary case were not adequate to prevent or uncover scientific misconduct. I have placed, in retrospect, too much trust in my highly talented collaborator."[166]

Battlogg, at least at that point, still appreciated Schön's talent, even after the highly disappointing affair. He directly confronted the lack of verification measures to personal trust and he also positioned himself and Schön as collaborators, rather than at different levels within the academic ladder.

Institutional Charisma

> "This isn't a coincidence that this happened. We've been working on this for years. But this is an example of Bell Labs doing what it is supposed to do, to find, create, and define new directions."[167]
>
> – Bertram Batlogg when interviewed on Schön's (now disproven) laser.

Charisma and institutions are usually seen as polar opposites where charismatic rule is "antithetical to stable authority lodged within fixed codes and customs"[168]. However, institutions, to function on a daily basis need an extensive network of charismatic relationships. The networks of knowledge production need places of knowledge production. In the case of religious networks, it is the different types of religious institutions ranging from places of prayer to places of academic teaching. For science, it is the institutes with their laboratories, their professors, doctorate and, graduate students, but also their surrounding networks that keep the institution functioning. This entire network exudes a certain charisma to potential students and the public interacting with it. As previously discussed with its logo, but also with its culture Bell Laboratories, just as any other scientific institution presented itself as reliable, but also leaning into its legacy of patents, Nobel Prize winners, inventors and most prominently the name of Alexander Graham Bell to produce such charismatic connections. Charisma, as it just has been shown, can become problematic, as it can overrule the basic principles of fact-checking.

Thomas Robbins defines 'Charisma' through its Weberian and Wilsonian roots as:

> "Charismatic authority nevertheless represents personal and noninstitutionalized leadership, although Weber employed the term routinized charisma to refer to the partial institutionalization of charisma through the establishment of specified positions open exclusively to persons who demonstrate personal specialty. Institutionalized charisma is also represented by charisma of office, which pertains to beliefs that certain officeholders, by virtue of occupying a sacred office (e.g., priesthood), acquire certain special powers or qualities. In contrast, the pure personal charisma of prophets and sages resists institutional influences."[169]

[166] Brumfiel, Misconduct funding at Bell Labs shakes physics community, p. 419.
[167] Toupin, Electrically powered organic laser lights the lab, Photonics Online, 7. August 2000.
[168] Robbins, Charisma, Encyclopaedia of Religion and Society
[169] Robbins, Charisma, Encyclopaedia of Religion and Society

The boundary between non-institutionalised and institutionalised charisma becomes blurry in the investigation of offices, such as priesthood, named by Robbins, but also other offices in power. This, although written for an analysis of religion, applies to any human hierarchical network, and is thus also applicable to the scientific community. Robbins further analyses the instability of pure charismatic leadership, where non-institutionalised, charismatic leaders have to be on the lookout for dissent threatening their network.[170] This remains partially true for institutions of science, as they are institutionalised enough not to be threatened as a whole, but reliant on charismatic relations to be threatened by a negative perception. Bell had to let Schön go, as not to threaten the entire institution's earned trust within the network. However, before that the name "Bell Laboratories" or "Lucent Technologies" also served as a cover for misconduct by being perceived as a lighthouse of scientific truth, blinding onlookers with reputation. This reputation is actively promoted within institutions as institutional charisma as a culture produces narratives of achievable greatness. It drives the institution as a business and influences personal choices of future candidates where to study. Institutional charisma is a promise to the future. If only one learns to work in science at Lucent Technologies or Bell Labs, one too can become Nobel Prize laureate or the next Alexander Graham Bell. Exhibits of achieved greatness are shown prominently as part of university culture and are part of an institution's pride. If only one studies at UZH like Einstein did, proven by the large certificate at the entrance, one too can revolutionise our understanding of physics.

Although obviously not as famous as Bell or Einstein, a personality cult around Schön as a scientist appeared to form. Lydia Sohn was interviewed for a documentary, in which she likening him to "David Beckham in Soccer [...] some major rock star"[171], apparently "He could actually go by his first name 'Hendrik'[sic.] and we would all know who he was"[172]. Schön was about to become defined by his achievements within physics rather than his personal charisma just as Bell had become for his work on the telephone rather than his language talents or family life.

Charisma of office is produced through titles, such as professor, chair or in the case of Schön doctor. The same applies for the association with some of the publishers. 'Thin solid films' or 'physical status solidi' might not be evocative of respect and awe, but 'nature' and 'Science' were perceived as an achievement. Lydia Sohn, herself a professor of engineering at UCLA at the time recalled being confronted with the question why she had not published as much in 'nature

[170] Robbins, Charisma, Encyclopaedia of Religion and Society.
[171] Horizon, Time: 04:35-04:40.
[172] Horizon, Time: 04:45.

and 'Science' as Schön had.[173] The perception of the publishers as safe and equally noteworthy protected the idea, that Schön must have done something incredible to science for him to be where he was when others were not. However, as she is vital to the discovery of Schön's misconduct, her full story will be discussed in the chapter 'Reactions and Repairs'

Blinding Approval

Schön had received approval through several channels, which all had the power to partially or totally overrule the ideal of review and fact checking. As shown in the last two chapters this was partially due to him fitting into the inter-personal network or through institutions directly linked to his career being perceived as trustworthy. However, he had also received approval through channels, which were more universal.

The Price of Praise

Praise and prizes have been part of the scientific community since the early 18th century, when the Copley Medal was first awarded, which is commonly referred to as the world's oldest scientific prize.[174] Originally it had been the award for experimental discoveries, but has now taken on the role of a lifetime achievement award. Besides the monetary value of such prizes, they come with a high publicity and yet another form of approval from a committee deciding on the "worthiness" of possible candidates. A prize on this scale is thus perceived as a judgement not only of the individually achieved breakthrough, but also the entire life of a person, thus approving everything they have done.

When in 1901 the first three prize winners were seated right behind the royal Swedish royal family,[175] a new level of social status would be coined in the Nobel Prize. One century later rumours about a new potential candidate making his way to the ranks of Nobel Prize winners began to spread. Ilka Seer wrote to congratulate Jan Hendrik Schön on his "Otto-Klung-Weberbank Prize for Physics" in 2001 with the title "Nobelpreisverdächtig" putting the hopes of an entire branch of physics for Schön into one highly prestigious word. Her article gave an insight into the history of the Otto-Klung prize, but also into why many have assumed that Schön was on his way to a Nobel Prize.

[173] Reich, Plastic Fantastic, p. 192.
[174] The Royal Society, Copley Medal, online.
[175] Henschen, From the first Nobel Prize award ceremony 1901, online.

It also exemplifies several key aspects of the breakthrough narrative and the overall hype around the person Jan Hendrik Schön:

> «Er ist jung und auf dem besten Wege, eines Tages Nobelpreisträger zu werden. Der 31-jährige deutsche Physiker Dr. Jan Hendrik Schön ist mit dem Otto-Klung-Weberbank-Preis für Physik ausgezeichnet worden. Auf Vorschlag der Auswahlkommission am Fachbereich Physik der Freien Universität erhielt Schön, der seit drei Jahren in Amerika forscht, den mit 50.000 DM dotierten Preis für seine „richtungweisenden Arbeiten über organische Halbleiter und zur Supraleitung.»[176]

Mentioning Schön's age acts as a common hook to start his tale. For one it is an impressive fact. To anybody remotely familiar with the academic structure 31 means, that he must have been at it at a consistently fast pace to have reached a degree and already work in America for three years. Calling his work "richtungsweisend", no matter if translated as 'trend-setting' or even 'leading the way' put him and his work in a position of power over the field of physics and its future. To those following reports of the Nobel Prize, his age presented a noticeably massive outlier. After all, the average age for receiving a Nobel Prize for Physics between 1969 and 2016 was 60.9 years.[177] Even in the 1950s the average gap between a recognizable work and its award had been 12 years with the gap growing over the decades to 28 years in 2010-2019.[178] Such a young physicist to be even considered worthy of a prize was, and still is, a rarity. For comparison only two Nobel Prize for physics were awarded to people below forty since 1973, one to Eric Cornell at 39 and one to Konstantin Novoselov at age 36.[179] Schön would have been 32 or 33, depending on the nomination period and if he had been accepted. The Otto-Klung-Weberbank prize he received, was itself a marker for potential worthiness of a Nobel Prize as four previous recipients went on to get one.[180] Schön's laudatio was held by one of those double recipients Prof. Dr. Horst Strömer, who had received the Nobel Prize in 1998 and opened his speech with the words "Welcome to the club"[181], heavily implying Schön would go on to repeat his success. He then continued to praise him for discovering things nobody would have thought to be possible, and explained the possible future technologies based upon this process.[182] In his laudation themes of praise and astonishment, but also themes of applicability were heavily featured as he speculated several use cases from laptops to supermarkets would soon integrate Schön's new technological breakthrough.[183]

[176] Seer, Nobelpreisverdächtig, p. 13.
[177] Mitsis, The Nobel Prize time gap, p. 5.
[178] Mitsis, The Nobel Prize time gap, p. 4.
[179] Nobel Prize laureates by age. NobelPrize.org.
[180] Seer, Nobelpreisverdächtig, p. 13.
[181] Seer, Nobelpreisverdächtig, p. 13.
[182] Seer, Nobelpreisverdächtig, p. 13.
[183] Seer, Nobelpreisverdächtig, p. 13.

The legacy of the Otto-Klung-Weberbank prize itself tells a tale of how science and its awards were though of:

> Der Otto-Klung-Weberbank-Preis wird durch die Otto-Klung-Stiftung an der Freien Universität in Verbindung mit der Fördergesellschaft der Weberbank gGmbH verliehen. „Die in diesem Jahr begonnene Zusammenarbeit mit der Fördergesellschaft der Weberbank ist für die Otto-Klung-Stiftung eine gute Chance, dem gemeinsam verliehenen Preis noch mehr Gewicht und Geltung zu verschaffen", erläutert Kurt Hammer, Vorstandsmitglied der Otto-Klung-Stiftung, die neue Kooperation. Gegründet wurde die Otto-Klung-Stiftung 1973 als Vermächtnis des Berliner Kaufmanns Otto Klung (1893 – 1968). Klung brachte es vor allem nach dem zweiten Weltkrieg zu finanziellem Erfolg. Der gelernte Maschinenbauer und graduierte Ingenieur bedauerte es zeitlebens, dass er keine Gelegenheit hatte, ein weiterführendes naturwissenschaftliches Studium zu absolvieren, das es ihm ermöglicht hätte, den Fortschritt in Wissenschaft und Gesellschaft aktiv mit zu gestalten. Durch sein Vermächtnis und die nach ihm benannte Stiftung gelang es ihm aber, einen bleibenden Beitrag zur Förderung herausragender junger Wissenschaftler in Deutschland zu leisten."[184]

For one, it is an award given through the authority of a university, thus solidifying his claim for a position within the academic network compared to a prize by a private entity. Just before Schön had received the prize its meaning had changed. Incorporating the "Weberbank", drastically increased the perceived importance. Schön was thus the first to receive the new and improved version of an already difficult to achieve price in its first year of being even more important. For the other, the personal legacy of Otto Klung brings with it perceptions of applicability, as he had studied machine engineering. His idea for the prize was to honour those who, unlike him, managed to bring forth inventions that would shape science and society. By handing Jan Hendrik Schön this prize, the idea was promoted, that he had done just that with the academic approval of a university backed by the – then more than after 2008– trusted institution of a bank.

James Heath of UCLA shared his impressions of Schön being close to reaching the Nobel Prize in an article for the Guardian. "Big trouble in the world of 'Big Physics" was written by Leonard Cassuto in September 2002, thus reacting to the immediate aftermath of the Beasley Report, but without knowing the full extent of Schön's retracted papers:

> "I saw these results being presented to a German audience," […]"and they knock on the chairs instead of clapping. It was incredible - they got a 'standing knocking.' I thought, these guys are going to Stockholm."[185]

To James Heath, there was no doubt, that someone receiving such strong approval would be headed to Stockholm to collect the Nobel Prize. Schön's proximity to a Nobel prize would go on to be reflected in countless other sources, either to reflect on how promising his career had appeared or as a warning sign and memory item to those who might have only heard about the first half of his story.

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[184] Seer, Nobelpreisverdächtig, p. 13.
[185] Cassuto, Big trouble in the world of 'Big Physics', The Guardian, 18. September 2002.

Treacherous Tales

How could things have come so far? Sure, Schön had been charismatic and people liked and trusted him, Bell had a good name, so did 'nature' and 'Science' in the public and the other publishers in the physicists' eyes. He even managed to score an important prize and was – potentially – about to be approved by the highest scientific prizes, but those factors in themselves only influenced the authority of the breakthrough narrative through *who* told the tale, not *what* it was about. The answer to that lies partially directly within the core, namely his papers, and partially far beyond the individuum an institutions within the strong narrative of success and applicability, as well as the people's readiness to believe it. The belief in the (potential) hero of science Jan Hendrik Schön was constructed in many spheres. The first and closest was that of his co-authors and co-workers as discussed previously in 'individual charisma', the second part was constructed in the sphere of institutions and already extending into public perception of such institution's trustworthiness as discussed in 'institutional charisma', the third was the 'blinding approval' through prizes and rumours thereof. However, there was one last ingredient emerging in the late 1990s and early 2000s that left the public as consumers of science with a new picture of science where a superstar would fit right in.

The rising path to stardom of Jan Hendrik Schön was littered with reports of his and his teammates' newest successes. Long before the façade would show its first cracks the hype around Jan Hendrik Schön had authors strongly favouring a tale of breakthrough and new explorations. When the success became increasingly unbelievable and first doubts about replication crept in, the lore of Jan Hendrik Schön as a scientist with near-magical abilities and special equipment displaced the doubt with new ideas that would keep the narrative going.

The tale of Jan Hendrik Schön's amazing new inventions struck a chord with those reading it, be it co-authors, supervisors, or in a wider sense the general public. This reception was built on two main ideas, which had both undergone drastic change in the years leading up to his work. Those ideas are best summarised as that of what science *could do if only it were given the chance* and that *what science should do for society*.

Ideas of what science could do were based upon the recent experiences of scientific progress. Production and consumption of science and products of scientific progress had greatly increased in a few decades. Thus, society, and its interactions with technology and science had changed significantly in the latter half of the 20th century. New technology penetrated everyday life, new skills emerged, drastically changing work places and education, and new imaginations of science and its possibilities emerged.

The boom of technology and information had been a topic of discussion well before Schön was even born. Most famously Radovan Richta and his research team wrote Civilizace na rozcestí - společenské a lidské souvislosti vědecko-technické revoluce (or in its English version "Civilization at the Crossroads: Social and Human Implications of the Scientific and Technological Revolution") in 1968, as well as other works contemplating the role of technology for humanity. This work coined the term "scientific revolution" in the late 1960s. Richta's work offers a glimpse into the beginning of a new analytical framework, but also the collision of science and everyday life. On the new status of science in society Richta reports:

> "Today it is commonplace to see the upsurge of science as the feature of our age. Fifty years ago there was nothing in the world to compare with the research centres of today, the network of laboratories, the new towns catering for scientists and universities. Science has penetrated the foundations of contemporary society, infused the dynamics of historical movement1 so thoroughly that the whole pattern of change appears as a "research revolution" and the coming age as one of "scientific civilization". If we free the innumerable reflections on this subject from the fog of popular illusions that see science as a magic wand without identifying the social and human sources of its power, we discover that the crux lies in the new status of science"[186]

The emerging network of science as it exists in the latter half of the 20th century produced new interactions based upon historical movement. Described as a "research revolution", this idea also brought about the tale of unity and unification in a world so thoroughly divided by an ideological conflict. This new status of science in society also appears threatened by the "fog of popular illusions that see science as a magic wand"[187]. One of the dangers emerging from this "scientific revolution" was the pace at which needs and wants adapted to progress. In his chapter "Man and His Changing Needs" Richta addresses the dangers of this development in contrasting them with the slow pace of the past:

> "In pre-industrial communities, human needs — at least within the life span of a single generation — showed no appreciable change. […] With rapid technical advance, the system of external manipulation of consumption incessantly inflates mass demands for private enjoyment of amenities, it imposes an array of senseless, fictitious wants, sponsored by advertisement, prestige appeal and undercutting. Man is made a slave of his consumption, human activity is turned into a mere means to this end; instead of taking possession of the world, we have the appropriation and consumption of things. […] The age of science and technology knows many components of this need [to develop]. We can mention only the foremost: the need for creative work, the need for life-long education, the need for all-round abilities and self-assertion, the need for unsullied relationships and human sympathy, the need for complete mobility and information, the need for free physical activity, the need to enjoy beauty and nature, the need to see a way forward — all these are intrinsic, indissolubly linked human claims on the progress of modern civilization."[188]

It is here, that one should reflect the time and country of origin of Richta, as he clearly writes a critique of mass consumption from a perspective under Soviet influence. His critique,

[186] Richta, Civilization, p. 211-212.
[187] Richta, Civilization, p. 212.
[188] Richta, Civilization, 164-170.

however is a valuable frame for the emerging needs that would play a role in the tales of greatness and promises played at in the breakthrough narrative of Jan Hendrik Schön.

The intrusion of technoscience into everyday lives brought with it the high pace of ever-changing technological advancements. Massive revolutions in computing technology, such as those promised by Schön's work would not even have been plausible in prior decades, because the pace at which technology progressed would simply exceed a human life. This, linked with new ways of consuming this technological progress in the latter half of the 20th century made those claims even remotely believable to readers of Schön's papers or reports thereof. The emerging needs, seen by Richta in the late 1960s informed the by then deeply engrained needs for information, mobility and progress in the society of the early 21st century, which read and received news of the breakthrough driven by Schön et al.

What science could achieve for society was also greatly reframed. As previously introduced with Kohlenberger's work on the popular imagination of science and technology, science as a topic had become 'cool'. Kohlenberger ties this emerging notion to consumption of technological devices, as well as new services emerging in the internet leading to a new electronic culture.[189]

Kohlenberger states, that coolness itself has undergone significant changes, but "remains an irresistible cultural force in contemporary information societies, but it has also notably adjusted its focus", in which new images of science prevail.[190]

The two thoughts of what science could should do were, and still are far from isolated. Public perception of science mattered deep within the network. Kohlenberger appreciates the network of mutual influence in an unspecific example:

> "The grant proposal for a new research project may have been inspired by journal articles, in-formal talks with colleagues and reports in the mass media. Popularization is accordingly no longer understood as external to the scientific production process, but constitutes an integral part of it."[191]

In this example, which appears a realistic scenario, co-dependence of self-perception of scientists and the public perception of the network's abilities merge. Scientists, it appeared, should cover societies' evolving needs. Schön appeared motivated and more importantly capable of doing just that.

[189] Kohlenberger, The New Formula for Cool, p. 41.
[190] Kohlenberger, The New Formula for Cool, p. 43.
[191] Kohlenberger, The New Formula for Cool, p. 83.

Poisonous Promises

"All hail the TR100! These 100 brilliant young innovators – all under 35 as of Jan 1. 2002 – are visitors from the future, living among us here and now. Their innovations will have a deep impact on how we live, work and think in the century to come."[192]

- MIT Technology Review, 2002.

In its second ever edition – the first had appeared in 1999[193] – the MIT's magazine of Innovation: Technology Review, listed 100 researchers who appeared to be able to change the future. A panel of 25 judges, including two Nobel laureates, company founders, several professors and highly regarded members of the scientific community had decided on who had to be on it.[194] Although the introductory quote to the TR100 should be read with a grain of salt, the selection process and resulting approval were serious business indeed. Their entry for Schön held his promises high:

> "Hendrik Schön is reinventing the transistor at the place it was born. He and his Bell Labs coworkers have produced single-molecule transistors whose electrical performance is comparable to that of today's best silicon devices but which are hundreds of times smaller. Making such molecular transistors, which could lead to ultrafast, ultrasmall computers, has been a goal of researchers for years; Schön's clever design established Bell Labs as a leader in the race. But Schön is not interested in simply reinventing the transistor. He wants to change the very materials that form microelectronics, replacing inorganic semiconductors with organic molecules. Schön has made an organic high-temperature superconductor, renewing hopes that superconductors could have widespread electronic applications. He also helped devise the first electrically driven organic laser, which could mean cheaper optoelectronic devices. The soft-spoken Schön recalls being "very surprised" by how well his molecular transistors worked. But it won't be a surprise if Schön helps transform microelectronics."[195]

The short introduction of Schön uses several important motives in quick succession. It starts out with a claim of novelty and development. "Reinventing the transistor" also puts this novelty close to a key component of technological development of the new millennium. "where it was born", instantly produces a sense of legacy, so do the mentions of the institution's name "Bell Labs", which, as discussed previously, was in itself an established name and decently familiarised, especially in the North-American technology market. His new technology was supposedly the new and improved version of the established silicon transistors, which themselves had displaced germanium transistors by the 1970s, thus evoking the memory of this drastic change within computer technology. This was then immediately followed up with a comparison to the status quo and an interpretation as both "clever" and useful. It also presents Schön as the final piece to a long existing research goal, which others have not been able to solve. As Gordin describes the overall issue behind the system: "Applicants need to present

[192] MIT Technology Review, p. 65.
[193] MIT Technology Review, p. 65.
[194] MIT Technology Review, p. 97.
[195] MIT Technology Review, p. 87.

their work as superior [...]"[196]. The claim to superiority is shared between Schön personally and Bell Labs as an institution. Moving on, the claim is put into perspective as a revolution in materiality. His claim to the (faked) organic high-temperature superconductor was presented to the reader as something he had actually produced, not something that still had to be tested or theorised, but read as a material, proven, physical object that works and was supposedly ready to work towards a better world. It is in this article, that Schön is not only presented as having achieved one thing, but also a second claim to the "first electrically driven organic laser", which would later turn out to be just as falsified.[197] This laser was, again, put into the context of a potential use case in optoelectronic devices. Lastly the short description adds a note to Schön's personality as soft-spoken, which, through the functions of personal charisma, takes out any doubt about competitiveness, that might be an invitation for critique by the public. Describing his own discoveries as a moment of surprise adds to the overall idea of surprise and discovery, which in turn was used by Schön to defend the fact his data remained elusive to those who wanted to reproduce it.[198] The MIT technology review ends the note on an appraisal, where it appears to be unsurprising if Schön helps transform microelectronics.

The tale of Schön prominently features ideas of where he could take technoscience, if he were to progress his research. An overarching theme within reports of Schön's success story was the promise of applicability. Even within his papers themes of certainty and applicability set the mood for readers. The retracted paper "A Superconducting Field-Effect Switch" by Schön, Kloc, Haddon and Batlogg started with:

> "We report here on a novel realization of a field-effect device that allows switching between insulating and superconducting states, which is the widest possible variation of electrical properties of a material. We chose C60 as the active material because of its low surface state density and observed superconductivity in alkali metal– doped C60. We induced three electrons per C60 molecule in the topmost molecular layer of a crystal with the field-effect device, creating a superconducting switch operating up to 11 kelvin. An insulator was thereby transformed into a superconductor. This technique offers new opportunities for the study of superconductivity as a function of carrier concentration." [199]

The theme of novelty might not be too uncommon in science papers, but it still suggests relevance and being at the cutting edge of science. Realisation, or rather the theme of timeless certainty was then proclaimed as if to call upon a long-awaited effect to finally be observed by the team. The idea of having created a superconductor out of an insulator subverted fundamental expectations of physics, as did many others of Schön's claims. Breaking open

[196] Gordin, on the fringe, p. 78.
[197] Reich, Plastic Fantastic, p. 92.
[198] Reich, Plastic Fantastic, p. 124.
[199] Schön et al., A Superconducting Field-Effect Switch, p. 656.

those expectations on such a fundamental level might well be what drove the overall perception that Schön could make anything happen. The last sentence heavily implies applicability for the field as a study object mirroring the more public reports of Schön's science being applicable to new technology.

"Solution processed CdS thin film transistors" by Schön, Schenker and Batlogg featured even stronger promises of applicability and discussed and starts with promises of low-cost preparation and application in areas such as display or storage technology in its first sentence.[200] In the conclusion the team stated their certainty in a wide range of applications:

> "Hence, we believe that the CBD [Chemical Bath Deposition (A process strongly associated with mass production and reduction of cost)] of inorganic semiconductors could be an interesting technique for the low-cost fabrication of large area microelectronic devices on a variety of inexpensive, flexible substrates. Potential applications include wireless identification tags, electronic shelf tags, low-end data storage, or even emissive displays."[201]

The promise of new technology quickly became popular around the world. The German speaking press was aware of Schön's breakthrough, Schön was German after all. Till Mundzeck's article for "Die Welt" already predicted the new era of computer technology in the title "Der Mikrochip der Zukunft besteht aus Kunstoff" opening with:

> "Mikrochips aus Silizium werden sich nach Ansicht von Experten in 15 Jahren nicht mehr weiter miniaturisieren lassen. Transistoren aus Kohlenstoff könnten dann eine neue Ära der Mikroelektronik einleiten.»[202]

Mundzeck's opening statement contains four main themes shared by other articles about Schön's progress. First is the death of current technology by the invention of a new one. Just as the advent of silicon had ended the use of germanium transistors this new technology by Schön et al. appeared to have the potential to end silicon's run time also present in the MIT Technology Review. The second common theme is the somewhat reasonable time frame. 15 years to the advent of the new technology puts it within the same scales of the popularisation of the internet from the time of its invention to the publishing of this article, which appeared to be a believable time frame for massive change in computational technology. The third is encapsulated in the formulation of "nach Ansicht von Experten". Which experts he had asked, or if that statement is even remotely justified remains obscure, but lends gravitas to the new claim. The fourth, more hidden theme is the end of current computer technology, in this case silicon transistors, as it appears to have reached its maximum potential in the end of miniaturisation. The debate whether or not Moore's law is dead is still ongoing, most recently in the famous debate between

[200] Schön et al., Solution processed CdS thin film transistors, p. 271.
[201] Schön et al., Solution processed CdS thin film transistors, p. 274.
[202] Mundzeck, Der Mikrochip der Zukunft besteht aus Kunststoff, Die Welt, 19.10.2001.

Nvidia CEO Jensen Huang claiming it is, whereas Intel's CEO Patrick P. Gelsinger refutes such statements.[203]

Mundzeck's article is one of few to directly quote Jan Hendrik Schön, rather than just referencing his research or a wider understanding thereof. He, apparently, directly stated the idea of one technology replacing another being quoted as:

> "Organische Elemente könnten einmal die heutigen Siliziumchips ersetzen, wenn diese nicht mehr weiter miniaturisiert werden können", prophezeit der deutsche Bell-Physiker Jan Hendrik Schön, der die winzigen Transistoren zusammen mit Kollegen in der jüngsten Ausgabe von "Nature" präsentiert. Von der Anwendung sei diese organische Molekularelektronik aber noch viele Jahre entfernt."[204]

The claim for having found an applicable replacement for silicon transistors seems to have originated either with Schön or within his closer network. This might have been influenced by the overall drive for applicability and persistent work culture relating to patents at Bell Labs in the early 2000s. It also appears that Schön has tried to relativise this claim in pushing out the date of applicability by several years. Judging by the continued hype around his breakthrough such relativisations appear to have fallen on deaf ears.

Mundzeck's article continues with short segments by another German scientist Prof. Franz Effenberger who worked at the university of Stuttgart at the time. In a trope common to popular science communication Effenberger explains that 2 grams of the new compound were supposedly enough to cover an entire football field.[205] At first glance this comment had nothing to do with the science at hand whatsoever, but it served to visualise the supposed efficiency of the process, a hidden promise of driving down cost with economies of scale.

Effenberger's comments to Mundzeck also reveal more about the hopes and promises of the industry:

> "Die Deutsche Forschungsgemeinschaft hat kürzlich einen Forschungsschwerpunkt für Transistoren auf Basis organischer Verbindungen eingerichtet. "Die Industrie interessiert sich sehr für diese Technik, weil sich rein organische Bauelemente flexibler, kleiner und billiger herstellen lassen", glaubt Effenberger. Auch biegsame Chips seien dann möglich."[206]

The DFG's focus on organic transistors at the time was new, maybe even driven by Schön's success, but at least showing a general interest in funding this research. Schön had received funds by the DFG for the period of August 1998 to January 2000.[207] The reason for this interest, according to Effenberger, appears to be driven by the industry and economies of scale. The idea of a flexible microchip is briefly introduced as yet another nod to more popular

[203] Orland, Is Moore's law actually dead this time? Arstechnica, 22.Sept. 2022.
[204] Mundzeck, Der Mikrochip der Zukunft besteht aus Kunststoff, Die Welt, 19.10.2001.
[205] Mundzeck, Der Mikrochip der Zukunft besteht aus Kunststoff, Die Welt, 19.10.2001.
[206] Mundzeck, Der Mikrochip der Zukunft besteht aus Kunststoff, Die Welt, 19.10.2001.
[207] Stellungnahme der DFG Jan Hendrik Schön 2004.

imaginations of science at the border between science and fiction. Bendable chips also promised applications in wearable technology and easier manufacturing of daily use technology.

In the last paragraph of the article Mundzeck used several other tropes as he wrote:

> "Der neue Winzling der Bell Labs, wo 1947 bereits der erste Transistor erfunden wurde, zeigt die Marschrichtung vom Silizium- zum organischen Nanochip an. Bislang seien etwa 1000 bis 10.000 Moleküle an dem Schaltprozess in dem neuen Transistor beteiligt, erläutert Schön. "Wir hoffen aber, das mit einem einzigen Molekül machen zu können." Es seien sogar Molekülkomplexe denkbar, aus denen sich 3D-Schaltkreise bauen ließen."[208]

The first sentence evokes the legacy of Bell Labs as inventors of the Transistor. Bell Labs legacy played a vital role in lending credibility to Schön's work as discussed in the chapter 'Institutional Charisma'. Legacy's power to guarantee future success is limited at best, but in popular science communication it appeared as one of the reasons why Schön was so successful. The numbers used in explaining the difference are striking and visualise the orders of magnitude of the supposed breakthrough. Schön, as quoted by Mundzeck, raised the promise of going down to the molecular level on an entirely new scale of imagination. The last promise is common to computer technology to this day. Miniaturisation by new geometry in 3 dimensions promised new and exciting microelectronics which might find their way into the households of readers. (How such a dense, high-power transistor array were to be cooled apparently didn't matter to the author).

Communicating complicated scientific facts to a wider audience can happen in different modes. One, as just shown was the appeal to the general masses through rather visual comparisons to everyday objects such as football fields. On this level of perception of a reader without a background in physics, the science Schön presented appears closer to the perception of science as magic Arthur C. Clarke had first discussed.[209] Between this level and the highly specific in-group level in the laboratory exists a near stepless spectrum of variety.

The very popular format "This Week in Science" by 'Science' magazine sums up different news from varying fields. For the last week of April 2000 earthquake probabilities, LED technology, air quality reports and genetic news were mixed with other short articles presenting the newest and most promising breakthroughs.[210] This suggests that the mixed format is aimed at people with a general interest in science, rather than a closed in-group of field experts.

[208] Mundzeck, Der Mikrochip der Zukunft besteht aus Kunststoff, Die Welt, 19.10.2001.
[209] Clarke, Clarke's Third Law on UFO's, Science, p. 255.
[210] This Week in Science, 28. April 2000, Vol. 288, Issue 5466, p. 573.

As part of this news segment on Jan Hendrik Schön's paper "A Superconducting Field-Effect Switch, (retracted in November 2002) was presented to a wider audience under the simplified title "Switching on Superconductivity" and the text:

> "Superconductivity is usually achieved by lowering the temperature of a material below its transition temperature. It should be possible to induce superconductivity by accumulating enough charge at the interface of a field effect transistor (FET), and this approach would allow superconductivity to be switched on and off. However, previous attempts to realize such a switch have failed because the resistance did not decrease to zero. Using alkali-doped C_{60} as the active material in the FET, Schön *et al.* (p. 656 [link to retracted paper]) have induced three electrons per molecule into the conduction channel of the FET and show that the channel becomes superconducting, and remains so up to 11 kelvin."[211]

The title "Switching on Superconductivity" implies two things. For one it suggests simplicity, a commonality of the process, rather than being cutting edge science, which might have lowered the threshold of doubt in suggesting what Schön did was common or based on common knowledge and thus reasonably achievable. The other suggestion hinted at in the title is again the usability as a transistor for binary processes such as computing. Mentioning previous failures plays into the theme of being achievable if only it were done right by a – maybe slightly special – team. Again, the temperature of 11 Kelvin is mentioned, which at least for this process would be incredibly high and, most importantly, again within a usable temperature range for applications running with Helium as a coolant, with the considerably cheaper Hydrogen not far off the charts either.

Clearly, the perception of Schön being part of a knowledgeable group of cutting-edge Scientists had become a theme in itself. Either he, or someone close to him was expected to solve the issues and bring about the promised outcome speculated on by the wider scientific network and more popular audience. The group around Schön, and especially himself appeared to produce unbelievable progress at an even more unbelievable pace. Yet the tendency not to believe, was cast aside for themes of hope and applicability.

Patrick Cassoux's article "Staying Neutral for a Change" groups Schön with several other scientists working on possible superconductors. His article puts the novelty and hopes into perspective, ending with:

> "Finally, could one have imagined just a few months ago that Schön et al. could turn pentacene into a superconductor by injecting this insulator with charge using a field-effect transistor [Footnote to Ambipolar Pentacene Field-Effect Transistors and Inventers by J.H. Schön, S. Berg, Ch. Kloc, B. Batlogg]? Yes indeed, never say never."[212]

The hopes Classoux stated for the field would be bitterly disappointed as the quoted paper would find itself in the investigative report to be retracted by November 2002 alongside 7

[211] This Week in Science, 28. April 2000, Vol. 288, Issue 5466, p. 573.
[212] Cassoux, Staying Neutral for a Change, p. 264.

others previously published in 'Science'. [213] Schön had substituted data in both the triode characteristics and the inverter characteristics.[214] Both were essential to the claim of turning anything into a binary switch. Schön's papers and the representation thereof in the surrounding media landscape elicited the feeling that anything could be possible.

Magic Hands and Funky Machines

"They said he had magic hands."[215]

- Matt Crenson, Seacoast Online; Fraud claims cast doubt on impressive results from Bell Labs' rising star., 29. September 2002.

Upon a first glance the idea of investigating misconduct in physics appears clear cut and highly fact based. Statements relating to magic hands, however, appear to be misplaced by centuries and in scale of relation. Art Ramirez of Los Alamos National Laboratory is one of the few associated with the quote of Schön having supposedly "magic hands" in what appears to be a now lost article in 'Science'.[216] In Leonard Cassuto's previously introduced "Big trouble in the world of 'Big Physics'" imaginations of Schön as a scientist with nearly magical abilities became clear. Cassuto quotes an unnamed Princeton professor as saying Schön had "defeated chemistry" and compares him to a modern alchemist, as he had apparently conducted electricity where it had never gone before.[217] When Eugenie Samuel Reich investigated the Schön case, the idea of magic had clearly been within the memories of people interacting with Schön. Bill Brinkman, former vice president of Bell Labs, told her, "that Schön could do experiments no one else could do because he had magical hands"[218].

This idea of Schön's supercharged abilities covered for doubts emerging, but he also partially evaded questioning. Chesterfield and the Team from the university of Minnesota reached out with questions, as they tried to get as many factors aligned as possible, from the distance of the sample in the sputtering machine to the vendor of the aluminium to be sputtered.[219] Although Schön actively encouraged them to proceed, they ended up with failure after failure.[220] This also suggests, that he actually hoped to be proven right, or that he did so to conform with ideas

[213] Bao et al, Retraction, p. 961.
[214] Beasley et al., Report, p. F-1.
[215] Crenson, Seacoast Online: Fraud claims cast doubt on impressive results from Bell Labs' rising star.
[216] Cassuto, Big trouble in the world of 'Big Physics', The Guardian 18. Sept. 2002.
[217] Cassuto, Big trouble in the world of 'Big Physics', The Guardian 18. Sept. 2002.
[218] Reich, Plastic Fantastic, p. 141.
[219] Reich, Plastic Fantastic, p. 124.
[220] Reich, Plastic Fantastic, p. 124.

of fitting in. When the sputtering process came under question by May 2002, Schön circulated an unpublished pre-print in an effort to help others replicate the process, wherein it was implied that only one unit could actually do it and it might have to be copied.[221] Rumours about the machine in Konstanz being special and theories about it working because it was contaminated were spread.[222] Even this late in the game it apparently could not have been Schön producing an epic case of misconduct, but one just did not have the right, funky machine to reproduce his process. The tale of the funky machine was contradictory and inconsistent. When confronted with the fact that other samples broke for being too close to the sputtering gun, he told others it only worked in the much larger chamber of Konstanz, as the deposition was gentler, but he had also told his fellow scientists to place the sample at a distance of 4 cm.[223] In Zurich Batlogg bought equipment Schön had claimed to use and sent out junior researchers to Konstanz to have a look at the magical machine.[224] Batlogg even told Schön to demonstrate the process, but according to some scientists who had attended this demonstration was a miserable failure.[225]

Reactions and Repairs

Where exactly the first cracks within the network of Schön's in-group had originated is hard to tell. Many, as previously mentioned, decided to keep their statements off the record. Overwhelming responses to Schön's misconduct might have biased former colleagues' perception towards having doubted him earlier. The time frame for when such cracks started growing is also hard to pinpoint as suspicion about Schön's approach had only grown slowly. Some doubt appears to have grown out of frustration in the race to replicate his work. Several laboratories started to interact with each other and all noticed, that the deposition of aluminium oxide, a vital step to many claims of Schön, did not work as promised.[226] Even so, the idea, that something new – an imminent breakthrough – was about to rapidly advance science, and this branch of technoscience in particular, protected Schön. In a Seminar in May 2001, chaired by Rogers and given by Schön, doubts had been voiced by Peter Ho and others in the audience about the supposed behaviour of the SAMFET.[227] Dick Slusher, then director of optical physics research also asked for details, but by the end of the presentation none of the questions had really been answered. However, according to Slusher, research, nobody doubted the data, but

[221] Grant, Is a bell tolling for Bell Labs? p. 789.
[222] Reich, Plastic Fantastic, p. 137-138.
[223] Reich, Plastic Fantastic, p. 141.
[224] Reich, Plastic Fantasitc, p. 146.
[225] Reich, Plastic Fantastic, p. 189.
[226] Reich, Plastic Fantastic, p. 131.
[227] Reich, Plastic Fantastic, p. 156.

the proposed mechanism of the device.[228] By November 2001, Schön's often hailed high productivity had come under suspicion. Giacinto Scoles outright commented, that he should be investigated for misconduct because of his publication history, when he was asked to provide a recommendation letter for Schön for a possible position of chair at Princeton.[229] Lydia Sohn, then professor at Princeton, had become suspicious of Schön's too clean data. She recalled her impressions of his presentation when speaking to Eugenie Samuel Reich for Plastic Fantastic:

> "Sohn attended, but found it hard to sit and watch as Schön paged through graph after graph of beautiful data from a wide variety of different nano-devices. When he showed some conductance data taken on his single molecule devices, Sohn said she spoke up. "I said, 'excuse me, how many devices have you actually measured?" she remembered. Schön gave some answer. Feeling that the audience didn't sympathize, Sohn fell silent. But she was backed up by Giacinto Scoles, an older and sometimes belligerent professor of chemistry, who spoke up to say that with the technology of the time, it was not possible to get self-assembling molecules to arrange themselves in the orderly way Schön had described, with one end sticking to one electrode and one to the other, as at least some of the molecules would end up lying flat, both ends sticking to the same electrode. Scoles added, according to another attendee, that he felt he had learned more about Schön's work from the New York Times than from his scientific publications. Schön apparently smiled, as if he did not realize that this was an insulting thing for one scientist to say to another. Lydia Sohn said that she left the room feeling that the Princeton audience was more impressed by Schön than by the criticisms of him, especially when another faculty member came up to her on the way out and asked how many papers she had published in Nature or Science recently."[230]

Reich's interview with Lydia Sohn shows just how powerless doubters of Schön appeared, even if they started to gather hard evidence and ask questions that should be reasonably answerable by someone who has actually measured these effects in a laboratory. The perception that science was clean, successful, presentable at all times, as it had become popular by that time, shaped the way Schön presented himself and his data sets. Real science is messy work, and the clean data Schön presented was frustrating, rather than convincing to those who actually worked with real data. In the example given by Scoles' remark, Schön's smile was interpreted as him not knowing the reality of science, but rather picking up on the false compliment of popularity. Princeton's institutional charisma, overruled the fact checking mechanisms, even if given the opportunity to pick up Lydia Sohn's suspicions. 'nature' and 'Science', or rather their popularity was seen as something that should be achieved by the faculty member asking her how Sohn's own publishing career was put into question by Schön's record.

To break this strong defence of Schön, many cracks would have to collide, but once they did the story of scientific misconduct happening at Bell laboratories was nearly uncontainable. For Lydia Sohn this experience appears to be the moment Schön's personal charisma, Princeton's institutional charisma, and the structures of trust around popular means of publication, more specifically 'nature' and 'Science', collapsed.

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[228] Reich, Plastic Fantastic, p. 192.
[229] Reich, Plastic Fantastic, p. 192.
[230] Reich, Plastic Fantastic, p. 192.

Reverse The Spell

As the very first step evidence had to be gathered. Scientific misconduct, although not always clearly treated as such, would be a serious allegation, especially with someone so prominently featured in the public eye. It would also mean to publicly admit failure of the hailed self-corrective mechanisms such as peer review and publication. To attack Schön meant to attack Bell, co-authors, publishers and Konstanz.

It was Lydia Sohn, Paul McEuen and several others who first started gathering hard evidence against Schön. Contrary to the frustratingly clean image of Schön's data it had been noise that brought first clues to his misconduct. Lynn Loo was among the first to notice that several of Schön's data sets presented the same noise.[231] Contrary to the previous doubts, where the level of skill to catch Schön would have been immensely high, noise was an understandable piece of evidence. Noise made doubting Schön's work accessible. Whereas other professors had been unsuccessful in questioning Schön's claims, anybody with a few frustrating hours of experience trying to measure anything in a laboratory could understand two instances of inherently random noise being the same as something terribly wrong.

Re-Check

Lydia Sohn was one of the first to notice and point out duplicate figures in Schön's work.[232] Lynn Loo had noticed copied graphs for the output of inverters, definitive proof of copying data.[233] She went on to check her impression with Julia Hsu, who agreed the curves looked similar.[234] Although neither wanted to go forward at first, they did so through the initiative of Bob Willet, who moved the issue forward to John Rogers and thus the management position.[235] Within Bell Labs a network of communication, checking and comparison began to move, that had previously been paralysed.

[231] Reich, Plastic Fantastic, p. 191.
[232] Service, Physicist Fired for Falsified Data, Science, 25. September, 2002.
[233] Reich, Plastic Fantastic, p. 193.
[234] Reich, Plastic Fantastic, p. 193.
[235] Reich, Plastic Fantastic, p. 195.

Retell

Immediately after the report the story of Jan Hendrik Schön began to spread throughout the networks of publications and science communication. A very important feature of the early postings was the retelling of the rise of Jan Hendrik Schön. Most casual readers had probably heard something about his breakthrough, but forgotten the name. Tying the early reports to the legend of the rise allowed for a wider reach and impact.

One of the more prominent voices was former FDA commissioner and former president of Stanford University Donald Kennedy, who had become Editor-in-Chief of 'Science' magazine in 2000.[236] Lauding the committee's effort who had been handed a "monumental challenge" and "met it admirably", he states:[237]

> "That does not settle the matter. Public interest in the case is intense: The research was an international effort, [...]. The Work was published in a number of journals – including prominently, this one. [...] Science has a standing policy that all authors of a paper must agree to its retraction. Bell Laboratories is working with all coauthors to get such agreements for each challenged paper. If neither they nor we can secure them we will move promptly to give notice. Linked to the published papers, that the work has come under such serious question that it cannot be relied on."[238]

Kennedy appeared to be willing to take on some responsibility in the face of public interest and the prominent standing of the magazine he had been in charge of, even in case a consensual agreement to retract would not materialise. Continuing in his editorial Kennedy addressed the critique 'Science' magazine had to face:

> "We have been asked whether this sad incident has given us doubts about how well the peer review process at Science works. Unhappy experiences should generate efforts to learn from them, and we will use the report to evaluate what we might have done differently in these cases. That said, we would reiterate that it is asking too much of peer review to expect it to immunize us against clever fraud. In other respects, our faith in our quality-control process remains solid. Reporters have also told us that individual scientists have charged us with being too interested in "flashy" papers, and thus overeager to publish these. That is non-sense. We do want important papers of high quality, and our peer reviewers told us in no uncertain terms that these were both."[239]

Critique brought forward against 'Science' was based on a potentially faulty peer-review process, but also on an overeagerness, and overall interest in 'flashy' publications. Donald Kenedy dismisses these accusations against the magazine, but the overall tone of the discussion between the anonymised scientists and the magazine picked up on the danger of breakthrough narratives. He deflects the responsibility for the misconduct to Schön in calling his misconduct "clever fraud", which is – although framed as a compliment – an ad-hominem attack at Jan Hendrik Schön.

[236] Sullivan, Donald Kennedy, Standford's eight president dead at 88. Stanford news online.
[237] Kennedy, Next Steps in the Schön affair, p. 495.
[238] Kennedy, Next Steps in the Schön affair, p. 495.
[239] Kennedy, Next Steps in the Schön affair, p. 495.

Kennedy further states his dissatisfaction in the Beasley report's handling of co-author responsibility:

> "There's another critical question, and it's one the Beasley committee raised but left hanging, after questioning whether the coauthors exercised "appropriate professional responsibility" in ensuring the validity of the papers' claims. In dealing with authorship issues in other institutional roles, I have encountered vigorous arguments on both sides of this question. One claims that given the interdisciplinary nature of science and the coparticipation of people with various specialties in a project, each author cannot be expected to take responsibility for the validity of the results. Another asserts that because all coauthors receive professional credit for the entire product, all should share the consequences if it is invalid."[240]

At the time no coherent regulation on the responsibility of co-authorship was widely accepted. 'nature' magazine retracted all of Jan Hendrik Schön's papers. Five of which had been part of the Beasley report, two of which were not. Considering why the remaining two papers were retracted the article "Retraction's realities" in March 2003 gave insights:

> "These [two redacted papers] did not fall within the remit of the investigation — which, in order to be prompt, restricted its scope to just a subset of Schön's vast output — nor have they subsequently been found to be formally lacking. So why are they nevertheless being retracted? Given the wide-ranging nature of the committee's findings concerning Schön's research practices, all of the authors on these two non-investigated papers were invited by this journal to consider their position with regard to this work. Nature did not insist on retractions, yet the authors (with the exception of Schön) were no longer prepared to support the conclusions of these papers and decided that they too should be withdrawn. Whereas Schön remains insistent that his results should stand unless faced with hard evidence to the contrary (a frustrating position that he maintained throughout the investigation), his former colleagues and collaborators have now assumed in full their scientific responsibilities as co-authors on the papers in question."[241]

The discussion had thus evolved from a provable concept of misconduct along pieces of evidence, to a larger discussion of trust where the wish of Schön to only disregard papers faced with hard evidence was overruled in the argument of having lost trust altogether.

Report

The committee tasked with investigating Schön consisted of M. R. Beasley, S. Datta, H. Kogelnik, H. Kroemer and D. Monroe.[242] They were faced with the monumental challenge of scrutinizing a massive library of papers, all of which had been deceptive enough to be approved by several other structures tasked with checking data for accuracy. Bell Labs, up until this point had never had to conduct such an investigation in its 77-year history.[243]

Reporting the damage of Schön's extensive misconduct was the first important step in letting the rest of the network know just how extensive the damage was. The report was thus structured into seven main chapters and 8 appendices. The executive summary was intended to quickly communicate ideas established the massive, 129-page document.[244] 'Background' explained the

[240] Kennedy, Next Steps in the Schön affair, p. 495.
[241] Nature editorial, Retractions' realities p. 1.
[242] Beasley et al., Report, p. 2.
[243] Service, Winning Streak Brought Awe, and Then Doubt, Science, p. 34.
[244] Beasley et al., Report, p. 2.

initial concern and the position of Bell regarding Federal law.[245] 'Allegations' informed readers of how they were collected, and that they had to cut off the ever growing document after June 20, 2002.[246] 'Procedures' discussed the list of final allegations, questionnaires and interviews including a note, that all coauthors and management had the opportunity to review the report.[247] 'Findings' summarised the findings into 9 categories, all of which indicating Schön as mainly or solely responsible.[248] Their conclusions discussed scientific misconduct, responsibilities of co-authors, as well as the limited capabilities of the report to pass judgement, and how it is just the base upon which such considerations might be based.[249]

The 8 appendices further discussed the position of Bell Labs and the report. '´Charge to the Investigation Comitteee', declared its intentions, its principle of openness and its right to collect evidence in the name of Bell Labs.[250] 'Biographies' contained an overview of all committee members to lend them credit in their roles.[251] 'Federal Policy' was an appendix nearly directly copied from the federal register, so readers could immediately know upon which law they had based their decisions.[252] 'Allegations and Observations' was a brief overview of all instances reported until June 20, 2002.[253] 'Elaborated Final List of Allegations' went into close detail for all papers on the final list.[254] 'Papers in Question' summarised all allegations,[255] 'Questionnaires' presented the used questionnaires for co-authors[256], 'Responses of Authors to this Report' contained two letters by Batlogg and Schön.[257]

The report of this committee was in itself an extensive paper on how to properly conduct a research misconduct investigation, who should do it, why it should be done and how one should present its findings. It also reflected upon its limits and was well aware of its responsibility to spread this information rather than containing it.

[245] Beasley et al., Report, p. 4.
[246] Beasley et al., Report, p. 6.
[247] Beasley et al., Report, p. 8.
[248] Beasley et al., Report, p. 8-11.
[249] Beasley et al., Report, p. 18-19.
[250] Beasley et al., Report, p. A-1.
[251] Beasley et al., Report, p. B-1.
[252] Beasley et al., Report, p. C-1.
[253] Beasley et al., Report, p. D-1.
[254] Beasley et al., Report, p. E-5.
[255] Beasley et al., Report, p. F-1.
[256] Beasley et al., Report, p. G. 1-1.
[257] Beasley et al., Report, p. H. 1.

Remove

Jan Hendrik Schön was fired from Bell Labs the same week the report was published. Robert F. Service wrote the news article for 'Science' magazine reporting on his firing immediately afterwards.

> "Jan Hendrik Schön, a Bell Labs physicist whose papers promised to revolutionize the fields of organic electronics, superconductivity, and nanotechnology, fabricated data and falsified reports from 1998 through 2001, according to a report released today by a committee of independent investigators. Schön was fired from Bell Labs Tuesday night, shortly after officials there received the report. The findings mark this as one of the most extensive cases of scientific misconduct in modern history."[258]

The extent of Schön's misconduct, even though almost half of it was still unknown at that point was a historical precedent. His removal from the institution most likely happened in accordance with the U.S. Policy on Research misconduct cited in the Beasley report appendix C, subsection V 'Agency Administrative Actions', as such the usually private act of firing had to be made publicly accessible in the interest of restoring or repairing the research record. [259]

The reactions of the scientific community to the then very recent news of the report and the firing of Jan Hendrik Schön were full of mixed emotions:

> "Other physicists said they are pleased with the thoroughness of the report, but saddened by its conclusions. "It's just stunning," says Lydia Sohn, a Princeton University physicist who was one of the first people to point out duplicate figures. "But this shows that the system of checks and balances in science works." According to Bell Labs vice president for research Cherry Murray, Bell Labs is now working with all of the authors to see which of Schön's papers should be retracted. Regardless of the decision, says Los Alamos National Laboratory physicist Art Ramirez, few physicists will ever reference the papers again. Says Ramirez: "For me this basically invalidates the whole body of work.""[260]

Even though Lydia Sohn had been at the source of investigation from the beginning, her astonishment still rings through months after the investigation had started. Her idea of science as a self-correcting network of checks and balances was upheld. For Art Ramirez, the reset of progress caused by Schön extended to all papers involving him. This shows that even though the report was a regulated process of limited extent and ultimately some of the papers were still uncontested, the damage extended to legitimate science as well. In causing distrust towards valuable data tainted by a personal legacy.

[258] Service, Physicist Fired for Falsified Data, Science, 25. September, 2002.
[259] Beasley et al., Report, p. C-4.
[260] Service, Physicist Fired for Falsified Data, Science, 25. September, 2002.

Removed from the DFG

Back in Germany the "Deutsche Forschungsgemeinschaft» (DFG) who had funded part of his research reacted to the scandal. Abuse of DFG funds could lead to serious sanctions from a public warning to a demand for the return of grant funding.[261] Ultimately, they decided to formally revoke several of his rights and exclude him from the DFG with the statement explaining:

> "In its meeting on 14 October 2004, the Joint Committee of the [DFG] acted on allegations of scientific misconduct against physicist Jan Hendrik Schön. Schön, who had once held a post at the University of Konstanz and had been engaged in research for Bell Laboratories, New Jersey, USA, was deprived of his active right to vote in DFG elections and serve on DFG committees for an eight-year period. During this time, Schön will not be able to serve as a peer reviewer. In addition, Schön will not be able to apply for DFG funding over the next eight years. The Joint Committee also issued a reprimand against Jan Hendrik Schön. This decision was communicated to Schön, to the vice chancellor of the University of Konstanz as well as to the Minister of Science of Baden-Württemberg. By taking this course of action, the Joint Committee followed a recommendation of the Committee of Inquiry on Allegations of Scientific Misconduct, which, after thorough investigation, reached the conclusion that Jan Hendrik Schön had based two publications on fabricated and manipulated information. According to the Joint Committee, another aspect of Schön's scientific misconduct was the inappropriate storage and documentation of primary data. The sanctions imposed are in line with his severe breach of rules pertaining to good scientific practice. From August 1998 to January 2000, Jan Hendrik Schön received a postdoctoral DFG fellowship. During the term of the fellowship and up until September 2002, Jan Hendrik Schön worked as a researcher for Bell Laboratories. The DFG's investigation concentrated on the publications "Ambipolar Pentacene FieldEffect Transistors and Inverters", Science 287, 1022 (2000), J.H. Schön, S. Berg, Ch. Kloc and B. Batlogg, and "Electrical Properties of Single Crystals of Rigid Rodlike Conjugated Molecules", Physical Review B 58, 12952 (1998), J. H. Schön, Ch. Kloc, R. A. Laudise and B. Batlogg, which are specified in the final report."[262]

With this statement Schön had officially been removed from several functions within the scientific community in Germany. The two papers were seen as under the DFG jurisdiction as he had received funds during that time. His handling of primary data and his misconduct were two key components of this decision. Interestingly the DFG did not permanently ban him from participation, but only for 8 years, a long, but somewhat reasonable gap for a scientist as young as Schön.

[261] Abbott, Rising star crashes back to Earth, p. 421.
[262] Stellungnahme der DFG Jan Hendrik Schön 2004.

Revoking Schön's Degree

In 2004 the university of Konstanz had decided to revoke his title. He in return took legal action and appealed the decision, which is why in the following court documents he appears as the plaintiff (Kläger) and the university of Konstanz appears as defendant (Beklagte). The case had moved through several instances, the "Verwaltungsgericht Freiburg", had initially even decided in his favour.[263] The primary discussion was that of 'worthy' behaviour, which had a complicated legal legacy in Germany. The legal basis for the revoked degree was §35 (7) of the "Landeshochschulgesetz" for Baden-Württemberg, which is noted as:

> "§35 (7) Der von einer baden-württembergischen Hochschule verliehene Hochschulgrad kann unbeschadet der §§ 48 [Regulating professorships] und 49 [Pertaining the permanent position of Professors] LVwVfG entzogen werden, wenn sich der Inhaber durch sein späteres Verhalten der Führung des Grades als unwürdig erwiesen hat. Über die Entziehung entscheidet die Hochschule, die den Grad verliehen hat."[264]

This put the authority of judging unworthy behaviour and revoking the degree within the power of the university which had given the degree in the first place. The Bundesverwaltungsgericht restated several reasons for why a title might be revoked in the highest ruling on the case:

> "Entsprechend einem von dem Promotionsausschuss Physik der Beklagten gefassten Beschluss entzog dessen Vorsitzender dem Kläger mit Bescheid vom 4. Juni 2004 unter Berufung auf § 55c Abs. 1 UG BW a.F. den verliehenen akademischen Grad eines Doktors der Naturwissenschaften, weil sich der Kläger im Sinne der Vorschrift durch sein späteres Verhalten der Führung des Grades als unwürdig erwiesen habe. Der Begriff der Unwürdigkeit sei wissenschaftsbezogen zu verstehen. Der Ausschuss sei auf Grund einer eigenen Würdigung des B.-Reports zu der Auffassung gelangt, dass ein wissenschaftliches Fehlverhalten des Klägers in Gestalt der Datenmanipulation, der Präsentation von Daten in falschem Zusammenhang und der künstlichen Erzeugung von Daten in einem in der deutschen Wissenschaftsgeschichte bisher beispiellosen Ausmaß nachgewiesen sei. Das Interesse der Beklagten, eine Person, die wissenschaftliches Fehlverhalten in einem derart erheblichen Umfang zu verantworten habe, nach außen sichtbar aus dem Kreis derjenigen auszuschließen, die durch den Doktorgrad die Zugehörigkeit zur qualifizierten wissenschaftlichen Forschung dokumentierten, überwiege das persönliche Interesse des Klägers, durch die Führung des Titels seine erfolgreiche Promotion zu belegen und seine beruflichen Chancen zu verbessern."[265]

According to the judge Schön had proven himself "unworthy" of the title in a scientific sense. The extent of manipulation also overshadowed any previous instances of German history of science. The last sentence of the paragraph weighed the interests of the university to exclude someone who had shown such a high degree of scientific misconduct against Schön's personal interest to use the degree for better career chances. This also showed an awareness of how a degree might be perceived and why one might abuse it in the first place.

[263] Brendler, Umstrittener Physiker darf Doktortitel behalten, Badische Zeitung 27. September 2010.
[264] Gesetz über die Hochschulen in Baden-Württemberg, §35, p. 76.
[265] BVerwG, Urteil vom 31.07.2013 - 6 C 9.12 – p. 3.

Even more important for the German legal context was the proof, that during his time as post-doc and receiving DFG funding Schön had also worked improperly:

> "[Quoting the issues raised in the DFG's decision to remove him] Die Voraussetzungen für den Entzug des Doktorgrades nach dem zwischenzeitlich an die Stelle des § 55c Abs. 1 UG BW a.F. getretenen, wortgleichen § 35 Abs. 7 LHG BW lägen vor. Der Kläger habe über einen längeren Zeitraum und in erheblichem Umfang wissenschaftliches Fehlverhalten an den Tag gelegt und dadurch seine Kernpflichten als Wissenschaftler massiv verletzt."[266]

Thus, he had hurt the core duties as of a scientist over a longer period and in many instances. The court also saw the removal of the degree as a justified and appropriate reaction to the overall misconduct of Jan Hendrik Schön, stating:

> «Insbesondere stehe die Entziehung des Doktorgrades in Ansehung der Gesamtumstände in einem angemessenen Verhältnis zur Schwere des Eingriffs.»[267]

Overall, the verdict of the legal process was clear:

> "Die wissenschaftsbezogene Auslegung einer landeshochschulrechtlichen Vorschrift, nach der ein Doktorgrad entzogen werden kann, wenn sich der Inhaber durch sein späteres Verhalten der Führung des Grades als unwürdig erwiesen hat, genügt - anders als ein auf die Enttäuschung nicht hinreichend fassbarer gesellschaftlicher Vorstellungen über den Doktorgrad bzw. dessen Träger abstellendes Verständnis - dem rechtsstaatlichen Gebot der hinreichenden gesetzlichen Bestimmtheit und verletzt darüber hinaus keines der durch das Grundgesetz gewährleisteten Grundrechte."[268]

The scientific definition of the terms in use was enough to revoke the degree and does not need to consider a public understanding of what a scientist was supposed to do, thus separating and clarifying the authority of the university over its scientists, no matter if Schön had been understood as more than that by the public.

The discussion of the term "unwürdigkeit", especially given Germany's history led to uncomfortable associations.

> "Der Begriff "Unwürdigkeit" im Landeshochschulgesetz ist nicht unumstritten, denn die Formulierung geht auf die Nazizeit zurück. Die Nazis entzogen damit Juden und auch anderen "unerwünschten" Akademikern die Doktorwürde. In der jüngeren Vergangenheit wurde zum Beispiel Schwerverbrechern mit diesem Passus der Doktortitel entzogen. Was aber "unwürdig" ist, lag im Belieben des Gerichts."[269]

The brutal history of the formulation 'unworthiness' in the law applied to Schön was an issue that had to be discussed, but which was ultimately separated out by the judges who reduced the charges to be only within the network and the duties of Schön.

[266] BVerwG, Urteil vom 31.07.2013 - 6 C 9.12 – p. 4.
[267] BVerwG, Urteil vom 31.07.2013 - 6 C 9.12 – p. 5.
[268] BVerwG, Urteil vom 31.07.2013 - 6 C 9.12 – p. 24.
[269] Löhr Doktortitel entzogen, TAZ 16. September 2011.

As previously mentioned Schön remained adamant, that his misconduct was primarily rooted in mistakes. The German court clearly opposed this interpretation in the final verdict on the matter of removing Schön's degree:

> "Ein Titelinhaber erweise sich deshalb dann als unwürdig im Sinne des § 35 Abs. 7 Satz 1 LHG BW, wenn sich der mit der Verleihung des Doktorgrades begründete Anschein wissenschaftskonformen Arbeitens angesichts gravierender Verstöße gegen die Grundsätze guter wissenschaftlicher Praxis und Redlichkeit - insbesondere in Form der Fälschung von Forschungsergebnissen - als unzutreffend herausstelle und zum Schutz vor Irreführung korrigiert werden müsse. Demgemäß sehe auch § 3 Abs. 5 Satz 3 LHG BW vorsätzliche oder grob fahrlässige Falschangaben in wissenschaftserheblichem Zusammenhang als beispielhaft für einen Verstoß gegen die allgemein anerkannten Grundsätze guter wissenschaftlicher Praxis an."[270]

This passage also mentioned his extensive and repeated misconduct. According to the court his title had to be revoked "Irreführung", misleading others, thus implying that they understood the title as a function of approval that could be abused to gain trust in a scientific network.

Repair

Of 101 papers between 1994 and 2002 partially or fully written by Jan Hendrik Schön 33 were retracted, whereas several non-retracted papers are still regarded with suspicion.[271] As with any misinformation, the correction rarely reaches 100% of the misinformed audience. Especially since the communication about it and discipline vary between fields, level of controversy and overall perceived importance of the retraction. "Reducing the Inadvertent Spread of Retracted Science: recommendations from the RISRS report" a 2022 study by Jodi Schneider, Nathan D. Woods, Randi Proescholdt and the RISRS team states the main goals of retraction as: "alerting readers to unreliable material, cleaning up the literature, correcting the literature, amending the literature".[272] The study also alerts to a cascading effect in what the authors call a "second generation of polluted science" meaning papers citing papers that cite an originally retracted paper.[273] They exemplify this effect by tracing 33 retracted papers – about the size of Schön's library of retractions – in 2020, which had been cited 236 times in the first and 834 times in the second generation.[274] Another team tracked 46 Covid-19 related retractions in 2020 and could find more than half of them without a mention of retraction on various websites 8 months later.[275] Discipline in mentioning retraction in citations appeared to be very low in some cases

[270] BVerwG, Urteil vom 31.07.2013 - 6 C 9.12 -p. 10.
[271] Overview in the Appendix, Note: Luwel et al. only counted 30 retractions, an overview of the case is notoriously difficult, so even 33 might not be the final number as of today.
[272] Schneider et al. Reducing the Inadvertent Spread of Retracted Science, p. 2.
[273] Schneider et al. Reducing the Inadvertent Spread of Retracted Science, p. 3.
[274] Schneider et al. Reducing the Inadvertent Spread of Retracted Science, p. 3.
[275] Schneider et al. Reducing the Inadvertent Spread of Retracted Science, p. 3.

with only 5.4% of citations acknowledging the retraction in a data set of 13'252 post retraction citations studied by Tzu-Kun Hsiao and Jodi Schneider in 2022.[276] The issue of traceability of papers in private libraries aggravates the spread of misinformation with 75% of the traced retractions being available in Mendeley without comments. [277]

Citations of Jan Hendrik Schön's papers have been traced by Marc Luwel, Nees Jan van Eck and Thed N. van Leeuwen in 2018 in their contribution to the conference "Science, Technology and Innovation indicators in transition" in Leiden. Although the team only looked at primary citations and did not include the secondary generation of possibly polluted papers, they still found a citation activity of about 50 annual citations between 2004 and 2016.[278] In the case of Jan Hendrik Schön the retraction mechanisms appear to have worked, partially because of the short period of his activity and the prominence of the scandal. After the initial wave caused by the Beasley report, further retractions followed as Robert F. Service summarised the situation for 'Science' in early 2003:

> "In 2001 Jan Hendrik Schön, the former physics prodigy at Bell Laboratories in Murray Hill, New Jersey, cranked out papers at the astounding average rate of one every 8 days. Now, in the wake of a 25. September Bell Labs report that concluded Schön had committed widespread misconduct [...], the retractions are coming almost as fast. In November, Science published retractions of eight papers by Schön and colleagues. Nature posted linked warnings to its electronic versions of Schön's papers and said it would soon issue retractions in print. In the last round of backpedalling officials at the American Physical Society (APS) and the American Institute of Physics (AIP) announced last month that they were issuing retractions for 12 papers Schön and co-authors had published in their journals."[279]

One important part of the overall retraction process was the meta-communication of it in articles such as this one to raise awareness of the ongoing retraction process. To further enhance awareness of the person in question, memorable items were part of this and many other introductions. In 2003, tales of Jan Hendrik Schön began by mentioning the astounding pace at which he had written the papers, and his status as former physics prodigy, but now the tone had changed into critique of the misconduct. Mentioning the breakthrough narrative in corrective measures like this was and still is important for several reasons. One is to reach a further audience, that might not immediately recall Schön's name or papers, but might remember a tale of a groundbreaking German physicist, that needs correcting. Another is to dismantle the mythical aspects of his tale in scientific reporting, that was not technically scrutinised as part of investigations about scientific misconduct. In other words, the mythical star figure Jan Hendrik Schön had to be dismantled by the kind of reporting, that had put him

[276] Hsiao / Schneider, Continued use of retracted papers p. 1162.
[277] Schneider et al. Reducing the Inadvertent Spread of Retracted Science, p. 3.
[278] Luwel et al. The Schön case, p. 1026.
[279] Service, More of Bell Labs Physicist's Papers Retracted, p. 31.

on the pedestal mere years before. As such, critique of his qualities beyond his immediate data fabrication such as his publication rate were part of the corrective process. A third reason to mention the publishing rate so prominently is the warning aspect of the sheer quantity of papers in question. The 'American Physical Society' further planned to post notices alerting readers of two controversial papers, that were not retracted but written or co-written by Schön as well as further review any paper that Schön co-authored since 1998, not only those in affiliation with Bell Labs.[280] Warnings in the form of errata were added to print publications by APS, and their online publications would be amended with a red notice saying "retraction" and a link to the official retraction.[281]

Shortly before, on 20. Dec. 2002, Robert F. Service wrote about the Schön case. His title for the article "More Scarlet Letters for Schön: Six more papers by the former Bell Labs physicist to be retracted", picked up on the theme of stigmatisation. Just as he would do later, this text featured memorable items in its introduction:

> "In 2001 Jan Hendrik Schön, the former physics prodigy at Bell Labs, wrote papers at the astounding rate of one an average of every 8 days. Now in the wake of a 25 September Bell Labs report that concluded Schön had committed widespread misconduct, the retractions are coming almost as fast. Today, officials at the American Physical Society (APS) announced that they were posting retractions of two papers online today, with more to follow early next week." [282]

The way APS chose to retract his work was aimed at an immediate and widely received correction on the internet. Service continues with a warning about the initial report being incomplete:

> "According to Martin Blume, editor-in-chief of APS's journals, all authors on the two papers being pulled today agreed to the retractions. Those papers, Blume explains, were red-flagged by the Bell Labs committee as likely containing "substituted data," a clear case of scientific misconduct. APS also plans to post retractions for four additional papers that were not reviewed by the committee. In this case, all the authors except Schön have agreed to the retractions. Blume adds that APS also plans to post notices for two other papers that are not being retracted. These will alert readers to the controversy, but add that the authors continue to stand behind the papers: In one of those papers Schön is the only author." [283]

Schön has appeared as the accepting recipient of the primary report, but in this case, he did not share the intention of retracting, which left the co-authors with the responsibility of retracting his work. The warning of Schön's unreliable approach to science was extended to non-retracted papers. One of which he was the only author of. In this case the controversy of his overall misconduct tainted papers, that technically were not contestable as misconduct.

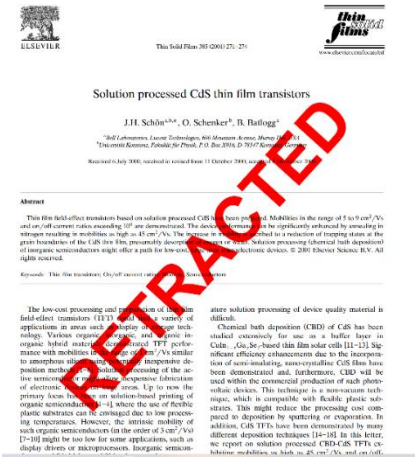
[280] Service, More of Bell Labs Physicist's Papers Retracted, p. 31.
[281] Service, More of Bell Labs Physicist's Papers Retracted, p. 31.
[282] Service, Robert F: More Scarlet Letters for Schön, Science 20. Dec. 2002.
[283] Service, Robert F: More Scarlet Letters for Schön, Science 20. Dec. 2002.

The question arose whether one should remove the tainted papers, or whether they should stay as a warning.

> "Blume says APS editors felt it was important that all of the papers that included Schön as a co-author since 1998 be dealt with, and not just those flagged by the Bell Labs report. "Given the notoriety of this case, we felt that people ought to know the status of all of the articles," Blume says. Instead of taking the retracted papers off the journal's Web sites, the journals instead will link retractions to the online papers and publish errata in the paper copy journals. "We do not want to tamper with the archive of published papers," says Blume. "It will say in red 'retraction.' It's like a scarlet letter."[284]

According to Blume even badly performed science should be kept in the record who clearly advocated for a correction, rather than a removal. The choice of words "scarlet letter", was, most likely, in reference to Nathaniel Hawthorne's "The Scarlet Letter", a story of strong stigmatisation of a daughter born out of wedlock.[285] Although its use as a stigma for scientific misconduct, as well as stigmatisation of misconduct in general are rare[286], the intention behind this choice of words was clearly a reference to strong stigma.

The magazine 'Thin Solid Films', by the Elsevier group, took the "scarlet letters" to an entirely new level. Where 'Science' has added retraction notices online, 'Thin Solid Films' edited the PDFs of all involved papers to clearly show "RETRACTED" in bold red letters across the entire page. In this case the stigma of the scarlet letter became a visual aid to quickly differentiate valid papers from retracted ones. To the scientific network it was now perceived as more useful to acknowledge the misconduct and make it visible than to hide it as it had been the case in the previous decades. It appears, that 'Thin Solid Films' has since kept up the practice of marking retracted papers in such manner, such as the retraction of "Current conduction mechanisms" by Hou-Yen Tsao and Yu-Wu Wang in 2016 and others. However, further retracted papers in the Archive before the Schön scandal appear without red lettering. It remains unclear if Schön was indeed the first to cause such a visual reaction, as there was no official statement. The library practice might suggest this, but ultimately appears inconclusive given the small data set of only nine retracted papers for the years 1998, 1999, 2000, and 2001, all of which do not show red lettering.[287]



[284] Service, Robert F: More Scarlet Letters for Schön, Science 20. Dec. 2002.
[285] Xu, Research Retraction Due to Misconduct Should be Stigmatized, p. 1.
[286] Xu, Research Retraction Due to Misconduct Should be Stigmatized, p. 2.
[287] Comparison of all available papers by the author of this thesis.

Remember

The Schön affair left a quite strong impression on the perception of him as an individual scientist as well as his co-authors. On the other hand, a trend emerged in reports of scientific progress that removed Schön's misconduct as a concept from the papers that were actually inflicted. Derek Lowe, an author for 'Science' magazine, primarily focussed on news about the wider scientific community, has used the figure of Jan Hendrik Schön in several reports of fraud. In November 2011 he wrote "Faking Two Papers A Month. For Seven Years" which reacted to the scientific misconduct of social psychologist Diederik Stapel. Stapel had made up data and manipulated students as well as colleagues.[288] Using Schön as an example Lowe, just as Goodstein had in 2002[289] pondered the question of which fields were more susceptible to misconduct and fraud:

> "Well, he [Stapel] did have skill and creativity - I mean, we're talking about someone who's published over 150 papers in the last seven years. And that means that he wasn't lazy, either, because keeping that many balls in the air is no small job. No, what we have here is an industrious, committed, fraud with a real talent for his chosen line of work: fakery. I'd like to think that it's somewhat easier to get away with this (for this long) in a social science field, but then, there's Jan-Hendrik Schön [link to Schön Scandal on Wikipedia] to think about. So, I'm not sure that my high ground is all that high."[290]

Defining Stapel as skilled, creative and not lazy differentiated Lowe's perception from the still underlying suspicion of personal deviance in cases of scientific misconduct. Almost a decade later scientifically inclined authors such as Lowe were still discussing how shaken their perception of a supposedly impenetrable high ground of physics had been by Schön's misconduct. In this instance Schön, as an affair or scandal became a warning sign for misconduct in general, rather than specifically for physics.

More recently in August 2018 Derek Lowe wrote an article for 'Science' magazine about unreliable, and probably copied and falsified results in super conductivity titled "A Room Temperature Superconductor? Well…". He describes perfectly matching noise patterns over a series of measurements, which is not possible.[291] This very issue was present in several of Schön's papers.[292] Lowe vigorously criticised the 2018 publication by Kumar et al.:

> " This isn't possible. Noise is noise, and it's different every time you take a series of measurements. As Skinner delicately puts it, this behavior "has no obvious theoretical explanation", but by gosh it has a very obvious practical one that is immediately obvious to even a casual observer. That is, someone copy-pasted one of the lines, changed the color of the points, and offset the new line a bit. If there were doubts about the validity of this report before this, they shrink into nothing compared to the doubts that people have now. Think about it: if you were about to report a world-changing result like a room-temperature superconductor, wouldn't you want to make sure that everything about the paper was solid? Go over it a

[288] Lowe, Faking Two Papers A Month, Science, 2. November 2011, online.
[289] Goodstein, In the matter of J Hendrik Schön, November 2002.
[290] Lowe, Faking Two Papers A Month, Science, 2. November 2011, online.
[291] Lowe, A Room Temperature Superconductor? Well…, Science, 13. August 2018, online.
[292] Beasley et al., Report, p. E-5 – E-6.

> time or two? Make sure that a key figure didn't include an obvious copy/paste that would call into question the veracity of the whole damn thing? The name "Jan Hendrik Schön" [linking to the Schön Scandal Wikipedia page] comes to mind, and that's not something anyone wants to hear."[293]

The wording of the article is written in a warning tone not to be associated with Schön, who appears not as person, but a coded call-back to a group of informed individuals and a warning to those unaware. His name has been clearly associated with scientific misconduct, to a point where even in 2018 an author could just drop it to a scientifically literate community for them to know what the author implied. For those unaware of the Schön scandal – it has been quite a few years in between after all – Lowe went the extra step to link the Wikipedia article to inform readers of his intention in using the name in both instances. His name carried symbolic meaning beyond the immediately implicated crisis.

Two instances of this symbolic meaning becoming part of the cultural practice within the physics community were recorded, but many more are probably happening in non-written interactions.

In 2019 Pablo-Jarillo Herrero was to present his new findings in graphene superconductivity. He, just as Schön is sometimes referred to as being close to a rock star and having found 'a magic angle'.[294] When presenting his findings in Los Angeles, conference delegates teased him by likening him to Schön in saying: "the last time someone had presented something so cool, it was Jan Hendrik Schön."[295]. Although clearly identified as a joke, Schön had become remembered for his conferences, his coolness, and for his undoing, to be used as a reminder for new and rising physicists. Remembering Schön had become a memorial figure for vigilance in the face of breakthroughs.

In a third article titled "Superconductor Chaos" in July 2023 Derek Lowe summarised the chaotic nature of currently ongoing research into superconductors. This time it wasn't Lowe, but a user named Daen de Leon, who commented "This has definite echoes of the Schön Affair…" to which Lowe responded "It does, unfortunately […]."[296] Over the last two decades the words "Schön affair" had become a reference to the scandal and its echo instead of the person at its centre.

[293] Lowe, A Room Temperature Superconductor? Well…, Science, 13. August 2018, online.
[294] Gibney, Superconductivity with a twist, p. 15.
[295] Gibney, Superconductivity with a twist, p. 16.
[296] Lowe, Superconductor Chaos, Science, 05. July 2023, online.

Reflect

"Debate Still smolders [sic.] about whether the scandal reflected the success of science's self-correction or the failure of its institutions."[297]

- Dan Garisto, APS News, September 2022.

Dan Garisto looked back upon the debate of the self-corrective mechanisms within science in a piece written for Advanced Physics Society 20 years after the release of the report. His choice of words, even 20 years later, was one of devastation and about as charged as the initial wording used to present Schön as the new star of science. The phrases like "still smoldering"[298] and "fallout"[299], Garisto used, were in continuation to the first reactions to Schön, in which people first reflected upon the immediate damage with a nuclear undertone.

Twenty years earlier, in the first weeks of the scandal unfolding, David Goodstein's reaction to the release of the Beasley report tied Schön to one of the strongest debates of ethics and sin in physics in his opening statement:

> "The physicists have known sin," J Robert Oppenheimer is famously said to have remarked on the occasion of the first nuclear explosion. Sin in the form of faking scientific data seemed to be restricted to biology and related sciences, not physics. I used to think I understood why."[300]

By immediately tying Schön's sins to Oppenheimer's, Goodstein also connected the two instances in scale and meaning for the world of physics. David Goodstein, then still in his role of vice-provost[301] and professor of physics, used Schön as an opportunity to reflect his own bias in understanding physics as immune to misconduct. For the future Goodstein saw potential in scientific misconduct as an accusation being handled in a sensible way without getting scientists worried of being accused thereof.[302] He also added a warning against complacency, differentiating science from other belief systems:

> "In this case, the system worked. Science is self-correcting, as it is supposed to be. But we must not be complacent. If this kind of misconduct were to become commonplace, science would cease to be self-correcting and would be no better than any other belief system. Rooting out scientific misconduct in a sensible way will always be a grave responsibility for all of us."[303]

For Goodstein the difference is in the self-corrective measures within science, that keep it in its current position and bound to the truth.

The Schön scandal had not only rattled the field of physics, but the very ethics of proper scientific conduct. The silver lining Kennedy had hoped for appeared in the adoption of new

[297] Garisto, Schön Scandal Report is Released, APS News Online.
[298] Garisto, Schön Scandal Report is Released, APS News Online.
[299] Garisto, Schön Scandal Report is Released, APS News Online.
[300] Goodstein, In the matter of J Hendrik Schön, November 2002.
[301] Goodstein, In the matter of J Hendrik Schön, November 2002.
[302] Goodstein, In the matter of J Hendrik Schön, November 2002.
[303] Goodstein, In the matter of J Hendrik Schön, November 2002.

codes within the field and reactions in teaching. The American Physical Society immediately amended their guidelines for professional conduct based on the Beasley report.[304] The new guidelines were then adopted on November 10th 2002, less than two months after the report had come out and even before additional papers were retracted in the second wave.[305]

The urge to change something within the immediate aftermath spread along Schön's networks. Seemingly far away from the epicentre the ETH set up a working group to formulate new guidelines for research carried out at the ETH in 2003 in a direct response to the Schön-scandal, which were ratified by 1. May 2004.[306] This was partially motivated by Schön's co-author Christian Batlogg moving to the ETH where suspicion remained even as he was cleared by the investigative report.[307] This new code was disseminated throughout the institution. Every researcher at the ETH was given a copy of "The Research Culture at ETH Zurich" and the brochure "On being a scientist".[308] Although the latter had been in print since its first edition in 1995, the newer editions all include the warning tale of Schön's misconduct.[309] Its distribution on the ETH campus appeared to have been a remarkable shift in teaching ethics and awareness.

Immediately after the news of Schön broke the president of the APS Myriam Sarachik stated her belief in self-correcting science, but also admitted that the APS might have to develop programmes to teach graduate students good laboratory practice.[310]

In 2004 the APS too formed a task force on Ethics Education, citing "several high-profile ethics violations among physicists" as their primary reason to do so.[311] Those high-profile cases are most likely Jan Hendrik Schön and Victor Ninov. In an effort to educate future students on the ethics of science the APS task force released the "Ethics Case Studies" a discussion guide for courses and seminars on ethics education. The guide is publicly accessible and a shared, open resource for higher education on the matter of ethics in science. Schön's legacy is mentioned twice. Once it is referenced in the section "Supplementary Guidelines on Responsibilities of Coauthors and Collaborators", as the students are confronted with the official guidelines.[312] The other time Schön is represented as an example for students to work on as an early assignment in the course regarding the importance of whistle blowing.

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[304] APS Policy statements, APS Online.
[305] APS Policy statements, APS Online.
[306] Meier, Research off the rails, ETH Life online.
[307] Meier, Research off the rails, ETH Life online.
[308] Meier, Research off the rails, ETH Life online.
[309] National Academy of Science, On being a Scientist, p. 16.
[310] Abbott, Rising star crashes back down to Earth, p. 421.
[311] Doss, APS Physics, Ethics Case Studies Teacher Edition, p. 1.
[312] Doss, APS Physics, Ethics Case Studies Teacher Edition, p. 68.

The task for students starts out in a fictional setting where a student encounters troubles, as she first suspects her supervisor of manipulating data and then finds evidence thereof. [313]

The students are invited to discuss this fictional case and present what they would do and who they could ask for help, followed by the assignments specifically working with Schön's legacy:

> "1. Have a class discussion on students' responses before presenting the discussion below, which is also included in the student text.
> 2. Inform the class who the designated misconduct officer is at your institution, if that is their title or if another title is used, the location of their office, and phone number or email.
> 3. Consider assigning students to research and report on the ethical misconduct of Jan Hendrick [sic.] Schön, who formerly worked at Bell Labs, and the consequences that followed.
> 4. Check your school's web site for guidelines about whistle blowing."[314]

Schön's legacy has been transformed into a teaching assignment with the goal of teaching future students in their perception of ethics in science and their ability to stop such misconduct early. The discussion of ethics along the Schön affair had taught the scientific community a lot, and in repeating this discussion on a smaller scale more could be taught to its future participants.

In a 2011 debate in the Bundestag, Dr. Frank-Walter Steinmeier and the SPD, the Social Democratic Party, pushed for the German government to take more responsibility for the reputation of Germany as a part of the scientific community.[315] Schön and two others had caused discussions and according to the SPD necessitated a stronger reflection of how misconduct is handled in Germany and how Universities might handle the revoking of titles without facing criticism for having promoted that person before.[316] The SPD put in the motion to review the criteria of scientific misconduct and even to aim for an international consent within the European Union.[317] Although strongly diluted over time, the silver lining of the Schön affair had reached the international discussion in reactions to it, just as it first had in its promises.

[313] Doss, APS Physics, Ethics Case Studies Teacher Edition, p. 17.
[314] Doss, APS Physics, Ethics Case Studies Teacher Edition, p. 17.
[315] Deutscher Bundestag, Drucksache 17/5758, p. 1.
[316] Deutscher Bundestag, Drucksache 17/5758, p. 2.
[317] Deutscher Bundestag, Drucksache 17/5758, p. 4-5.

Celebrate?

Working with the media-phenomenon that was the scandal around Jan Hendrik Schön one inevitably stumbles upon the – and there is no way of putting it more gently – rather curious piece of media that is the BBC documentary "The Dark Secret of Hendrik Schön". Originally this documentary for the format "Horizon" aired for the first time on Feb. 5th 2004.[318]The documentary presents itself as a mixture of telling the story of Jan Hendrik Schön and fear-mongering in regards to future technologies. Even though many of the sci-fi heavy parts of the documentary definitely appear vastly different to the usual sources on Schön, the account of his story can be considered historically accurate. Science-fiction such as this one has its place in communicating science and surrounding expectations. As mentioned above, it too shapes the public perception of where science is, should be, or in this case should not be, headed.

Given the popularity of the series and some of its interviewees, it can be assumed, that many within the British public learnt about Schön in this unique environment. The series, as it operates far away from scientific fact is probably best characterised as dystopian science-fiction, rather than a documentary. However, it also prominently features interviews with co-workers of Schön and thus very closely represents the in-group of the scientific network in question. It also features interviews with several experts, who are introduced with their full academic title and function lending them credibility, thus utilising common structures of producing scientific respectability.

When the documentary first aired Horizon had already come under heavy scrutiny for its decreasing scientific accuracy and questionable reporting during its over four decades on British TV, but especially so during the early 2000s, when it was called out for "cult-like" tendencies.[319] As many other documentaries, "The Dark Secret of Hendrik Schön" was moderately spread throughout the internet with one copy on YouTube having over 17'000[320] views between 2015 and 2024 on a private channel and another (partial upload) having over 12'000 views on "Science Channel"[321]

The documentary features popular science communicator Michio Kaku who, to fans of futurism and documentaries featuring technology, is a household name. In sections more focussed on Schön, interviews with former co-workers, as well as Paul McEuen and Lydia Sohn, who had discovered and reported his misconduct, lend the narrative credibility. It starts

[318] IMDb: The Dark Secret of Hendrik Schön.
[319] Orlowski, BBC abandons science, The Register, 27. Oct 2006.
[320] Horizon, view count, 17’556 as of 27.05.2024.
[321] Section on Moore’s law in The Dark Secret of Hendrik Schön on Science Channel, Viewcount 12’504 as of 27.05.2024.

with the hyperbolic statement, that Jan Hendrik Schön could have "created an extraordinary new world".[322] Immediately after the intro-music and the "Horizon" logo, the documentary shifts drastically in tone with thunderclouds, foreboding music and the voiceover stating "Our day of reckoning has come and gone" while scenes of fictional "London 2098"[323] are shown. The supposed apocalypse in the fictional future is explained by the prominence of nano-technology. The "grey goo" hypothesis – the nanotech equivalent of the "China syndrome" for nuclear accidents – was widely received and strongly discussed at the time. "Grey goo" was feared to be the end all, be all after nanobots had taken over the planet.[324] The fear of nanotechnology, partially due to its potential and due to its strong connotation of controlling fundamental building blocks of nature was publicly discussed as it too raised ethical concerns. It was in no relation to the progress made in the laboratories.[325] However, pieces of media such as this BBC documentary spread the fearful discussion of frightening nano-bots to its audience. Interview sections with Dr. John Alexander and Ray Kurzweil of Kurzweil technologies go into detail of the invisibility and group intelligence of such machines, two essential factors involved in nearly all discussions of fearing nano-bots.[326] The documentary features several other statements by authority figures lending credibility to the "grey-goo" fear, such as Prince Charles.[327] He had indeed tasked the Royal Society with discussing the environmental and social risks of nano-technology out of fear over the environment being destroyed by such an apocalypse.[328] Since the British Royal Family is highly reported on and any statement made by a member spread far and wide across the media landscape, this suggests a wide reception of the topic at the time.

Jan Hendrik Schön is mentioned in two functions. For one he – according to the narrator Jack Fortune – had the potential of bringing the world close to a point where the dystopic fiction of "grey goo" would become actual science.[329] Upon this statement Schön is introduced with a montage featuring ecstatic music and strong statements such as "Hendrik Schön was one of the greatest minds the world of physics had seen for years"[330], and Prof. Lydia Sohn of the university of Berkeley likening him to "David Beckham in Soccer [...] some major rock

[322] Horizon, time 0:22.
[323] Horizon, time 1:15.
[324] Sample, Should we be scared, Guardian, 6. Nov. 2003.
[325] Sample, Should we be scared, Guardian, 6. Nov. 2003.
[326] Horizon, time 2:00-2:25.
[327] Horizon, time 3:52.
[328] Radford, Brave new world or miniature menace? Guardian, 29.04.2003.
[329] Horizon, Time: 04:15.
[330] Horizon, Time: 04:33.

star"[331], followed by the statement "He could actually go by his first name 'Hendrik'[sic.] and we would all know who he was"[332]. According to Reich he at times was referred to as "Hendrik" within the laboratory.[333] This suggests a strong familiarity within the core group, as they internally deviate from the more conventional name. This section of the documentary recalls the hype and breakthrough promises by the wider audience. The likening of him to an athlete or rock-star by a professor at a famous university further heightens the anticipation of his rise to fame. Lydia Sohn, as previously mentioned, was essential to the discovery of fabricated data and finding evidence of fraud.[334] So her statement is one from someone within the core group and familiar with Schön's work and the following investigation.

Jack Fortune's voiceover narration continues to recall Schön's remarkable career by mentioning the age, as well as breakthroughs in lasers and superconductors.[335] Former co-workers Prof. Paul McEuen and Prof. Jeremy Baumberg are also introduced with statements about unbelievably accurate work done by Schön.[336] Prof. Baumberg goes as far as stating "This was a new level of science, that you had to match yourself up against. Everybody knew they couldn't meet that. It was like competing against a god"[337] Baumberg's statement is then picked up by Fortune's narration explaining Schön's placement at Bell laboratories as "This scientific god accepted a permanent position at one of the world's greatest research facilities"[338].

Re-telling Schön's remarkable career in such heavily loaded terms and 'god-like' abilities by his former co-workers, although heavily biased by the overall narrative structure of science-fiction, reflects on the internal connections in the in-group around Schön. It also picks up the theme of charismatic institutions as Bell laboratories are introduced as the world's greatest research facilities. Even beyond the fame of Bell Laboratories, the approval of Schön through recognizable institutions is mentioned. Prof. Günther Schatz of the University of Konstanz is interviewed and, in his statement, he distinctly remembers the rumours of a Nobel-prize surrounding Schön.[339]

Prof. Michio Kaku's statement brings the theme of the documentary to the discussion of fear about nano-technology and computational capacities in raising suspicion if the end of Moore's

[331] Horizon, Time: 04:35-04:40.
[332] Horizon, Time: 04:45.
[333] Reich, Plastic Fantastic, p. 63.
[334] Service, Physicist Fired for Falsified Data, Science, 25. September, 2002.
[335] Horizon, Time: 04:50-4:55.
[336] Horizon, Time: 5:20-5:30.
[337] Horizon, Time: 5:55-6:03.
[338] Horizon, Time: 6:05.
[339] Horizon, Time: 06.54.

law could be a threat to economy.[340] The documentary's style then drastically changes for several minutes with explanations of Moore's law intercut with scenes of violence and fear of stagnation being presented. Schön is then presented as the "rising star" who could bring about the transition away from silicon towards organic superconductors.[341] The previously discussed promise of applicability is shown to viewers in a quick montage in which several usages of transistor technology, such as air conditioners and satellites are cut back-to-back.[342]

Up to this point the documentary follows the structure of many accounts of Jan Hendrik Schön previously explored in this paper. The high promises of applying the resulting technology are then quickly taken massively out of proportion by the futurist Ian Pearson, with vast promises of the future introducing ideas such as live-saving shirts imbued with nano-technology to even the promise of "downloading thoughts" from a brain fused with nano-computers.[343]

Fortune's narration continues on to the perceived threat, that organic compounds might reproduce themselves (vastly oversimplifying the notion of 'organic') which would be the base for the nano-technology apocalypse.[344] One way in which this could happen in the potential future conjured by Horizon is through war, as Dr. John Alexander, adviser to US Special Operations explains in his interview section.[345] His introduction is then followed by a section explaining how nano-bots could be used to kill people.[346]

Fortune continues his voice-over with "and then, of course, there's grey goo"[347] specifically mentioning the popular term for a potential apocalyptic scenario by nano-bots by name, but also implying it was, at least to the informed viewer, a term that should already be known. This acts in two ways. First, it familiarizes the uninformed viewers with a simple term to remember the fear by, just as "China-syndrome" was popularised in the 1980s. In the same function it picks up the already somewhat popularised debate and ties it back to reports about Prince Charles calling for the investigation. The other function is, that the term at this point most likely could have served as a dog-whistle for conspiracy theorists and the far-right neo-survivalist scene emerging at the time. The voice-over changes direction from a fatalist view for a few seconds as even Jack Fortune admits "Extinction at the hands of nano technology is definitely farfetched, but it is beginning to worry many influential people around the world."[348]

[340] Horizon, Time: 08:05.
[341] Horizon, Time: 13:46-14:07.
[342] Horizon, Time: 16:30-16:45.
[343] Horizon, Time: 21:41-25:07.
[344] Horizon, Time: 25:40.
[345] Horizon, Time: 29:17.
[346] Horizon, Time: 29:00-31:00
[347] Horizon, Time: 30:55.
[348] Horizon, Time: 31:47.

In yet another harsh break of style Prof. Lydia Sohn's discovery of Schön's duplicate data is dramatically reenacted and the investigation explained to viewers.[349] She then explains the issue of data duplication and duplicated noise in a very accessible manner by overlaying two graphs of two different papers in which the noise is exactly the same.[350] In this moment the at times highly problematic documentary takes up the previously discussed effort of educating on the matter of data duplication in the graphs of Jan Hendrik Schön. Karl Ziemelis, who works at 'nature', was also interviewed for this documentary.[351] In the intervie, he presents the theme of publisher's responsibility and self-corrective measures of the scientific publication apparatus to a wider audience. Schön's firing from Bell Labs is re-told by a former co-worker in an anecdote in which Schön apparently reacted amicably to being let go of his position with the words: "It's been a privilege and an honour to work here. Thank you. And then he was marched out of the building by two security guards"[352]

Schön appears in another role towards the end of the documentary, that of the saviour. His fall from grace and the reveal, that his data was manipulated appears as a pivotal moment in which the "grey-goo" catastrophe has been averted. This representation mirrors the picture of the heroic scientist who could and should do it all is present in the fiction of the time, but also continues structures of the fiction built around Jan Hendrik Schön. In not doing what a scientist was supposed to do, he appears to have stopped a fictional universe in which his technology might have ended the world. With this sentiment the strong tension built by this episode of Horizon is relieved as viewers are told they could rest "a little more secure"[353] just before the credits roll.

[349] Horizon, Time: 34:10.
[350] Horizon, Time: 36:00.
[351] Horizon, Time: 37:00
[352] Horizon, Time: 46:05.
[353] Horizon, Time: 47:30.

Conclusion

This thesis set out to examine how the "cloud cast by the Schön affair"[354] had come about, whether it had a "silver lining"[355] and what "thoughtful examination of the issue"[356] resulted from it. To find the origins of the cloud, it examined imaginations of science and scientific misconduct in the early 2000s, how they changed shortly before, but especially after the Schön affair. A silver lining can indeed be found in the extensive thoughtful examination of the network's reaction to the affair. Jan Hendrik Schön has left the scientific community with new, unique material for thought and with new discussions, checked biases, new guidelines, new critical thought about structures of approval and responsibility, as well as a new figure to memorialise scientific misconduct. Schön certainly left unique traces, to the point where his name, that had once been synonymous with hopeful scientific breakthrough – so much so that he was set to become the next Alexander Graham Bell – has now become a shorthand, for scientific misconduct and a memorial to the cracks within the networks of knowledge production.

Examining Jan Hendrik Schön's rise to fame revealed several factors of breakthrough narratives which had become a danger to scientific accuracy. By the time first news of his achievements broke, the world was more than ready to hear and believe what he had to say. What science could and should do, had always been part of the imagination of science, from early fantasies of flying public transport in centuries past, to the boom of science fiction in the 20th century. By the early 21st century, a new wave of imagining scientific potential had rolled over the popular representation of science, and it focussed on presenting individual scientists in a favourable manner. New popular imaginations featured cool, celebrated scientists. Movies as well as several new series, such as CSI, helped the public reimagine an extreme picture of how accurate science could and should be. This new picture of accuracy was primarily focussed on how certifiable knowledge and epistemic truth had to be produced as inherently valid and fact based in networks of science by default. Scientists, at least as they appeared in the public imagination, were not to be doubted, especially those who worked in fields with strong rules such as physics.

In this cloud of new expectations and hopeful beliefs about science, a scientist to do the unbelievable not only seemed possible, but likely. Popular culture as well as the internal narratives of the scientific community were readily accepting the narrative about a scientist

[354] Kennedy, Next Steps in the Schön affair, p. 495.
[355] Kennedy, Next Steps in the Schön affair, p. 495.
[356] Kennedy, Next Steps in the Schön affair, p. 495.

rising above all others, reinventing several technologies and reforming the field of technoscience all by himself, about an individual figure bringing about progress through the means of certifiable knowledge. Knowledge, that could be converted into consumption, worthy of recognition in a world desperate to heal and progress after many had been disillusioned by the recent crisis of the dot-com bubble bursting.

Jan Hendrik Schön appeared to be capable of doing just that. He who was about to revolutionise computing.[357] He who has brought about the new age of information transfer with lasers, and nanotechnology.[358] He who had received praise and prizes and was, at least so it seemed, well headed to the most prestigious of them all.[359] Doubting Schön had become nearly impossible, even deep within the otherwise critical networks of professors and laboratory workers.[360] After all, who was to question the rockstar of science, the 'Beckham'[361] of nanotechnology.

In the early 2000s a near perfect storm had started brewing at the edges of the scientific community and it was headed for a corner of science that had previously been deemed safe. Biomedicine and other 'softer' fields in STEM had had their own crises in the 1980s and 1990s. Physics, as it was based on hard evidence and numbers, was deemed less prone to scientific misconduct.

In the centre of this storm stood a man, who understood more about the network of fellow scientists, how to use them and their imaginations of science to produce new stories of breakthrough and how to avoid their scrutiny, than anybody would have expected and he was also skilled enough to earn the network's trust. Schön proved capable enough in scientific theory to produce results that would be accepted even by the highly literate professors reading his work. Protected by a network of lies he told when put under pressure, as demonstrated by his evasive action, presented in 'Funky Machines' and under the cover of personal and institutional charisma, as well as deceptive ideas about science, he continued his work undetected. Based on this, to disprove the superstar of science would have to be an immense mental workload, going against better beliefs in humans, institutions, and the idealised structures of science itself. Still, the first cracks that rose through the high pedestal he had been put on were deep enough for anybody to see and understand them, as noise, as first presentable proof of his scientific misconduct, was not bound to out-performing or outranking him as a scientist, but relatable to anybody with a passing interest in the scientific process.

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[357] Service, Physicist Fired for Falsified Data, Science, 25. September, 2002.
[358] MIT Technology Review, p. 87.
[359] Seer, Nobelpreisverdächtig, p. 13.
[360] Reich, Plastic Fantastic, p. 191.
[361] Horizon, Time: 04:35-04:40.

The story of Jan Hendrik Schön's rise to fame and fall from grace shook the scientific community. In the bright flash of his career, dark shadows in his surrounding network became visible. Strong narratives of hope, greatness, contempt, and trust were broken as many awoke from their benevolent slumber, still blinded by tales of greatness. Schön, for many important institutions of the scientific networks of knowledge production was the reason to question themselves and they did, learning in the process and applying said knowledge to the network itself. He had delivered them the ideal case study in 'defraudistik'[362] to learn from, especially because physics had been considered near insusceptible to fraud. To investigate him meant to also investigate their own role in his rise, and trying their best to repair some of the cracks that had either formed, or which were there before and allowed him to reach this much power in the first place.

Tasked with the major challenge of undoing the spell Schön had had on the scientific community, several important steps had to be taken to fully heal and rehabilitate the immediate network of co-authors, co-workers and institutions close to Schön, but also the wider scientific community and its connections to the public.

As the very first step evidence had to be gathered. Scientific misconduct, although not always clearly treated as such, was a serious allegation, especially with someone so prominently featured in the public eye. It also meant to publicly admit failure of the hailed self-corrective mechanisms such as peer review and publication. Admitting Schön had misled the network also posed a danger to the supposedly amazing places of knowledge production he had worked at. The charisma of institutions such as laboratories and universities faced the danger of taking a significant hit.

Knowledge of this investigation had been kept under wraps at first, until a solid first case against Schön could be presented. The "Report of the Investigation Committee on the Possibility of Scientific Misconduct in the Work of Hendrik Schön and Coauthors", conducted by Beasley et al. was released after four months of hard work in September 2002. The report, although only uncovering about half of the total extent of his scientific misconduct, had already been damning.

In its immediate aftermath first repair mechanisms were put to work. Schön was fired within hours of the report being finalised. The report itself was publicly spread with journals picking it up within the day, reporting on the misconduct and retelling the tale of Schön's rise to fame to gather the attention of anybody who might have heard about him. Further retractions

[362] Di Trocchio, Der große Schwindel p. 7-8.

followed by 7 publishers, with several other publishers and public outlets commenting on the evolving crisis. Two other instances of removing Schön from the scientific community were already started, but took longer to finalise. The DFG banned him from partaking in German science networks and the University of Konstanz prepared for the decade long legal battle of revoking Schön's title of doctor of science. Especially the last instance featured lengthy discussions of what it means to be a scientist in the institutional definition and in the eye of the public. Both, so the final verdict, had been gravely abused by Jan Hendrik Schön making him 'unworthy'[363] in the academic sense of carrying such a title.

As for the record of scientific integrity, this scandal led to great mistrust with over 40 papers labelled as untrustworthy, yet still a danger to contaminating further research based upon them. This damage had to be contained, and if possible repaired. Countless errata and retractions were part of this repair mechanism. Explanations of why this data, although one would have liked to believe it, was untrustworthy told a tale of deception through the words of correction. The discussion evolved from one about proof of misconduct to loss of trust through misconduct as papers, which had not been proven to contain any falsified data were flagged as untrustworthy because of their authorship.[364]

Schön, within the first years, became more than a last name, even more than a person. It became a concept. When other cases of fishy data emerged, Schön was called upon to remember the people of the last time. Authors started linking to the ever-growing Wikipedia-article and other sources covering his rise and fall as a memorial to scientific trust within technoscience. Even two decades later new fraudulent data in superconductivity has been described as "having echoes of the Schön affair"[365].

All this memorial work has over time become restructured to a more systematic approach. Institutions such as the ETH, and APS released new guidance on how to properly conduct science in reaction to Schön.

Public perception of the scandal inspired countless reactions, new legislation, but also new scientific fiction. For a niche audience consuming this fiction Schön had become the stop-gap separating humanity from a possible disastrous future imagined by technophobe reporting in the early 21st century.

Schön changed how scientists see themselves and their fellows. He was not the first to produce such a gigantic scandal within the scientific community, he was also by far not the last, and as

[363] BVerwG, Urteil vom 31.07.2013 - 6 C 9.12 – p. 3.
[364] Service, Robert F: More Scarlet Letters for Schön, Science 20. Dec. 2002.
[365] Lowe, Superconductor Chaos, Science, 05. July 2023, online.

of today he is not even the worst in terms of retractions or public outrage. However, his timing in relation to evolving imaginations of science, new codification of scientific misconduct, the lack of such codification in many institutions in his wider network and the relevance of his promised breakthrough for society led to a massive discussion redefining what it means to investigate scientific misconduct. Jan Hendrik Schön might not have been the scientist to revolutionise micro-electronics, lasers or even nanotechnology, but he inadvertently helped transform science as a network. In reacting to the breaking news of his misconduct networks of knowledge production questioned their own role in producing epistemic truth. His legacy remains deeply engrained in the memory of a scandal whenever doubt is present, but also in the teaching of new, hopefully more ethical scientists.

The limited format of this thesis did not allow for several follow up questions an investigation into Schön might inspire. One of them would be to compare his legacy to those of other scandals starting out with promising tales of breakthrough and examine if there is a concept of being the "Stapel of social psychology" or the "Hwang Woo-suk" of genetics. It would mean to ask more about the dangers of breakthroughs and why they break down, of which this thesis might be but a longer introduction. Another would be to delve deeper into the conceptions of sanctity and sacrilege in the scientific community, as has been hinted at in several sources discussing Schön's mishandling of primary data. Both would certainly reveal more about the ideas scientists have about themselves and how those form the network of knowledge production we commonly refer to as science.

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Appendix

The list of retracted and contested papers is extensive, putting them into context shows the massive issue the scientific community was left with immediately after the scandal:

> "Electrical properties of single crystals of rigid rodlike conjugated molecules", "Ambipolar Pentacene Field-Effect Transistors and Inverters", "A superconducting field-effect switch", "Fractional Quantum Hall effect in organic molecular Semiconductors", "A light-emitting field-effect transistor", "Perylene: A promising organic field-effect transistor material", "Solution processed CdS thin film transistors", "Ambipolar organic devices for complementary logic", "Hole transport in pentacene single crystals", "New phenomena in high mobility organic semiconductors", "Fast organic electronic circuits based on ambipolar pentacene field-effect transistors", "Field-effect modulation of the conductance of single molecules", "An Organic Solid State Injection Laser", "High-Temperature Superconductivity in Lattice-Expanded C60", "Band-Like Charge Transport in C60 Single Crystals", "Sputtering of alumina thin films for field-effect doping", and "Gate-induced superconductivity in a solution-processed organic polymer film"[366]

contained substituted data according to the Beasley report.

> "Superconductivity at 52 K in hole-doped C-60", "Superconductivity in CaCuO2 as a result of field-effect doping", "Superconductivity in single crystals of the fullerene C-70", and "Ballistic hole transport in pentacene with a mean free path exceeding 30 μm", showed unrealistic precision, indicating fabrication. "Nanoscale organic transistors based on self-asembled monolayers", "Josephson Junctions with Tunable Weak Links", and "Plastic Josephson junctions"[367]

among other papers were judged contradictory to physics.

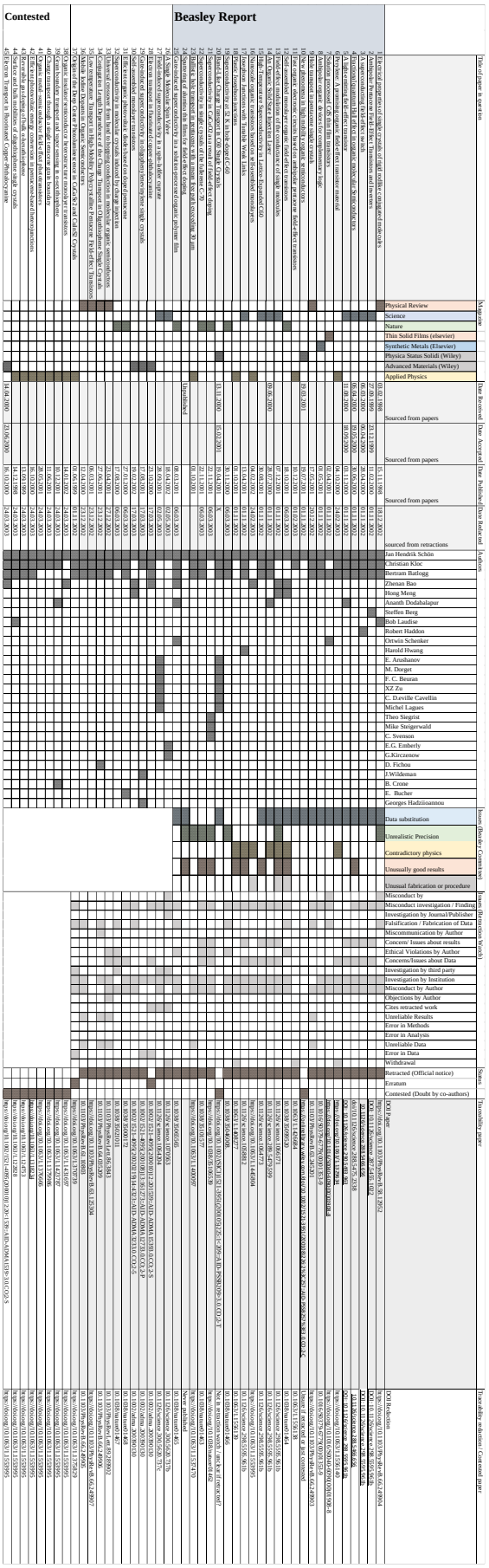
> "A Single Molecular Spin Valve", "Field-induced superconductivity in a spin-ladder cuprate", "Electron transport in fluorinated copper-phthalocyanine", "Gate-induced superconductivity in oligophenylenevinylene single crystals". "Self-assembled monolayer transistors", "Efficient organic photovoltaic diodes based on doped pentacene", "Superconductivity in molecular crstals induced by charge injections", "Universal crossover from band to hopping conduction in molecular organic semiconductors", "Conjugation Length Dependence of the Charge Transport in Oligothiphene Single Crystals", "Low temperature Transport in High-Mobility Polycrystalline Pentacene Filed-effect Transistors", "Mobile Iodine Dopants in Organic Semiconductors", "Origin of the Deep Center Photoluminescence in CuGaSe2 and CuInS2 Crystals", "Organic insulator/semiconductor heterostructure monolayer transistors", "Grain boundary transport and vapor sensing in α-sexithiophene", "Charge transport through a single tetracene grain boundary", "Organic metal–semiconductor field-effect phototransistors", "Efficient photovoltaic energy conversion in pentacene-based heterojunctions", "Reversible gas doping of bulk α-hexathiophene", "Surface and bulk mobilities of oligothiophene single crystals", and "Electron Transport in Fluorinated Copper-Phthalocyanine" [368]

were retracted after the Beasley report. To better understand the network the next part in the appendix contains a visual representation of the papers and categories of publishers, co-authors, their dates of admission and retraction, the issues with them, the label they got and the traceability of the papers and retraction articles.

[366] Beasley et al., Report, p. H-3.
[367] Beasley et al., Report, p. H-3.
[368] Collective Data sourced from individual retractions of the papers in “Physical Review”, “Science”, “Nature”, “Advanced Materials (Wiley)”, and “Applied Physics”.

Graphical Overview of Jan Hendrik Schön's Authorship network

Graphics produced by Julian Fischer based upon collected information from retractions, retraction-watch, and the Beasley-Report.



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